U.S. Department of Transportation
National Highway Traffic Safety Administration

TRAFFIC TECH
Technology Transfer Series

NHTSA

DOT HS 813 343

August 2022

Pedestrian/Bicyclist Safety in Numbers: Program Evaluation

Background

Fatalities involving bicyclists and pedestrians continue to rise. Over the decade 2011 to 2020, the number of bicyclist fatalities increased 38% and the number of pedestrian fatalities increased 46% (NCSA, 2021, 2022a, 2022b). Many agencies are trying to understand what factors influence bicyclist and pedestrian crash risk and how to better improve nonmotorized safety. One of the factors that may impact bicyclist and pedestrian crash risk may be explained by the concept of Safety in Numbers (SIN).

SIN posits that there is an inverse relationship between the extent of walking/bicycling and the probability of a motorist collision with a pedestrian/bicyclist (Jacobsen, 2003). In other words, this theory proposes that when the volumes of bicyclists and pedestrians increase, the probability of bicyclists and pedestrians being involved in a crash decreases. Such a perspective can be used to encourage programs and policies that increase the amount of walking/bicycling. However, this theory has faced challenges in the research community with some research indicating the opposite effect; increasing rates of walking/bicycling can increase the risk of crashes involving vulnerable road users (Ramsey & Richardson, 2017). The evaluation described briefly herein was undertaken to investigate the effect of pedestrian- and bicyclist-focused programs in increasing walking and biking and if implementing such programs creates a demonstrable SIN effect. (For full details on the research study, see the final report by the same name available at https://rosap.ntl.bts.gov/.)

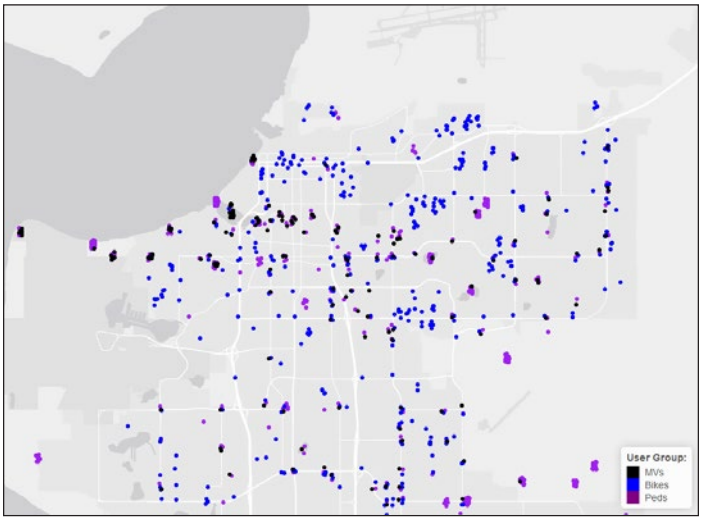
Method

After completing a literature review exploring these competing perspectives (see Kehoe et al., 2022), the research team developed a plan to evaluate the relationships between pedestrian and bicyclist programs and respective road user volumes, and the relationship between said volumes and crashes. For purposes of this study, programs were defined as ongoing or repetitive efforts directed toward the behavior and well-being of pedestrians and/or bicyclists. A program scan helped identify sites suitable for the evaluation. After discussions and further research, these three cities were used.

- Fort Collins, Colorado, and its Safe Routes to School program, Open Streets events, Bicycle Ambassador Program, and Bike to Work Day
- Philadelphia, Pennsylvania, and its Indego Bikeshare Initiative
- Anchorage, Alaska, and its Bikeology program

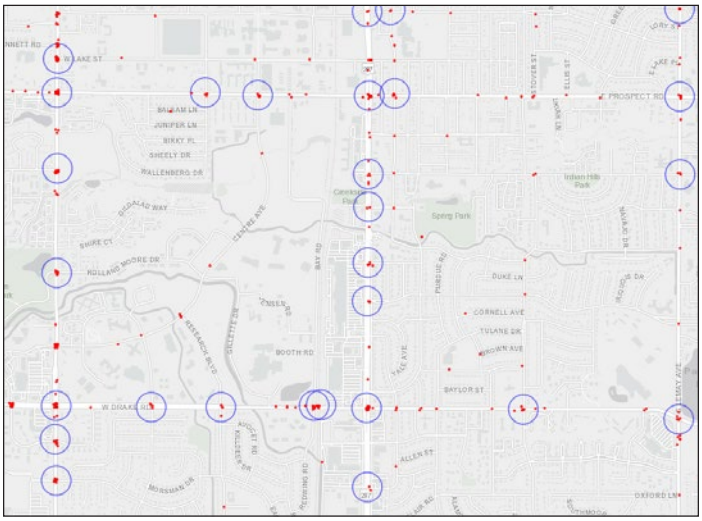
The research team worked to acquire the relevant datasets, including program metrics (e.g., numbers of participants or attendees at program events), crash data, and traffic volume data. Each of the datasets required individualized plans for data preparation. These included converting short-term volume counts into annual average daily volumes, connecting and interpolating data from single-mode counters, geocoding count and crash locations, and determining appropriate crash zone sizes (see Figures 1 and 2).

Figure 1. Examples of Geocoded Crashes in Anchorage



Leaflet | Map street data © OpenStreetMap contributors, CC-BY-SA, Tiles ©Esri – Esri, DeLorme, NAVTEQ

Figure 2. Examples of Bicyclist Crash Zones in Fort Collins



Programs were evaluated on how effective they were at increasing bicyclist and pedestrian volumes using established statistical models. The SIN phenomenon was investigated with similar statistical models to determine the relationship between pedestrian and bicyclist volumes and corresponding motor vehicle related pedestrian and bicyclist crashes.

Results

Several statistical model variations (Poisson, negative binomial, and zero-inflated) were fit to available data to investigate the effects of outreach programs and quantify SIN. Results for each of the localities are briefly discussed here. Specific results for each program are available in the full report.

Program Effectiveness

Fort Collins program effectiveness results were mixed and, depending on the specific program, raised questions about the nature of the programs evaluated and the quality of the underlying data. The bikeshare program in Philadelphia was found to positively affect bicyclist volumes with no effect on pedestrian volumes. Although initially thought a suitable site, program data from Anchorage was insufficient for analysis.

Table 1. Summary of Program Effectiveness Results

Site	Program effectiveness	
	Bicyclists	Pedestrians
Fort Collins	Unclear	Unclear
Philadelphia	Success	Not Applicable
Anchorage	Insufficient Data	Insufficient Data

Safety in Numbers Effect

Results indicated complete SIN for bicyclists and partial SIN for pedestrians in both Fort Collins and Anchorage, but no evidence of SIN in Philadelphia. Complete SIN is said to occur when bicyclist/pedestrian crashes increase at a rate less than proportional to simultaneous increases in bicyclist/pedestrian and motor vehicle volumes. In contrast, partial SIN occurs when bicyclist/pedestrian crashes increase at a rate less than proportional to increases in bicyclist/pedestrian or motor vehicle volumes.

Table 2. Summary of Safety in Numbers Results

Site	Safety in Numbers	
	Bicyclists	Pedestrians
Fort Collins	Safety (complete)	Safety (partial)
Philadelphia	No relation	No relation
Anchorage	Safety (complete)	Safety (partial)

An ad-hoc analysis was conducted to investigate the role of infrastructure. The presence of 17 pedestrian/bicyclist facilities (bike lanes, sidewalks, crosswalks, pedestrian hybrid beacons, etc.) was coded for each crash observed in Philadelphia. This new information was added to previously described models and yielded statistically significant results for volumes and crash rates among both modes. Most notably, both standard and high-visibility crosswalks were associated with higher rates of crashes among bicyclists, and pedestrian signals were associated with higher crash rates among pedestrians. While this seems counterintuitive, the findings may result from increased exposure and higher volumes of pedestrians and bicyclists at these locations.

Discussion and Conclusion

Robust, multifaceted data are required to evaluate program effectiveness and SIN. The literature and the analysis described in the full report demonstrate how these data are challenging to obtain. While the SIN theory is often used to support programs and policies that encourage walking and biking, it is important to realize that without changes to the system, crashes, injuries, and fatalities are likely to increase as more road users are entering the system; the theory states that this increase will be at a rate less than the rate of increase in road users. As more agencies are focusing on ways to reduce crashes, including efforts such as the Road to Zero or Vision Zero, measures that might increase pedestrian and bicycle crashes are a concern. Safety in Numbers may help to provide an understanding of potential outcomes associated with increasing the amount of people walking and bicycling.

One question that still lingers is: What causes Safety in Numbers? This research can point to correlations in the data but not causation. With increased and improved datasets, researchers can come closer to understanding the factors influencing SIN. Despite the wealth of research on this topic, the exact cause of the SIN effect is unknown. Some research points to behavioral changes, others question the involvement of related infrastructure. There also are data gaps, specifically regarding infrastructure and non-motorized volume data and frequently a lack of consideration of human behavior. As work is advanced in SIN, it will be important to convey considerations to researchers and practitioners seeking to use SIN to develop policies and initiatives.

References

Jacobsen, P. (2003). Safety in numbers: More walkers and bicyclists, safer walking and bicycling. *Injury Prevention, 9*(3), 205-209.

Kehoe, N. P., Goughnour, E., Jackson, S., Sykes, K., Miller, S., & Blackburn, L. (2022, June). *Safety in numbers: A literature review* (Report No. DOT HS 813 279). National Highway Traffic Safety Administration.

National Center for Statistics and Analysis. (2021a, October). *Bicyclists and other cyclists: 2019 data* (Traffic Safety Facts. Report No. DOT HS 813 197). National Highway Traffic Safety Administration.

NCSA. (2022a, May). *Pedestrians: 2020 data* (Traffic Safety Facts. Report No. DOT HS 813 310). National Highway Traffic Safety Administration.

NCSA. (2022b, May). Early estimates of motor vehicle traffic fatalities and fatality rate by sub-categories in 2021 (Crash•Stats Brief Statistical Summary. Report No. DOT HS 813 298). National Highway Traffic Safety Administration.

Ramsey, J., & Richardson, J. (2017, August 15-18). *Cycling safety in numbers effect – Does it exist in Melbourne?* Australian Institute of Traffic Planning and Management National Conference, Melbourne, Australia.

How to Order

The final report *Safety in Numbers: Program Evaluation* (Report No. DOT HS 813 342) can be downloaded at https://rosap.ntl.bts.gov/ Kristie Johnson, Ph.D., was the task order manager for this project.

Suggested APA Citation for This Document:

Office of Behavioral Safety Research. (2022, August). *Safety in numbers: Program evaluation* (Traffic Tech Technology Transfer Series. Report No. DOT HS 813 343). National Highway Traffic Safety Administration.

U.S. Department of Transportation

National Highway Traffic Safety Administration

1200 New Jersey Avenue SE
Washington, DC 20590

TRAFFIC TECH is a publication to disseminate information about traffic safety programs, including evaluations, innovative programs, and new publications. Feel free to copy it as you wish.