Concord Avenue Striping Plan Briefing

Last Updated: 04/21/2022

Project Overview:

As part of its existing Concord Avenue restriping project, the Transportation Advisory committee, working in conjunction with Nelson\Nygaard Consulting Associates and the Office of Community Development and the Department of Public Works, is proposing to reorient the road lines so that the bike lane is closest to the curb, separated by a three foot buffer, then the parking lane and then the travel lane. This would happen eastbound from the Unitarian Church to the Cambridge border at Blanchard Road and westbound from Underwood Street to the Unitarian Church.

This project came about when the High School Traffic Working Group expressed a desire to explore the possibility of reconfiguring the bike lane and parking lane on Concord Avenue. Glenn Clancy (Office of Community Development) asked Bill Schwartz (Nelson/Nygaard) to look at revising the bicycle lane on Concord Avenue.

Referencing standard practices and design guides such as the NACTO, MassDOT guide for Separated Bike lanes and the National Highway separated bike lane guides, Nelson/Nygaard laid out the striping plan as presented and the plan has been amended over the course of the year as TAC has held multiple meetings and public forums on the plan.

Existing Conditions:

The existing bicycle lane configuration presents dangerous conditions to bicyclists needing to travel along Concord Avenue.

- Bicyclists are not protected from vehicle traffic behaving erratically (e.g., passing stopped cars using the bicycle and parking lanes).
- Bicyclists are not protected from vehicles pulling over across the bicycle lane to park on the shoulder of the road or to drop off passengers.
- Once a vehicle is parked, bicyclists are not protected from a driver opening their car door into the bicycle lane, blocking the lane and possibly sending the cyclist careening into the car door, or into traffic.
- There is no buffer zone between the bicycle lane and the parked vehicles.

Pros of the Proposed Parking-Protected Bicycle Lanes:

- Creates a buffer between the bicycle lane and vehicle travel lane. This discourages vehicles entering the bicycle lane for any reason and creates physical separation between the moving vehicles and the moving bicycles.
    - Eliminates vehicles swerving across the entire bicycle lane to pass stopped cars.
    - Eliminates vehicles crossing the bicycle lane to park on the shoulder, drop off passengers, or stop completely in it to parallel park.

    - Eliminates the possibility of a driver opening their door into the bicycle lane. The buffer between the parking and bicycle lanes also dramatically reduces the likelihood of a passenger also "dooring" a cyclist. In the unlikely event of a passenger "dooring" a cyclist in spite of the buffer zone, the bicyclist would end up on the sidewalk instead of the motor-vehicle travel lane.
- Narrowing the travel lane will result in some degree of traffic calming and the new configuration should result in more drivers slowing down to familiarize themselves with the layout.
- Clearly defining the setbacks for side streets and driveways will help eliminate confusion about where drivers can park and larger setbacks will improve sightlines for access to and from Concord Avenue via abutters' driveways.
- Increased safety and comfort will encourage more people to use bicycles, reducing traffic across town and promoting healthy and ecological friendly transportation options for residents.

Cons of the Proposal:

- There is some community concern that narrower travel lanes could give larger vehicles less leeway in where they can position on the road.
- Placing a buffer of parked vehicles between the travel and bicycle lanes could hamper driver and cyclist's line of sight of each other prior to intersections if proper setbacks are not implemented. This could potentially cause issues when drivers turn right across the bicycle lane onto side streets.
- Parked cars will open their driver side door directly into traffic, instead of a bicycle lane.
- The bicycle lane will be along the shoulder of the road, where there is often more debris between street cleanings.

Summary of Public Comments at the February 2022 Open Forum:

2022-02-17_pbl-open-forum_PUBLIC-COMMENTS_rev-1.pdf

Best Practices for Bike Lane Implementation:

The following is meant to give an overview of what Separated/Protected Bicycle lanes are and why towns and cities are installing them.

One of the best cities for observing the use of these lanes in the country is Cambridge, MA and many Belmont residents who commute into Cambridge by bicycle or car regularly use or encounter them. Somerville and Boston are now also leaders in installing better bike lane infrastructure. The mantra for this type of design is that "Separation means Safety". The more bikes are physically separated from vehicular traffic the safer the street is for all users.

Separation removes two of the three largest hazards for cycling on the streets: collisions with cars invading the bike lane and "doorings" from drivers exiting their parked cars. The third hazard is the right turn "hook" where a vehicle turning onto a side street hits a pedestrian or cyclist. The design proposed enforces 20 foot setbacks that are already used as a safety feature for driver visibility of pedestrians to reduce this hazard.

There are three main reasons why municipalities are installing these quick-build lanes that this document addresses. What follows is a brief description of the three reasons and then three following sections of links to documents that go into more detail.

1) Safety for the existing cyclists/drivers: Separated lanes are the safer design for existing cyclists and drivers too. Bike lanes against the curb with a buffer/parking lane between them and the travel lane take cyclists out of the lane in front of the moving cars and also remove the risk of "dooring" because the vast majority of doorings occur from the driver opening his/her door into the existing bike lane. Separation makes the traffic flows more predictable.

2) Vehicle Traffic Calming and Speed Reduction in the travel lane: In the absence of daily speed enforcement by police departments, narrowing the travel lane for drivers creates a heightened level of perceived risk for the driver. The driver slows in the same way he/she might when turning into a narrow side street and encountering parked vehicles. Municipalities are narrowing travel lanes for this reason. A row of parked cars enforces the travel lane width.

3) Separated/Protected bike lanes promote cycling: Historically, it is estimated that 7-10% of commuters will bicycle under almost any traffic or road-design conditions. These are either the hardy commuters or the road warrior sport cyclists that people are used to seeing on the roads. These cyclists are overwhelmingly adults and male. There has been, however, a large increase in both commuter and utility (shopping, school commuting) cycling in the last 10-15 years and the newer cyclists are of a much broader range of ages and abilities. Many of these people identify as "Interested but Concerned" in that they want to use a bicycle more but are concerned about the safety of the roads. Municipalities, researchers, and transportation officials have used a survey process to both estimate the size of this group and understand the habits and concerns of these riders.

Below are resources that address each of the goals of the bike lane design. These are a collection of documents and links that hopefully inform the Select Board on how neighboring municipalities are approaching bike lane design and why they are taking these steps. They are grouped according to each of the three goals listed above. The type of bicycle lane Belmont is considering is known as a Quick-Build Separated lane as opposed to the raised cycle track that Cambridge built along its section of Concord Ave.

A Quick-Build design uses the existing road pavement with no changes to drainage or road pavement. The current proposal from Nelson/Nygaard does not use the white flex posts or stanchions seen with other installations so the design does not require any specialized equipment for maintenance, eg. street sweeping, snow removal, etc…

1. Safety for Existing Cyclists/Drivers; What is the Safety Improvement of a Separated Bicycle Lane?

For the definition of the Quick-Build Separated bike lane design look through the 2020 Cambridge Bicycle Plan, Chapter 4, page 4.

i. https://www.cambridgema.gov/-/media/Files/CDD/Transportation/Bike/bikeplan/2020/finalchaptersjune2021/4facilitytoolbox_20210618.pdf

For studies of the results of two of the Quick Build projects in Cambridge, check out the studies done in 2018 and 2019 for the Cambridge Street and Brattle Street projects respectively.

ii. Cambridge St. between Quincy St and Inman Sq
https://www.cambridgema.gov/cdd/projects/transportation/cambridgestreetbicyclesafetydemonstrationproject

iii. Brattle St. in Harvard Square
https://www.cambridgema.gov/CDD/Projects/Transportation/brattlestreettwowayseparatedbikelane

Each of these pages has multiple documents discussing specifics and each has a good overview document, a "Date Evaluation Summary", gives a good summary of the before and after effects for vehicles, pedestrians and cyclists:

iv. Cambridge St. bicycle lane (first link above) results discussion.
Cambridge Street Data Evaluation Summary - Cambridge Massachusetts

v. Brattle St. bicycle lane (second link above) results discussion
Brattle Street Data Evaluation Study - Cambridge Massachusetts

A quick note on these results. The survey response generated from combining a protected bike lane with traffic calming using the parking lane to narrow the travel lane generates greater satisfaction from the bicyclists and decreased satisfaction from drivers. That is part of the bargain as the implementation is a rebalancing between the modes to afford greater safety for the cyclist at the expense of the speed of the vehicular traffic. In Belmont, the majority of affected traffic is during the two rush hours with the morning 1 hour period that combines the school and work commute and the majority of the vehicular traffic is through commuters. The density of parking along Concord will vary, depending on the level of student parking during the school year and during the summer break. In this design, the parked cars protect the bike lane and, with the buffer, the two lanes are no longer in conflict with each other.

These summaries above also include studies of the effects on parking in the areas around the projects. Nelson/Nygaard has done an analysis of the projected number of parking spaces for Concord Ave that is included in the presentation slides for Concord Ave.

2. **Traffic Calming and Speed Reduction:**

The purpose of a narrower travel lane is to reduce vehicle speed without resorting to active speed monitoring and ticketing. The three most common types of calming are lateral deflection (islands or features placed in the roadway that force the driver to slow in order to move around the feature), vertical deflection (speed tables) and narrowing. The common sense example for the effect of narrowing is a driver turning into a side street and encountering cars/trucks parked on both sides, narrowing the lane. Objects pinching the lane width induce caution into the driver

and the driver slows down. Belmont approved its Traffic Calming Policy in 2019 and the policy has in it the description of traffic calming methods (Pages 3-4), including narrowing the travel lane. The proposed striping plan uses the narrowing method.

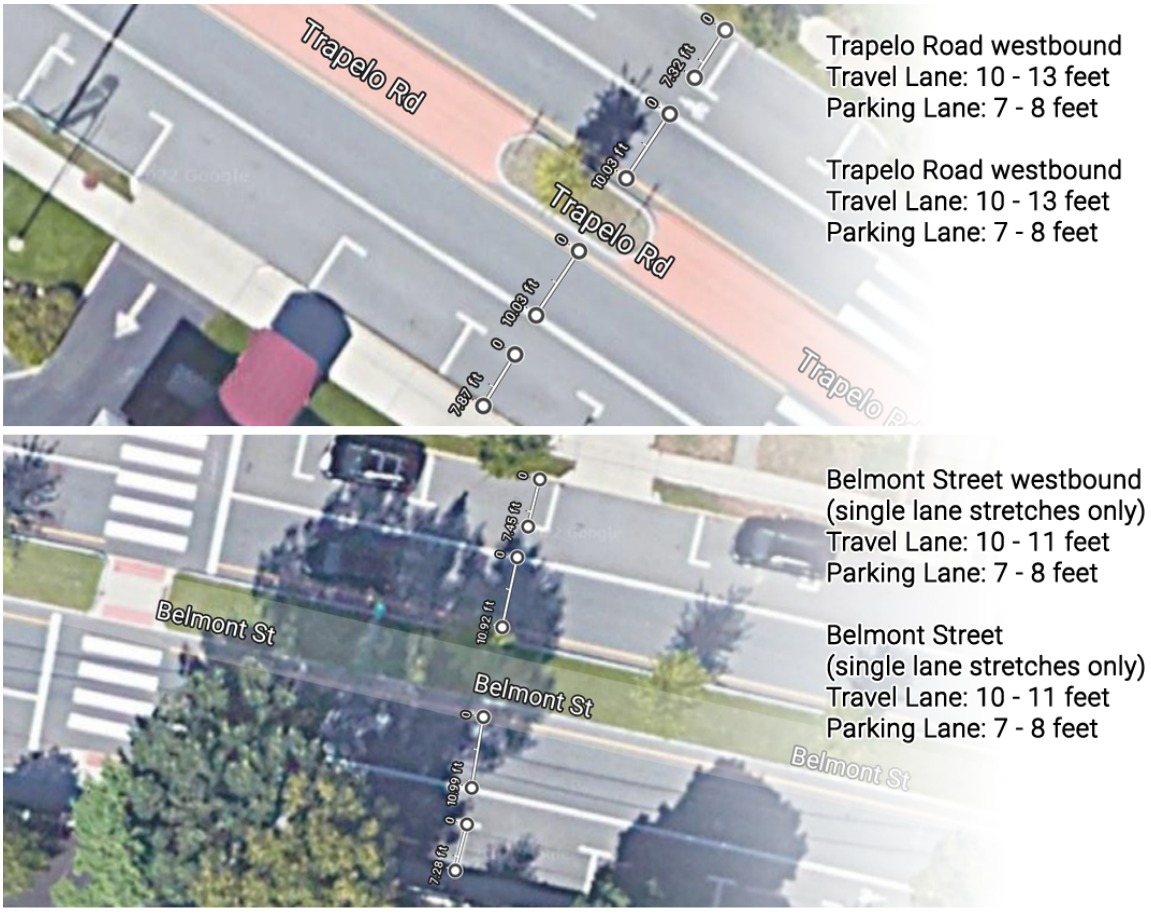
Belmont's traffic calming policy can be found here:
https://www.belmont-ma.gov/sites/g/files/vyhlif6831/f/uploads/tcp_approved_january_13_2020.pdf

In this application, the median on Concord Ave. works with the parking lane to constrain the travel lane at the two critical rush hours when traffic is heaviest on Concord Ave. **The proposed striping plan calls for a 11.5 foot travel lane and a 7 foot parking lane backed up with a 3 foot buffer. 5.5 feet is left for the bicycle lane.**

Narrowed traffic lanes and Safety

Other streets in Belmont already use dimensions in this range, Common St currently uses a 10 foot (from center of double yellow to inside edge of fog line) travel lane and Leonard St. in Belmont Center uses a 7 foot wide parking lane that is set against the curb. The examples in Cambridge use the 7 foot parking lane and 3 foot buffer. Travel lanes (with no median) are less than 11 feet. The discussion of lane width and Emergency access is discussed more fully in the Nelson/Nygaard Presentation.

Other major routes in Belmont, in addition to Common St, are using a narrowed travel lane, albeit without the traffic calming of the shifted parking lane. See the following illustration:

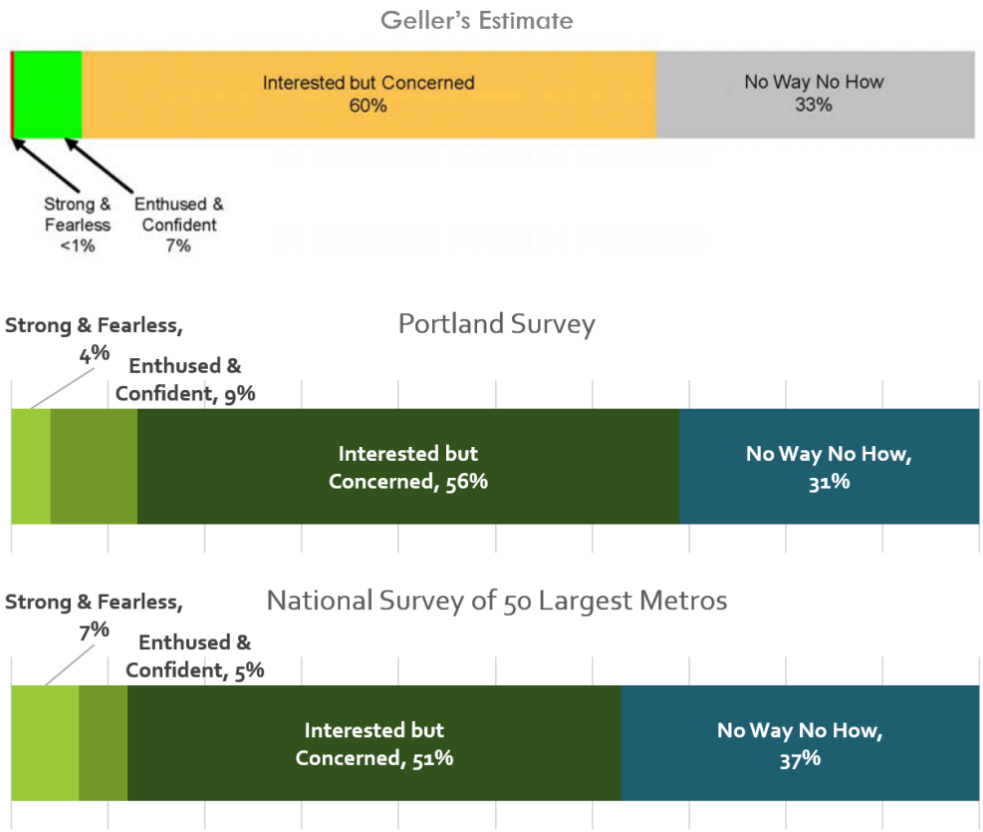


All measurements made using Google Maps' Measure Distance tool at 5 different locations along the road for the effective range

3. Separated/Protected bike lanes promote cycling:

Separation = Safety: The greater the degree of separation the greater the level of safety. For cities and towns that wish to increase the % of students who walk or bike to school the idea is that safer bike infrastructure makes more people feel comfortable cycling.

Research into people's attitudes about cycling have shown that a large percentage of people do not feel comfortable with the current on-street bicycle lane but would cycle more if they felt safer. This is the category that researchers refer to as "Interested but Concerned" and accounts for roughly >50% of people surveyed for a national sample. The graphics below show results for these types of surveys that have been conducted to assess the likelihood of cycling instead of driving. This larger group is much more sensitive to how safe the bike lane/path feels and will not ride in a bike lane that it feels is "risky".



Source for the discussion above: Jennifer Dill, Portland State University. The results of three different surveys of cyclists from 2006-2012 that attempt to characterize how cyclists perceive the risks of cycling on the roads and how likely they are to use them.
https://jenniferdill.net/types-of-cyclists/

A more in depth presentation on the subject is Dill, McNeil, August 2012: "Four Types of Cyclists? Testing a Typology to better understand Bicycling Behavior and Potential"
https://web.pdx.edu/~jdill/Types_of_Cyclists_PSUWorkingPaper.pdf

The gist of the above graphic is that a large percent of the public says that they would use a bicycle more if they feel safer on the road. The top graphic is from work done by Roger Geller, the Bicycle Transportation Coordinator for the city of Portland in 2006. The second is a replication of the survey in 2011 by Dill et. al. and the last is a 2015 national survey done by Dill et. al. that broadened the sample to 50 metropolitan areas around the US. The claim then is that this effect scales from small towns to large cities and is consistent across the country. If municipalities make safer bike lanes more people say they will make the trip by bike instead of by car.

Cambridge MA has built on this research and has combined it with the similar work (gauging Levels of Traffic Stress) of Peter Furth of Northeastern University to do a more detailed survey in preparing its 2020 Bicycling Plan. Cambridge has used a metric that they call Bicycle Level of Comfort to gauge where improvements in the bike infrastructure make for the biggest improvement in safety and gained ridership. They use the same type of rider categorization discussed above and pair it with riders judgment on the relative risk of riding specific streets. So Cambridge has used this method to help set criteria for bike lane installation and is focusing its efforts on installing a combination of Quick-Build Separated/Protected Bike Lanes and Raised Cycle Tracks.

Below is the Cambridge 2020 bicycle plan Chapter 3 discussion of resident's feelings and concerns about cycling in the city. The plan uses methodologies similar to the discussion above. The chapter has good graphics and summaries that give good detail that underpins the logic on ridership laid out above. For instance, the graphic on page 8 for "Concerned Bicyclists" gives an idea of how the "Interested but Concerned" segment discussed above feels above the standard bike lane (currently on Concord) and the Separated/Protected design that municipalities are implementing.

https://www.cambridgema.gov/-/media/Files/CDD/Transportation/Bike/bikeplan/2020/finalchaptersjune2021/3informationandreporting_20210618.pdf

Possible Alternatives to the Proposed Design:

There have been alternative designs suggested during discussions of the design. The proposed design largely removes the hazards of drifting cars and "dooring" from parked cars. The "Right Hook" is mitigated (as it is for pedestrians) by enforcing the 20 foot setbacks from the near entrance to the side streets. The two most widely suggested alternatives are:

Moving the bike lane to the left side of the travel lane, immediately adjacent to the median.

- This approach solves the issues or vehicles passing in the travel lane, parking cars blocking the bike lane and parked cars opening their doors into the bike lane. It also eliminates concerns about cars turning right onto Concord Avenue or side streets.
- However, it introduces new concerns about drivers turning left onto side streets now having to cross two bike lanes. It does not add any barrier to cars entering the bike lane and requires any bicycles entering or exiting the bike lane to cross traffic. It also has bicyclists on the left side of the travel lane, which is far less common and familiar, and complicates the ability of cyclists to make right turns.
- This design has little precedence and few local examples.

Cycle Track: Raising the existing bike lane to sidewalk height and moving the curb to the outside to physically separate the bike lane from the parking lane.

- This would eliminate the need for the buffer zone between the parking lane and the bike lane, resulting in a larger travel lane. However it massively expands the scope and cost of this project.
- It would require many up-and-down elevation changes in the curbs due to the numerous driveways and intersections, especially on the east-bound direction of Concord Ave. This design also requires moving any drainage grates next to the curb.

Academic Studies of Separated/Protected Bicycle Lanes

Lastly, There have been a number of studies done on the safety of Separated/Protected bike lanes and the perceptions of different groups about cycling. Below are a few abstracts with links to the referenced article.

1. Why cities with high bicycling rates are safer for all road users

Wesley Marshall 13 Year Study-full text.pdf

Highlights

- Cities with high bicycling mode shares have surprisingly good road safety records.
- Via negative binomial regression, we assess 13 years of data in 12 major US cities.
- Higher bicycling rates and 'safety in numbers' was not significant.
- Increased prevalence of protected bicycle facilities suggest safer cities for all.
- Variables representing gentrifying neighborhoods were also significant factors.

Introduction

Despite bicycling being considered ten times more dangerous than driving, the evidence suggests that high-bicycling-mode-share cities are not only safer for bicyclists but for all road users. We look to understand what makes these cities safer. Are the safety differences related to 'safety-in-numbers' of bicyclists, or can they be better explained by built environment differences or the people that inhabit them?

Methods

Based on thirteen years of data from twelve large U.S. cities, we investigated over 17,000 fatalities and 77,000 severe injuries across nearly 8700 block groups via multilevel, longitudinal, negative binomial regression models. We hypothesize three pathways towards better road safety outcomes: i) travel behavior differences (e.g. 'safety-in-numbers' or shifts to 'safer' modes); ii) built environment differences (e.g. infrastructure that helps promote safer environments); and iii) socio-demographic/socio-economic differences (e.g. some cities may be populated by those with lower road safety risk).

Results

The results suggest that more bicyclists is not the reason these cities are safer for all road users. Better safety outcomes are instead associated with a greater prevalence of bike facilities – particularly protected and separated bike facilities – at the block group level and, more strongly so, across the overall city. Higher intersection density, which typically corresponds to more compact and lower-speed built environments, was strongly associated with better road safety outcomes for all road users. The variables representing gentrification also accounted for much of our explainable variation in safety outcomes.

Conclusions

This paper provides an evidence-based approach to building safer cities. While the policy implications of this work point to protected and separated bike infrastructure as part of the solution, we need to keep in mind that these approaches are complementary and should not be considered in isolation. Moreover, our results – particularly the safety disparities associated with gentrification – suggest equity issues and the need for future research.

2. Estimating the effect of protected bike lanes on bike-share ridership in Boston: A case study on Commonwealth Avenue

Elizabeth Karpinski- Separated Bike lane on Comm Ave.pdf

Highlights

- Effect of a major intervention is studied through changes in the geospatial patterns of ridership activity in the city of Boston's bicycle sharing (bikeshare) system.
- Bikeshare ridership tripled on routes using the separated bike lane after its installation.
- Causal inference from differences-in-differences methodology suggests that the bike lane increased ridership on affected routes +80% compared to the control group.
- Analysis suggests that influence of the bike lane is strongest on routes with the most exposure to the bike lane.

Abstract

While many studies have studied the connection between cyclist ridership and the built environment, few findings provide relevant quantitative guidance to decision-makers. This study examines the effect of a single intervention (installation of a protected bike lane) in Boston, Massachusetts, on the nearby ridership of 'BlueBikes', a local bicycle sharing system (bikeshare). Bikeshare activity along the new protected bike lane almost tripled in the year following installation; however, ridership on routes unaffected by the new bike lane also saw dramatic increases in ridership. Using a differences-in-differences comparison, which assumes the bike lane had no influence on adjacent routes, suggests that the causal impact of the new bike lane increased bikeshare ridership +80% on affected routes. These quantitative estimates represent credible upper and lower bounds on the effect of replacing a conventional bike lane with a protected bike lane. Additional analysis also suggests that the influence of the bike lane is strongest when trip origins and destinations are a minimal distance (under 1.6 km) away from the bike lane, which may be useful information in planning bicycle networks.

3. Older adults' environmental preferences for transportation cycling

Cawenburg-older riders and protected bike lanes.pdf

Highlights

- Separation from traffic is a priority to stimulate cycling among older adults.
- Cycle path type is the most important attribute for the majority and most vulnerable.
- Traffic density and surface evenness are important but subordinate to cycle path type.
- Evenness is particularly relevant for e-bikers.

Results

In the total sample, type of cycle path was the most important environmental attribute (importance = 40.0, 95% CI = 39.0–41.0) determining older adults' preference for transportation cycling. The second most important attribute was traffic density (16.7, 95% CI = 15.9–17.4), followed by cycle path evenness (11.8, 95% CI = 11.4–12.1) and distance (10.6, 95% CI = 10.1–11.0). Six subgroups with different environmental preferences were identified. These subgroups could be characterized based on differences in cycling limitations, driving status, e-bike use and cycling levels.

Conclusions

The provision of well-separated cycle paths should be considered a priority in urban planning initiatives aiming to stimulate transportation cycling among older adults. Such initiatives should be evaluated to validate the current findings and optimize future initiatives.

Additional References:

Accident rate on streets vs cycle tracks- Lusk - Furth.pdf

Jessica Cicchino - Not all protected bike lanes are created equal.pdf