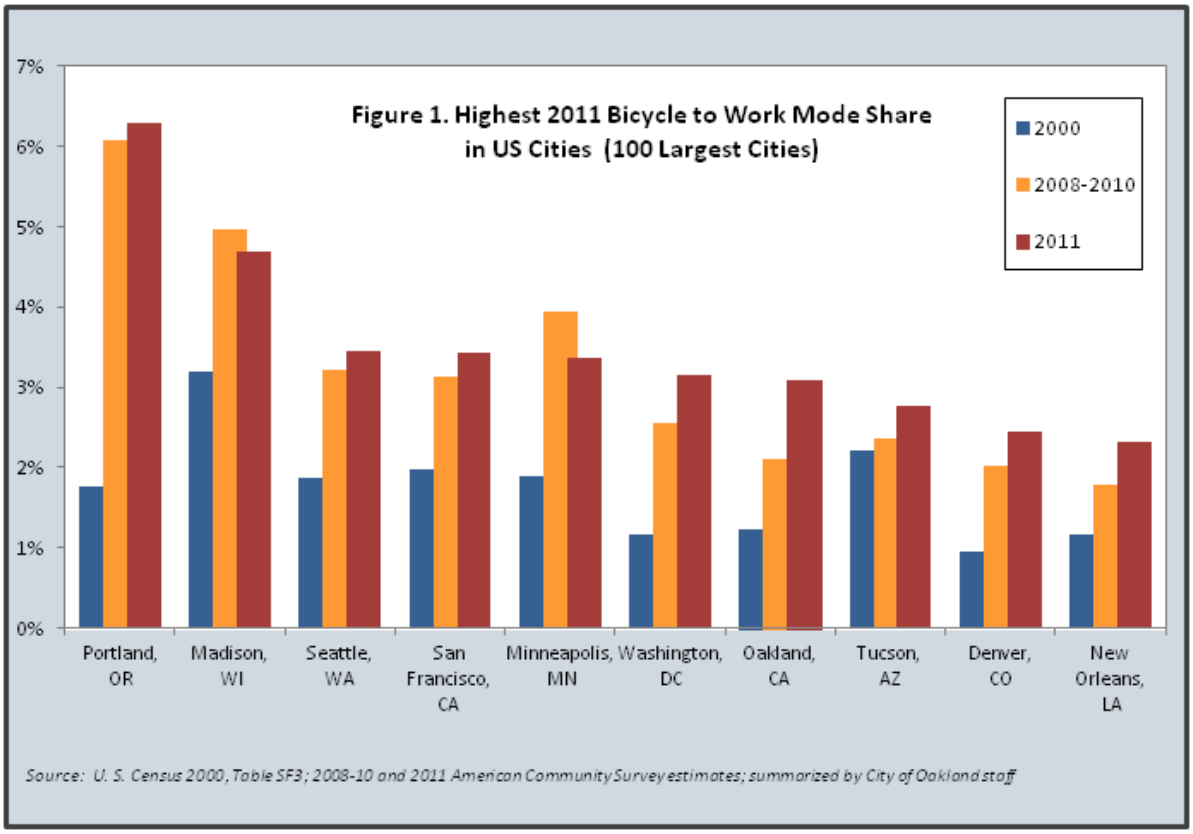
March, 2013

Draft: All Ages and Abilities White Paper

Seattle Bicycle Master Plan Update

1 Introduction

Cycling is on the rise in cities throughout the United States. Though still a small fraction of the US population[1], the number of people using bikes for commuting has grown dramatically in major cities during the last ten years (Figure 1). Seattle's mode share nearly doubled between 2000 and 2011, ranking third overall; in 2011, bicycle volumes in downtown Seattle were nearly 200% higher than in 1992. This is likely due to a variety of factors, including the recession, concerns about overall health and activity level, and greater awareness of cycling as a transportation option. However, much credit can also be given to the surge in bicycle facility installation since the late 1990's, when federal transportation law began to provide more support for non-motorized transportation. From paved shoulders on state routes to bike lanes in urban centers, increased on-road accommodation has increased cycling—and helped legitimize it as a way to get around.



[1] The 2010 American Community Survey, which measures work trips, calls the share .5 percent. However, the survey design has been critiqued as underestimating the extent to which people use bicycles for transportation.

Despite these improvements, the cycling mode share in U.S. communities lags behind international peers, such as Copenhagen, Denmark and Bogotá, Colombia, where facilities that minimize cyclist exposure to vehicular traffic have been major catalysts for change.

For example, in Seville, Spain a steep increase in bicycle mode share from 0.6% to 6.6% in three years has been credited in large part to the installation of 120 km of cycle tracks, which provide physical separation between cyclists and motor vehicles. Neighborhood greenways, residential corridors converted to bicycle priority routes, also attract a broad range of users. By providing a greater sense of protection than bike lanes and signed routes, low stress cycling facilities attract people who are more diverse in age, gender, ability, background, and travel needs—in other words, anyone who needs to move from points A to B and for reasons Y to Z.

Although on-street bicycle facilities and improvements have attracted more people to cycling, there are many who feel discomfort riding near motorized vehicles. Comfort thresholds vary greatly by person and context, especially when it comes to traffic tolerance. A college student with books in a rear basket might be more willing to use a bike lane next to parked cars and heavy traffic than a parent with a baby in a bike seat. For cycling to grow in U.S. cities, it needs to be a safe, pleasant, convenient option for the broadest array of people, often described as "8-80 years old" or of "all ages and abilities."

This paper seeks to answer the following questions:

- What does research say about mode choice and different types of cyclists?
- What are the limitations of bike lanes?
- What does a bicycle facility constructed for all ages and abilities (AAA) look like?
- How do peer cities plan for AAA riders?

> We cannot continue to deceive ourselves, thinking that to paint a little line on a road is a bike way. A bicycle way that is not safe for an 8-year old is not a bicycle way.
>
> *--Enrique Peñalosa, former mayor of Bogotá, Columbia.*

2 Needs and Preferences of "Interested, but Concerned" Potential Cyclists

Communities around the world are working to reverse the trend of decreasing bicycle mode share with varying degrees of success. One of the challenges facing U.S. urban areas is figuring out what potential cyclists need. In 2005, Roger Geller, Portland's bicycle coordinator, proposed four categories to help identify and understand the needs of those who do not regularly choose cycling as a transportation option (Figure 2). Reaching that potential market is necessary to achieving significant bicycling mode shift. The categories, first based on his own and colleagues' observations about behavior and attitudes in Portland, have since been tested and found to be sound by academic researchers[2]:

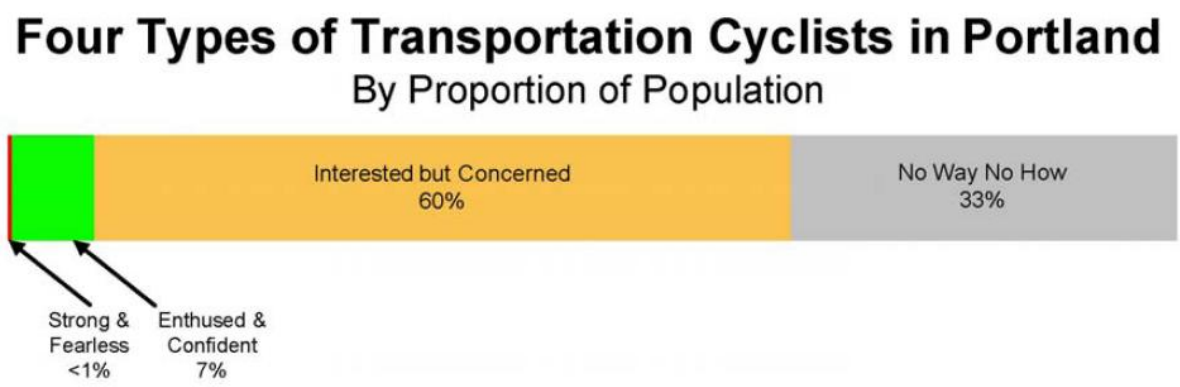


Figure 2. Four Types of Transportation Cyclists
Source: Geller, Portland Bureau of Transportation

Strong and Fearless: The less than one percent of the population who will ride anywhere, in any conditions, whether or not there are designated bicycle facilities. This number is common to urban areas, regardless of their level of bicycle planning and implementation.

Enthused and Confident: The seven percent (7%) who ride frequently, but prefer designated facilities and are more sensitive to context. Although bicycle friendly improvements have encouraged them to ride, intimidating gaps in the bicycle (and road) network affect their travel decisions about when, where and with whom to ride. For example, a parent might commute to work, but not be comfortable riding his child to school.

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[2] Dill, Jill., McNeil, Nathan "Four Types of Cyclists: Testing a Typology to Better Understand Bicycling Behavior and Potential." Portland State University, 2012.

Interested, but Concerned: At 60%, this is the largest group. They may not ride now, but would be more likely to if conditions were improved to address fears such as travelling along and across busy streets. They may not have the confidence and/or skills to ride next to cars and trucks with just a line of paint as "protection," and are uncomfortable navigating busy intersections, especially those with turn lanes.

No Way, No How: The 33% who are not interested, or cannot overcome fears of on-street cycling—at least not at this stage in our transportation culture.

> No person should have to be "brave" to ride a bicycle. . . .
> There are many cities in modern, industrialized nations around the world with a high bicycle mode split. They have achieved these high levels of bicycle use through adherence to various cycling-promoting policies and practices. But, one thing they share in common is they have substantially removed the element of fear associated with bicycling in an urban environment. They have created transportation systems in which bicycling is often the most logical, enjoyable and attainable choice for trips of a certain length for a wide swath—if not the majority—of their populace. For residents of these cities, concern about personal safety associated with bicycling is rarely a consideration, and certainly not to the levels we experience here.
> In these "fearless" cities septuagenarians are able to ride alongside seven-year-olds safely, comfortably, and with confidence throughout the breadth of the cities.
>
> *--Roger Geller, Portland Bureau of Transportation*

Geller's framework suggests there is great potential to encourage more people to ride. The success and popularity of cycle tracks and neighborhood greenways, here and abroad, suggest they can play key roles in reaching this untapped market.

Additional research provides insight into variables that influence mode choice, and facility preferences. Bike paths, cycle tracks and neighborhood greenways are consistently cited as the most preferred routes, with travelers willing to somewhat increase trip distance to use them instead of more direct alternatives. [3]A study of utilitarian trips of 50 randomly selected regular and occasional cyclists in the Metro Vancouver, BC area revealed a willingness to detour, on average, 400 meters; however, three quarters of the trips were less than 10% longer than the most direct option, suggesting limits to detour tolerance. Route choices were most affected by presence of bicycle facilities. To significantly increase bicycle mode share, the study recommends spacing bicycle facilities in urban areas no greater than 500 meters apart. [4]

[3] Multiple sources included data suggesting preferences for physically separated facilities (trails and cycle tracks) and residential streets, including neighborhood greenways. They are footnoted throughout this document.
[4] Cycling in Cities Research Team: Research Brief: How Far Out of the Way will we Travel?" University of British Columbia, undated.

In "Theory of Routine Mode Choice Decisions: An Operational Framework to Increase Sustainable Transportation,"[5] Robert J. Schneider proposes five major categories for understanding mode choice for a given trip, leaving room to reflect socioeconomic factors that can influence decisions (Figure 3). Awareness and availability are pre-conditions of any mode selection. For example, bike share stations in the public right of way build awareness of cycling as a transportation option while making bikes available to more people and for more trips. But a bike in hand does not automatically lead to rubber on the road. Schneider identifies three situational tradeoffs that travelers consider when deciding how to make a journey.

Within this framework, cycle tracks and neighborhood greenways are both attractive options; both are generally perceived as safe, with cycle tracks perhaps having an edge on convenience, and neighborhood greenways offering more in terms of enjoyment, depending on what the rider values.

Looking at this model through Geller's "Four Cyclists" lens, the "Interested, but Concerned" group is likely most sensitive to safety, security, and enjoyment considerations, which underscores the value of low stress bicycle facilities.

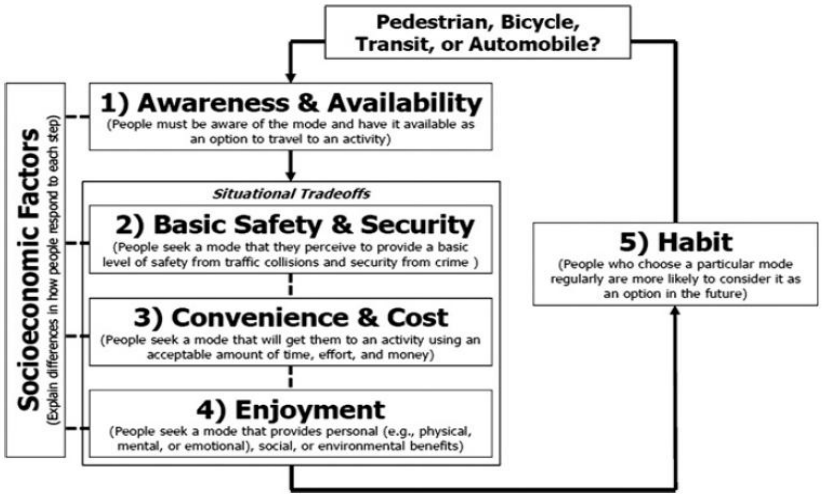

Figure 3: Proposed Theory for Routine Mode Choice Decisions

[5]Schneider, Robert J. "Theory of Routine Mode Choice Decisions: An Operational Framework to Increase Sustainable Transportation." Transp. Policy 2013; 25: 128-137.

3 The Limits of Bike Lanes

The street network provides the overall basis for much of the bicycle network. Even the most intimidating arterials have bicycle traffic, as they tend to serve major destinations. Early design manuals, such as Bikeways State of the Art, authored by the Federal Highway Administration in 1974, recognized the need for bicycle facilities on collector and arterial roadways, where cyclists are most vulnerable to traffic. At that time, four-foot bike lanes and eight-foot shared use paths were recommended as standard best practice. Facility types included separated lanes (bike lanes), separated pathways and shared roadways marked with bike route signs.

In recent decades, bike lane installation has been a key strategy for developing bicycle networks in cities such as Portland, Seattle, San Francisco and Chicago. Painted lanes delineate a space of at least five feet between motorized traffic and parked cars or the curb, usually on collector streets that have lower Average Daily Traffic (ADT) and slower travel speeds than major arterials, but better options for crossing major streets and other barriers than residential streets. These are often the routes that experienced and confident cyclists already use; adding a bike lane helps organize traffic and parked cars to maximize passing room, encourage cyclists to select safer and more comfortable routes than major arterials, and remind drivers that cyclists have the right to be on the road. They are often less expensive than other roadway treatments, especially when done as part of a resurfacing project, and generally do not significantly change the roadway's cross section, except when part of a road diet.

A recent evolution in bike lanes across the United States is the addition of a two to three foot painted buffer between the bike and travel lanes. These buffered bike lanes are described in detail in the National Association of City Transportation Officials (NACTO) Urban Bikeway Design Guide. They appeal to a wider cross section of bicycle users by increasing separation from motor vehicles and, in turn, the perception of safety[6]). They also provide additional space for cyclists to pass one another. Bicycle networks also typically sign, or at least map, lower volume and speed streets--often residential--that provide alternatives to and connections

[6] Dill, Jennifer. Monsere, Christopher. McNeil, Nathan. Evaluation of Bike Boxes at Signalized Intersections. OTREC. 2010.

between busier corridors. Signs that include miles and minutes to neighborhoods and destinations help with navigation and promotion, especially when biking travel times are competitive with other modes of travel.

Bicyclists ascending hills tend to lose momentum, especially on longer street segments with continuous uphill grades. This speed reduction creates greater speed differentials between bicyclists and motorists, creating uncomfortable and potentially unsafe riding conditions. By separating vehicle and bicycle traffic, uphill bike lanes (also known as "climbing lanes") enable motorists to safely pass slower-speed bicyclists, thereby improving conditions for both travel modes. Uphill bike lanes can be combined with shared lane markings in the downhill direction, where bicyclists can match prevailing traffic speeds. Seattle has multiple locations with uphill bikes lanes and will continue to use them where appropriate.

Although bike lanes have contributed to mode share increases, when implemented on busy arterials, they are generally not suitable for people of all ages and abilities. Riding on them requires not just traffic tolerance, but also quick reaction times and the ability to safely enter the driving lane to avoid hazards or double-parked vehicles. They also typically do not allow for side by side or close riding, which is often needed for those travelling with children on bikes.

Despite these limitations, bike lanes still play a role in the bicycling network. Design enhancements, such as street markings that provide in lane and intersection positioning, can increase comfort and attractiveness. On minor arterials with moderate to low speed traffic, lanes can be sufficient for providing a low stress cycling environment.[7]

> Bike lanes can exhibit the full range of traffic stress. Where they have ample width and are positioned on a road whose traffic is slow and simple (a single lane per direction), they can offer cyclists a low-stress riding environment. However, bike lanes can also present a high-stress environment when positioned on roads with highway speeds or turbulent traffic, or next to high-turnover parking lanes without adequate clearance.
>
> *--Mineta Transportation Institute*

In many cities, bike lanes already exist, and this dedicated space should be retained for bicyclist use. In some cases, construction of a facility that provides more cyclist separation is not possible in the short term because of funding limitations or political reasons. In these cases, reserving space through striping of bike lanes or buffered bike lanes provides a means to provide incremental upgrades to the quality of the bikeway network-- a practice currently used in both Portland and Vancouver, BC.

[7] Maaza C. Mekuria, Ph.D., P.E., PTOE, Peter G. Furth, Ph.D. and Hilary Nixon, Ph.D. "Low-Stress Bicycling and Network Connectivity." Mineta Transportation Institute, 2012.

4 Cycle tracks and Neighborhood Greenways

Bicycle paths, multi-use trails, neighborhood greenways and cycle tracks are the main types of facilities that serve people of all ages and abilities (AAA). Although quite different in design, they can provide environments where a broad range of people feel safe and comfortable.

Key components of AAA facilities are:

- Separation from high speed and volume motorized traffic (via physical barriers or speed and volume reduction).
- Easy to navigate intersections, especially at major arterials.
- Visual cues about presence and function.
- Convenient access to key community destinations.

Cycle tracks

Cycle tracks, also known as protected bike lanes (PBLs), are similar to bike lanes in that they serve critical bicycle travel needs on collectors and arterials. The main difference is that they provide a physical barrier, such as flexible bollards, jersey barriers, planters or vertical separation, and at least a three-foot painted buffer between cyclists and the motor vehicle travel lane. The most common configurations are:

- **One way with parking:** The cycle track, at least five feet, is situated between the curb and parked cars, with a minimum three foot buffer and physical barrier--essentially flipping the traditional bike lane/parking lane relationship to the curb.
- **One way without parking:** Similar to the above, but with the buffer and barrier between the cycling and driving lanes.
- **Two way:** With a minimum width of eight feet, these are sometimes used when curbside activities, transit, intersection configurations or other variables make it difficult to install a cycle track on both sides of the street. They can also be used on streets with one way motor vehicle traffic.

Preliminary data from U.S cities suggests that cycle tracks attract new and current riders, and are generally preferred to traditional bicycle lanes. After the installation of Chicago's first cycle track on Kinzie Street, ridership increased by 55% and 86%, compared to 17% in traditional bike lanes. Preliminary data also suggests a well-designed cycle track can benefit all roadway users. Since New York City installed a cycle track on 9th Avenue, the reported injuries on the street have fallen by 56 percent, with a 29 percent reduction for pedestrians and a 57 percent reduction for bicyclists[8].

These statistics are well documented and evidenced in cities such as Copenhagen, which has a longer history of cycle track implementation. They also help raise the visibility of cycling and increase comfort for motorists who fear passing too close to a cyclist.

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[8] Hernandez, Adolfo. "Protected Bike Lanes Spur Ridership." Mode Shift. Vol. 11, No. 2. Active Transportation Alliance. Web.

Challenges: Although cycle tracks have proven to increase comfort and safety for a wider range of users than traditional bicycle lanes, they are not without challenges, such as:

- Business owner buy-in
- Intersection design
- Maintenance and snow removal
- Conflicting curb side uses
- Pedestrian / transit interplay
- Hard to ride side by side or pass another cyclist
- Right-of-way (ROW) constraints
- Parking removal

Sometimes buffered bike lanes are used as a compromise or as an interim measure. Like traditional bicycle lanes, they are positioned between parked cars and the travel lanes. This helps address issues such as predictability and sight lines at intersections. They can be easier to implement because they are a less dramatic change to the streetscape. Like cycle tracks, buffered bike lanes provide a three foot painted buffer between the car and bike travelways. However, although this provides traffic separation, the lack of a physical barrier decreases comfort for some riders. It also retains the door zone concern.

Neighborhood Greenways

Neighborhood greenways, also known as bicycle boulevards, transform residential streets into comfortable cycling corridors that are generally very suitable for people of all ages and abilities. Although these routes do involve mingling with car traffic, the speed of the street is set for and by cyclists. Traffic calming strategies, such as bicycle-friendly speed humps, chicanes, and pavement markings, help keep the speeds lower than 20 mph. Traffic volumes are kept low via intersection strategies, such as diverters that allow cyclists to cross but force drivers to turn onto busier streets. Just as cycle tracks flip the position of the parking and bike lanes, neighborhood greenways invert the intersection hierarchy to give cyclists the right of way.

Other positives

Other positive attributes are associated with neighborhood greenways as well. These include: increased shade coverage, less noise/exhaust, the opportunity for side by side riding, pleasant views, increased real estate values of homes, better overall conditions for residents of the street (street becomes more multi-purpose). This is supported by Cycling in Cities

research conducted in Vancouver that reveals top reasons for riding on neighborhood greenways, such as freedom from motor vehicle noise and air pollution, beautiful scenery, and the ability to ride side-by-side.[9]

Challenges

Neighborhood greenways also present implementation challenges, such as:

- Greenways are on residential streets, so sometimes don't offer the same direct connections between destinations as arterials do.
- Neighborhood buy-in, as some are concerned that their street will become more challenging to access via a car. However, neighbors are typically the ones who enjoy the redesign the most.
- Concerns from emergency responders. Road configurations need to allow for quick access of large vehicles.
- Intersection treatments at arterials can be costly.

[9] Brauer, Michael. Cole, Christe. Cycling, air pollution exposure & health. An overview of research findings." VeleCity 2012. Web. Also see: Cycling in Cities Research Team, "Opinion Survey on Route Preferences and Motivations." University of British Columbia, 2006.

Reaching the Sixty Percent

As noted previously, Professor Dill's research at Portland State University supports Roger Geller's initial thoughts about the breakdown of Portland's types of cyclists and their willingness to bicycle given different roadway conditions. It also sheds light on the types of facilities preferred by those who are "interested but concerned." Using a comfort level scale of 1-4, with four being most comfortable, people who fall into that category were asked to rate a variety of road configurations for cycling. Bike paths and neighborhood greenways were most preferred, followed closely by residential streets below 25mph. The next highest level of comfort was for major streets with physically separated bicycle facilities. All of those options rated at least a three. Of particular note is the transformative effect of physical separation on major roads: comfort jumps from 1.4 and 1.3 to 3.2 and 3.0 on major arterials. Although striped bike lanes alone did not rank as highly, they were deemed preferable to no striping, especially on two lane commercial roads with speeds under 30mph, where comfort increased from 1.9 to 2.7. These rankings indicate preferences for facilities that provide physical traffic separation or traffic calming, while also acknowledging that even bike lanes can help increase comfort level, especially on lower stress arterials.

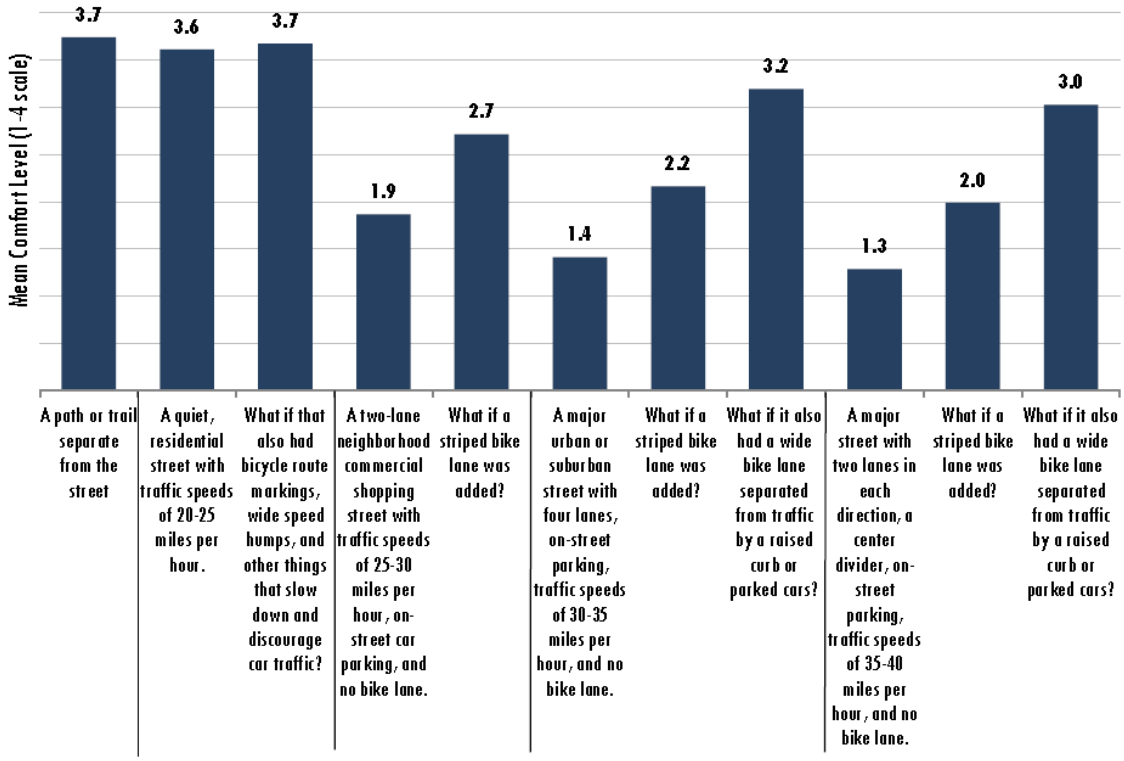

Figure 4. Level of comfort cyclists identifying as Interested but Concerned feel given different roadway conditions. Source: Dill, 2012

Planning and Implementation

Case Study - City of Portland - Retrofit on NE Multnomah Street

Portland is opportunistically pursuing roadway retrofits to develop a protected on-street bike routes through the Lloyd District, a central eastside neighborhood district characterized by arterial and collector roadways, several stadiums, the Rose Quarter Transit center and I-84. The roadway was reduced from five to three motor vehicle travel lanes and features wide bike lanes protected by a beige colored buffer and raised planters. The project was accomplished through coordination and support of key local business interests. Through discussion and partnership, the Portland Bureau of Transportation (PBOT), business owners and real estate developers were able to settle on a final design that converted unnecessary roadway capacity measured as average daily traffic (ADT) into protected bicycle lanes and new paid parking spaces. Roger Geller, Portland's bicycle coordinator, referred to the facility as a "poor person's cycle track" during a recent panel discussion at the 2012 NACTO Designing Cities conference. This project is a representative of Portland's commitment to incremental, opportunistic change (including retrofitting existing facilities) and points to an effective solution to improvement of the current cycling environment given a limited budget.

Figure 1. Physically separated bikeways on NE Multnomah St. Source PBOT

All Ages and Abilities Peer City Questions: Chicago

Alta conducted an interview with Mike Amsden, AICP, CDOT Bike Program Consultant Project Manager for Chicago, Illinois to understand how the city plans for bicyclists of all ages and abilities.

What does an all ages and abilities facility mean for your city?

It's safe, comfortable, sociable and useful for young and old, men and women, cycling novice and expert—regardless of ability or background. It provides low traffic volume and speed or separation from higher speed vehicles; easy to navigate intersections; and an overall pleasant, sometimes unique, experience. For example, a neighborhood greenway allows for side by side riding, and offers shade cover in the summer. A cycle track provides access to commercial destinations, while creating a physical (and, in turn, psychological) barrier to motorized traffic.

How do you plan for people of all ages and abilities? How were these types of connections considered when laying out and upgrading your bike network?

For all routes in the plan, the highest level of treatment is considered first—neighborhood greenways for residential routes and protected bike lanes for busier streets. When those treatments are not feasible, the next best options are explored, such as route signage through neighborhoods and buffered bike lanes on collectors.
Multiple variables went into route selection for the network, such as access to key destinations, safety, potential to attract new cyclists, and equitable coverage. But a major consideration throughout was feasibility. Some of the routes have been criticized because they are not straight shots. However, these are the streets that have the most potential to be transformed in the near future.
This is only an 8 year plan; quick wins are essential to building the cultural and political support needed for long term and/or more challenging projects.

What types of facilities do you consider to be all ages and abilities?

Trails (with the exception of Chicago's lake front path when it's most congested), neighborhood greenways, and protected bike lanes are the most accommodating to all ages and abilities, in that order. There are not yet many truly on-street all ages and abilities facilities in the US. In Chicago, the two-way Dearborn cycle track comes closest.
Key variables include speed, separation from cars, and intersection design. Curb side uses, such as alleys, loading zones, driveways, transit stops, and shared turn lanes can complicate the function of protected bike lanes, which reduces their suitability for all ages and abilities. In fact, in some cases buffered bike lanes are preferred because of better sight lines and separation from challenging curb side uses.
Another consideration is user behavior. Regardless of configuration, everyone needs to comply with the rules of the road for cycle tracks to really work.

What evidence have you seen, if any, that usage on all ages facilities is increasing?

Because those kinds of facilities (except trails) have been installed in the last 18 months, there is not yet a lot of "real" data. Monthly counts are conducted, so more data will be available in the future. However, according to counts and surveys taken before and after the Kinzie cycle track installation (Chicago's first), ridership increased by 55%; 86% felt safe or very safe in a PBL vs. 17% in traditional bike lanes; and 49% considered driver behavior safer. Also, at meetings, reluctant riders are expressing more interest and willingness to try biking in the city.
Is construction or development of all ages and abilities facilities prioritized in any way?
About 50% of projects piggy back on larger maintenance or reconstruction projects, which helps reduce costs. Other projects are initiated to address safety needs or community demand.

What is the public perception of all ages and abilities facilities?

It is improving. There has not been as much media backlash as in other cities. There has been much positive feedback from both current cyclists and those who would like to start.

Do you have programs or other 'soft' investments (e.g., a Sunday Parkways event) that are used to market all ages and abilities facilities?

Several aldermen have led neighborhood tours highlighting new facilities. Our Safe Routes Ambassadors help educate the public about existing facilities and offer tips for using them. They also partner with the police department to conduct targeted enforcement which is usually focused more on educating cyclists and drivers about correct behavior than giving tickets. Education, enforcement and incentives are all critical.

Have you heard or seen any reports of actual and perceived safety of all ages and abilities facilities?

See above.

Vancouver British Columbia - A Network of Bike Boulevards

Development of Vancouver's bike boulevard network began in the late 1980's. Concerns about right-of-way restrictions on arterials led cycling advocates and academics to discuss development of an offset grid network of residential streets with the City Council and relevant transportation officials. Initially, the key improvements on this network included signalized intersections to facilitate bicyclist crossing. Although initially contentious, the development of a neighborhood greenway and the accompanying traffic calming treatments have become welcome to residents of designated boulevards.

One acknowledged gap in the bike boulevard network was the downtown 'gap', which the city has started to fill in recent years by installing cycle tracks on Hornsby and Dunsmuir. This network of protected facilities helps to contribute to Vancouver's increasing bicycle mode share and reputation as a great biking city.

At the most basic level, the answer to this challenge is simple: plan a bicycling network that makes every user feel safe and comfortable. At the same time, a city or municipality must continue to meet the needs of other roadway users; in some situations it may not be feasible to construct a bicycle facility that provides complete separation from motor vehicle traffic.

AAA Facilities in Seattle

In Seattle, staff, members of the public and decision makers have expressed the desire to make cycling an activity that appeals to both current and potential cyclists of all ages and abilities. This desire and direction is consistent with international peer cities that have a high bicycle mode share and other U.S. cities seeking to promote livability, health and affordability. Seattle has taken the first steps down this path by planning a network of high-quality connected bicycle facilities for citywide trips while simultaneously planning for intra-neighborhood trips. While neighborhood greenways, trails and cycle tracks appeal to the broadest spectrum of users, bike lanes and buffered bike lanes still contribute to bicyclist safety and comfort and still have a place in the transportation planning toolkit. Seattle will continue to increase bicycle mode share and the improve the bicycling experience for all users by focusing on connections, constructing new facilities with attention to detail (e.g., at intersections), while opportunistically upgrading existing facilities and promoting both incremental and wholesale change.