Rethinking Streets for Bikes
An Evidence-Based Guide to 25 Bike-Focused Street Transformations

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About SCI
The University of Oregon’s Sustainable Cities Institute (SCI) focuses on sustainability and cities through applied research, teaching, and community partnerships. SCI works across disciplines that match the complexity of cities to address sustainability challenges. Projects range from regional planning to building design and enhancing engagement of diverse communities, to understanding the impacts on municipal budgets from disruptive technologies, and many issues in between.

SCI focuses on sustainability-based research and teaching opportunities through two primary efforts: 1) the Sustainable City Year Program (SCYP), a massively scaled university-community partnership program that matches the resources of the University with one Oregon community each year to help advance that community’s sustainability goals; and 2) the Urbanism Next Center, which focuses on how autonomous vehicles, e-commerce, micromobility, and the sharing economy will impact the form and function of cities. SCI shares its expertise and experiences with scholars, policymakers, community leaders, and project partners.

SCI further extends its impact via an annual expert-in-residence program, SCI-China visiting scholars program, a study abroad course on redesigning cities for people on bicycle, and through co-leadership of the Educational Partnerships for Innovation in Communities Network (EPIC-N), which transfers SCYP to universities and communities across the globe.

About NITC
The National Institute for Transportation and Communities (NITC) is one of five U.S. Department of Transportation national university transportation centers and is comprised of six leading universities. NITC focuses on applied research and education in the areas of: 1) Increasing Access to Opportunities; 2) Improving Multi-modal Planning & Shared Use Of Infrastructure; 3) Advancing Innovation & Smart Cities; and 4) Developing Data, Models & Tools.

COVER PHOTO CREDITS: top left: Tampa Magazine, top right: City of Oakland, bottom left: City of Davis, bottom right: Caltrans
ACKNOWLEDGMENTS

We would like to thank the Sustainable Cities Institute (SCI) at the University of Oregon, the National Institute for Transportation and Communities (NITC), the Department of Architecture and the School of Planning, Public Policy and Management (PPPM) at the University of Oregon, the Civil Engineering Department at Oregon Tech, and Rowell Brokaw Architects for their support of this project.

Additionally, we would like to thank our students who identified potential streets to include, developed the background database of information, and created all of the design templates throughout this guidebook (and countless designs that did not make the cut)! These students include Jamie Willeke, David Escobedo, David Grabicki, Cassidy Jones, Taylor Stevens, Neo D’Lehoko and Griffin Gilbert from the University of Oregon, as well as Jordan Preston and Elizabeth Cox from Oregon Tech. This project was funded by the National Institute for Transportation and Communities (NITC; grant number 1081), a U.S. DOT University Transportation Center.

Citation

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We are excited to present Rethinking Streets for Bikes, the second in the “Rethinking Streets” series. This installment focuses on high-quality street retrofit projects that prioritize bicycle transportation. We were extremely encouraged with the response to the 2015 release of the first book, which looked at completed street retrofit projects that benefited walking, biking, or transit. Those projects were very straightforward and could be implemented in communities across the country. We purposefully chose such normal-looking streets because we wanted to make it clear to a broad range of community stakeholders and decision makers that re-designing streets can be a win for all modes, as well as a boon for economic development and enhancing community quality of life. That book has been downloaded over 5,000 times by people in over twenty countries, and we are hoping this one will reach a similar audience.

Our goal for Rethinking Streets for Bikes is to carry forward this practice-to-knowledge-to-practice approach and present examples of high-quality, completed projects and do so in a highly visual way that policy makers, transportation planners and engineers, professional urban designers, advocates, and community members can all engage with. This book, as with the previous one, only highlights completed projects, not hypothetical ones, so everyone can understand the project and its outcome. Street design is commonly thought of as a technical task, but there is a place for innovative thinking by non-technical stakeholders and community members. A street is a publicly-owned canvas. How that space is allocated—to vehicles, to pedestrians, to cyclists, to art, to ecology, to play—is not a technical decision, but a political one. The more community members can understand street
design and provide their input, the more likely that streets will reflect the values of the community.

The examples in this book focus on bicycle transportation and are largely taken from U.S. cities. This is intentional. International cities like Copenhagen (Denmark) or Utrecht (Netherlands) have much higher rates of bicycle use and many lessons to teach American cities, but the European context is foreign to many people in the United States. The reality is that for most communities, it is easier imagine street design solutions from familiar U.S. communities. We have also chosen projects from a wide variety of U.S. contexts, from small towns to suburbs and big cities. No matter the community, there are several case studies in this book that are applicable to that particular context. We hope this book helps communities redesign their streets to be as safe, comfortable, and efficient as those found in other cities around the world.

Thank you for your interest in this book. We included a set of diverse, practical, and inspiring case studies that will demonstrate how we can rethink streets for bikes. We want the contents of this book to inspire communities to redesign more streets and complete their projects faster. Please use the case studies in this book to further your community’s efforts to redesign streets with bikes in mind. And please use this book as a starting point for your own street design innovations. We can’t wait to see what you come up with!
Changing the Framing of Our Streets

For the last seventy years, engineers, planners, and policymakers built streets to move vehicles quickly through space. This single-minded goal, largely accepted by a public that rapidly embraced driving, has damaged the urban fabric and made cities less safe. This focus on moving vehicles at all costs has counter-intuitively created more traffic. It was long believed that adding more lanes alleviates congestion, and although new lanes may solve the problem at first, such expansions ultimately induce new demand for driving for a variety of reasons including spurring new development at the outer regions of the widened road. The traffic jams return, but more people are stuck in traffic than before.

Framing matters. If we believe the purpose of our streets is to move vehicles as fast as possible with as little delay as possible, then traffic congestion becomes the primary problem to avoid or fix. What happens if we change our perspective? What if we ask engineers and planners to design streets for safety and for people of all abilities? Our streets would certainly look differently than they do now. This change of perspective is challenging, as most people make most of their trips by car. We all want to get where we’re going without delay.

We need a middle ground in street design, one that meets the needs of people who are trying to get to their destinations, as well those who want to enjoy life along the street. These efforts to “rethink the street” are not new—we wrote a book with that name in 2015—but recently this new framing has become more popular as people are rediscovering and preferring urban life and its amenities. Residents of these neighborhoods no longer need...
to drive for every trip, and appreciate a street that makes it easy to walk, bike, and take transit.

The table (at right) compares the different framings between the car-oriented decision-making paradigm with a new approach that places people at the center of street design. What frame does your community use?

**Mobility vs. Accessibility**
A mobility paradigm emphasizes the quick movement of vehicles, whereas an accessibility paradigm focuses on the ability of people to reach their destinations. Accessibility increases when the mixture and density of land use increases, bringing our destinations closer to where we begin. Our mode of travel may be slower, but it takes us less time to get where we are going.

**Throughput of Vehicles vs. Throughput of People**
Throughput is the measurement of how many things—cars, trucks, or people, for example—move on a street over a set amount of time. The traditional thinking is that the higher the throughput, the better. What is more important is how many people are moving on a street. In certain locations, more people on a bus, bike, or foot can get through an intersection than vehicles can, so optimizing for people instead of vehicles would seem to be a preferable approach to street and intersection design.

**Vehicular vs. Person Delay**
Similar to throughput, one common measure in the traditional paradigm is to look at delay in terms of vehicles. Delay for cars often emerges as a reason why bicycles cannot have preferred traffic timing. For which user should the intersection be optimized?

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*This table compares the traditional, car-first framing of street design with an alternative, people-first framing.*
Changing the Framing of Our Streets

ADT vs. ADT for All
Average Daily Traffic (ADT) is a common measurement of the number of vehicles that travel on a road per day. This number leads to recommendations on how many lanes or space on the street should exist to handle the vehicles. ADT counts cars and thus results in allocating space for cars, not people. ADT calculations almost never count pedestrians, cyclists, or transit users, so the count itself leads to self-fulfilling policy decisions and investments.

Plan for the Peak vs. Plan for the Off-Peak
In the traditional framing, rush hour level of vehicle use guides most street allocation decisions. Yet in many cities, the rush hour may be little more than one to two hours per day and non-existent on weekends. This paradigm produces streets vastly and wastefully overbuilt for traffic 90 percent of the day. These overbuilt streets are then unwelcoming for cyclists and pedestrians. Alternatively, how might streets be designed if the peak were thought of as the hours when kids are walking to or from school rather than adults commuting to or from work?

Journey to Work vs. All Trips
Streets are generally designed to maximize throughput for one kind of trip: the commute to work. This ignores many of the trips we make, such as to run errands, see friends, or meet at a cafe or bar. About 40 percent of these trips are under two miles in length. Yet, even though these shorter, non-work trips are more common, streets are not designed for walking, cycling or scootering, perfect modes for these short trips.
Congestion Reduction vs. Congestion Alternatives
Congestion is the enemy of the traditional framing. The new framing focuses on finding the most space-efficient way to help the most people access their destinations easily and congestion reduction is not a top priority. Since building more lanes generally does not reduce congestion, the new framing for streets reallocates space to make it possible for more people to conveniently travel by foot, bike, scooter, or transit. A single person on a bike uses significantly less space than a single person in a vehicle, so creating safe, comfortable, and pleasant bike infrastructure on an otherwise crowded roadway helps people access their destinations quicker, even though the throughput of vehicles may be reduced.

AASHTO vs. NACTO
New design standards are the perfect catalyst for transitioning to a new framing. Prior to 2011, the street design standards that almost all traffic engineers, and thus cities, followed in the U.S. was based on the American Association of State Highway and Transportation Officials’ (AASHTO) *A Policy on Geometric Design of Highways and Streets* and the Federal Highway Administration’s (FHWA) *Manual on Uniform Traffic Control Devices* (MUTCD). These design manuals were crafted by state highway officials, and the standards were focused on throughput of vehicles, congestion reduction, and minimizing vehicular delay. These may be appropriate principles for highways, but not for city and neighborhood streets. In 2011, a new organization called the National Association of City Transportation Officials (NACTO) began releasing its own design guides that focus on urban streets where cars, transit, bicycles, and pedestrians co-exist. The NACTO street design guides have liberated cities to redesign their streets in people-centered ways.

Street as Infrastructure for Going Somewhere Else vs. A Good Place to Be
Vibrant, busy streets are some of the best places to be. Streets are dynamic, and that’s what makes them the lifeblood of a city. But with the singular emphasis on throughput, many streets become solely a mechanism to get somewhere else, no longer a series of public and private spaces to be used, lived in, and enjoyed. The re-introduction of people moving at walking and bicycle speed creates a place that supports street-oriented businesses, residences, entries and porches, and higher densities of varied uses. This can even happen along busy streets.

Framing does matter. This is particularly true when we’ve been subjected to the traditional framing for so long we don’t realize that other paradigms exist. We live in a world where the car is the priority and streets are designed to move as many of them as quickly as possible. Our policies and investments all support this traditional framing. A shift in frame, from mobility to accessibility, and from infrastructure to place, can have a profound impact on our cities and its people.
Myths about Cycling

Street space is limited and contested among the users and proponents of different modes. The process of choosing a bike lane over a car lane, for example, is a political choice as much as an engineering one. Cycling is more popular than ever and new bike facilities are competing for space. This conflict breeds misconceptions about cyclists and bike infrastructure that may make it more difficult to build more bike facilities in the future. Below, we present ten common myths and misconceptions about bikes and the people on them.

**MYTH: Cyclists are always breaking the law and investments should not be made until cyclists follow the law**

**FACT:** All road users break basic traffic laws, like rolling through stop signs, at similar rates. Motorists, however, are much more likely to speed, fail to signal, to drink or text while driving, or fail to yield to pedestrians crossing streets, or give enough space to someone on a bike. Rarely is an argument made that society should stop investing in automobile infrastructure until drivers follow the law, but that is a common refrain arguing against investing in better bicycle infrastructure. An easy way to witness this reality is to sit and watch a residential street intersection and observe how many people in a car or a bike come to a complete stop at a stop sign. The reality is that few people do, unless there is cross traffic of some kind. Such behavior should be expected, for while it may be illegal, it is often prudent, safe, and appropriate. In Idaho, for example, stop signs are actually treated as yield signs for people on bike.
MYTH: Cyclists don’t pay their fair share because they don’t pay a gas tax or vehicle registration fee
FACT: Gas taxes and vehicle registrations only cover about half of the cost of road infrastructure. Other costs are covered through general taxes, property tax, and general bond measures—money everyone pays whether they drive or not. In addition to being one of the primary contributors to climate change, accidental death and injury, and other significant negative societal externalities, cars and trucks cause significantly more damage to our pavement than bikes.

MYTH: The safest thing a cyclist can do for safety is wear a helmet
FACT: The best thing that can be done to increase the safety of people on bike is to build connected systems of protected bikeways. The rate of cycling injuries and fatalities is significantly lower in global cities that have extensive networks of protected bikeways, where significantly more trips are taken on bike (over 35 percent of trips in some cities in Denmark and the Netherlands), and where helmet use is rare. Just like it is rare to bump into a fellow pedestrian in a way that results in serious injury, the same is true on bike when there is infrastructure that separates bikes from cars. Helmets do not cause harm, but they should not be the first focus for enhancing bicycle safety.

MYTH: Cycling in cities is bad for one’s health due to inhaling vehicle emissions
FACT: While it is true that cycling in car traffic does expose riders to increased air pollutants, the physical activity of cycling out-

Bike helmets should not be a community’s only—or first—solution to bicycle safety.
Myths about Cycling

weighs any negative exposure in all but the most polluted cities. As motorists begin to purchase electric vehicles, local exhaust emissions will decline. And, of course, the more trips taken by non-automotive modes, the lower the air pollution for all.

MYTH: Cycling is expensive and requires a big investment
FACT: Some cyclists choose to buy expensive bikes and high performance gear, but for most, cycling is a relatively inexpensive form of transportation. Bikes are much cheaper when compared to cars. It costs $8,800 per year to own and operate a new motorized vehicle, on average, in the United States.

MYTH: Bike-sharing programs make roads less safe by putting less experienced riders on the roads
FACT: While bike sharing programs do introduce more people to cycling, often on streets with inadequate bike infrastructure, there was only one reported fatality in over 130 million bikeshare trips between 2013 and 2017. Users of bikeshare systems also have fewer crashes and injuries than non-bikeshare cyclists.

MYTH: Cyclists must be fit and wear special clothes
FACT: The image of a fit, lycra-clad cyclist is a common one in the United States, but this isn’t the case everywhere. When cities invest in protected, prioritized, connected bicycle infrastructure, there is no need to ride quickly to keep up with cars or to make green lights timed for motorized traffic. In many global cities with high cycling percentages, it is more common to see people in suits or dresses on a bike than to see cyclists wearing special clothing. The design of the bikes themselves can make it easier to wear everyday clothes; features such as chain guards, baskets for holding bags, and step-through frames can keep riders clean.

Bikeshare riders do not make roads less safe, but they do give people another convenient way to traverse their community on bike.

Source: Nick Falbo via Flickr
and tidy. Most bikeshare bikes have these features to attract casual cyclists.

**MYTH: Streets are for cars**  
**FACT:** Engineers, policy makers, and planners may have designed streets with cars in mind, but this does not give motorists exclusive rights to the street. State laws allow people on bike to use streets just like people in cars, especially when no dedicated infrastructure for biking exists.

**MYTH: Bikes are for kids**  
**FACT:** Bikes are great fun for kids and adults. Research shows that when cities build infrastructure for safe and comfortable cycling, more people of all ages ride. In cities like Copenhagen—a city full of wide, ‘American-style’ streets—over 60 percent of residents use a bike to get to work or school.

**MYTH: Bike lanes cause gentrification**  
**FACT:** The forces of gentrification are complicated and are caused primarily by market forces and local planning and land use decisions. Great bike infrastructure everywhere adds transportation options for community members at all income levels as the cost to bike is low and the geographic range is relatively large.
Urban transportation is in the midst of transformational disruption. As described in this book, cities of all sizes are seriously investing in local bicycle transportation systems. This trend will continue and the benefits will multiply as piecemeal bike infrastructure projects of the past begin to add up to connected and more complete systems. A dense, interconnected network of bicycle facilities is one of the best ways to encourage people to use a bicycle for all types of daily trip making. At the same time, cities are witnessing the rise of vehicle sharing (e.g., Uber and Lyft, e-scooters, and dockless bikes) and autonomous vehicles. As cities make changes to the street to accommodate these new modes, the results may make cycling safer and more convenient as well. The opposite may also be true.

We don’t yet know the full effect of these new modes because they have burst onto the scene quickly and recently. Take a moment to understand the scale of transformation: in 2009, there were no ridehailing services, dockless bikeshares, or e-scooter systems. In 2017, the ridehailing companies Lyft and Uber provided over 20 billion rides worldwide, e-scooter companies Bird and Lime provided over 20 million rides their first year in the U.S. and continue growing exponentially, and dockless bikeshare systems represented much of the 25% growth rate in bikeshare utilization between 2016-17. Cities are struggling to keep up with permitting, enforcement, and design decisions as the adoption of these services outpace city policy.

This shifting transportation landscape raises many questions of relevance to cycling, including:

E-scooters have become a popular mode of transportation in cities around the world.
• How well will automated vehicles ‘see’ people on bikes?

• If automated vehicles are programmed to not hit people on bike (or foot), does that mean people on bike (or foot) can freely use the entirety of any street any time? Or will people on bike (and foot) be criminalized if ‘interfering’ with vehicles on the public street?

• Will a possible reduction in the need for on-street parking mean that street space will be allocated for better, protected bicycle infrastructure or something else?

• With increases in ridehailing services, will more vehicles be crossing bike lanes to drop off and pick up passengers or will curbs be systematically placed on the other side of bike lanes?

• Will automated transit become a reality? Will this increase transit/bike conflicts in mixed traffic environments?

• Does the rise of ridehailing and new space-efficient, mobility options like e-scooters, make it more likely that the future of transportation revolves around buying rides by mode depending on the trip need rather than buying vehicles?

Bicycles remain the most efficient human transportation invention and their positive qualities will appeal to new cyclists, especially as cities start implementing connected systems of low-stress bike infrastructure. With the quick rise in new forms of mobility, cities will need to make some quick decisions to help guide these technologies in complementary ways to the past investments in bicycle transportation already made.

Source: Wikimedia Commons/ Dllu

The details of how self-driving cars will change cities are not yet known, but it is clear that communities will soon have to plan for them.
Many of the streets in this book have new infrastructure to accommodate cyclists. Depending on the size of the street and the context within the community, there are multiple potential strategies that help cycling be safe, comfortable, and direct.

Sharrows are symbols painted in the lane indicating that drivers and bicyclists share the travel lane. Existing law generally already allows for shared use, and sharrows simply reinforce that reality in particular locations.

Bike lanes typically range in size from 4 feet to 8 feet, and are lanes specifically dedicated to cyclists, though they may occasionally share space with cars for right turns at intersections. They usually exist on busier streets and demarcate bicycle space from motorized vehicle space with a line of white paint.

Cycle tracks are like bike lanes, but are physically separated from the motorized traffic. The barrier further protects cyclists from cars and dooring (collisions between cyclists and the open doors of parked cars). Cycle tracks may be one way or two way, and are sometimes lined with posts or painted green for added visibility.

Buffered bike lanes are a hybrid design that widens the strip of paint between a bike lane and motorized vehicle lanes. This extra buffer, often 2-3 feet, provides extra space and comfort to a wider range of people on bikes. Like bike lanes, buffered lanes and cycle tracks are generally located on busier streets that have destinations where people want to go.

For a more detailed explanation of bicycle facilities and design guidance, see the NACTO Urban Bikeway Design Guide.
**The Street Cross Section**

**Curbs $$$$**
The curb provides a clear distinction between the sidewalk and the street, but is also important for the street's function. Changing the curb line impacts the drainage system on the street, and requires re-engineering the street system, which can become costly. Construction may be lengthy and result in partial closure of the street. Thus, street designs that include moving curbs often require a greater investment of time and resources.

**Parking $**
Although changes to parking may only require restriping or painting the curb, changing parking is often the most controversial and discussed aspect of redesigning streets. On-street parking typically is located next to the curb, although in some cases bike lanes are located between curb and parking to give cyclists protection from moving vehicles. In addition to cars, parking strips can contain bike parking (12 bikes = 1 car), leaving sidewalks to pedestrians.

**Right of Way $$$$$**
The right of way is the strip of land that accommodates all the elements of the street, including lanes and sidewalks. Expanding the right of way can be a complicated, lengthy and expensive process. In order to expand the right of way, the City typically must purchase the land along the roadway from individual citizens and businesses. In many cases, structures and other obstacles may exist in this area.

**Travel Lanes $**
Though re-striping lanes may require a traffic study, the cost to grind off old paint and repaint the lines is generally very low. Additionally, there is minimal disruption to traffic because the construction process is simple and can be done in phases. Cities can also test out new street designs with temporary restriping because of its low cost. Auto travel lanes can range from 9-12’ in commercial areas. Current standards recommend minimum 6’ bike lanes.

**Streetscape Elements $$**
Streetscape elements include benches, bike parking, trees, and other furnishings on the sidewalk. Though the city may have standards to maintain a clear walking zone, there are a variety of ways to improve the streetscape. Installing streetscape elements can improve the sense of place of a street and create pleasant pedestrian environments.
One-way protected bike lanes through Downtown Oakland increases safety for all users.

- In 2016, the City of Oakland removed one travel lane in each direction on Telegraph Avenue between 19th Street and 41st Street to create space for cyclist and pedestrian safety improvements.
- Low-cost parking-protected bicycle lanes serve as an interim solution while the City seeks funding for future capital improvements along the corridor.
Evidence of Change

Key Outcomes

Safe and Attractive for all Users
Not only has the previously “high-injury” corridor seen a decrease in the crash rate, but the narrowed vehicle right-of-way has reduced speeding and increased overall corridor safety.

Building Neighborhood Vitality
As part of a phased complete streets plan, bicycle and pedestrian traffic have almost doubled since implementation of the first redesigns. This may have helped boost retail sales in the adjacent KONO district, which have increased since the installation of the protected bike lanes.

Street Section Before and After

Facts and Figures

ONE-WAY PROTECTED BIKE LANE

STREET CLASSIFICATION
Principal Arterial

RIGHT OF WAY
Varies

LENGTH
0.65 miles

SPEED

BEFORE
AFTER
SPEED LIMIT
25
25

AVERAGE DAILY TRAFFIC
13,900

BEFORE

RESPONSIBLE AGENCY
City of Oakland
Based on their project progress report, which included deliberate community outreach, the City identified steps to improve visibility with new bollards and street paint. Without these additional buffers, many vehicles were parking in unclear buffer zones, significantly increasing monthly parking citations.

Since installing the project, the City has seen a significant decrease in speeding.

Fifty-two percent of bicyclists say they now travel through the corridor more frequently.

Telegraph Avenue Context

- Telegraph Avenue is an important corridor between the neighborhoods of northern Oakland and downtown and is a major connector to the City of Berkeley and its university. Prior to installing the bike lanes, there were two lanes of car traffic running in both directions and no dedicated facilities for cyclists.
- The ongoing Telegraph Avenue Complete Streets Implementation Plan seeks to balance the needs of all users and has set metrics to evaluate the project’s impact on safety, economic vitality, and user satisfaction. In addition to protected bike lanes, the City also installed pedestrian improvements (median refuge islands, ladder crosswalks, and curb extensions) and relocated bus stops to improve efficiency of bus transit operations.
- Based on their project progress report, which included deliberate community outreach, the City identified steps to improve visibility with new bollards and street paint. Without these additional buffers, many vehicles were parking in unclear buffer zones, significantly increasing monthly parking citations.
- Since installing the project, the City has seen a significant decrease in speeding.
- Fifty-two percent of bicyclists say they now travel through the corridor more frequently.
ONE-WAY PROTECTED BIKE LANE

Aerial view of Telegraph Avenue. Source: City of Oakland

New City of Oakland bike share program riders on protected bike lanes. Source: City of Oakland

Low-cost planters provided a demonstration of the future project during early project outreach. Source: Bike East Bay

Protected bike lanes increased ridership and accessibility on this busy downtown corridor. Source: City of Oakland