CHAPTER 2

BICYCLE TRANSPORTATION

BICYCLING IN AMERICA

Bicycles gained prominence as transportation vehicles in the late 19th century. In the United States, many early efforts to improve road conditions were sponsored by organizations such as the League of American Bicyclists. After the rise in popularity of the automobile, the situation changed rapidly, with motor vehicles dominating the country's roadway infrastructure; bicycles were not taken into consideration in the development of the transportation infrastructure for much of the 20th century.

In the 1960s, more people started using bicycles for both transportation and recreation, and many off-road bike paths were developed throughout the 1970s. However, paths alone do not meet all the travel needs of people who bike. Because it is our road system that provides the most efficient – and often the only – connections between destinations, the City of Cambridge supports the premise that roadways should accommodate all users and that revisions to the layout and function of many streets will be required to ensure support for bicycling.

Bicycles are found in most American households, with an average of 0.86 adult-size bicycle per household.[1] In 2012, 13.0 million bicycles were sold in the U.S. (12.2 million new cars and trucks were purchased that year).[2] The bicycle industry has a positive robust economic benefit: in 2012, the bicycle industry in the U.S. was estimated to support 772,146 jobs and generate nearly $10.7 billion in federal, state and local taxes.[3]

THE BENEFITS OF BICYCLING

Bicycling is energy efficient, convenient, and improves health and quality of life, among many other benefits. This section explores a few of these benefits. For further information, refer to the references section.

ENERGY EFFICIENCY

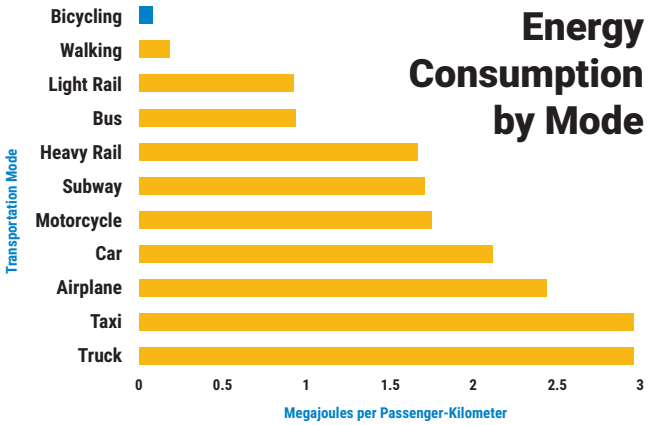


Figure 2.1: Energy consumption by mode. Bicycling is the most energy efficient form of transportation, getting the energy equivalent of over 1,000 miles per gallon.[4] [5]

ENVIRONMENTAL BENEFITS

Using a bicycle instead of other modes of transportation will have positive impacts:[6]

+ Reduced greenhouse gas emissions and lower contribution to global climate change
+ Reduction in pollutants related to air quality
+ Reduction in pollutants that are related to ancillary facilities; the manufacturing of automobiles contributes more pollution than the manufacture of bicycles

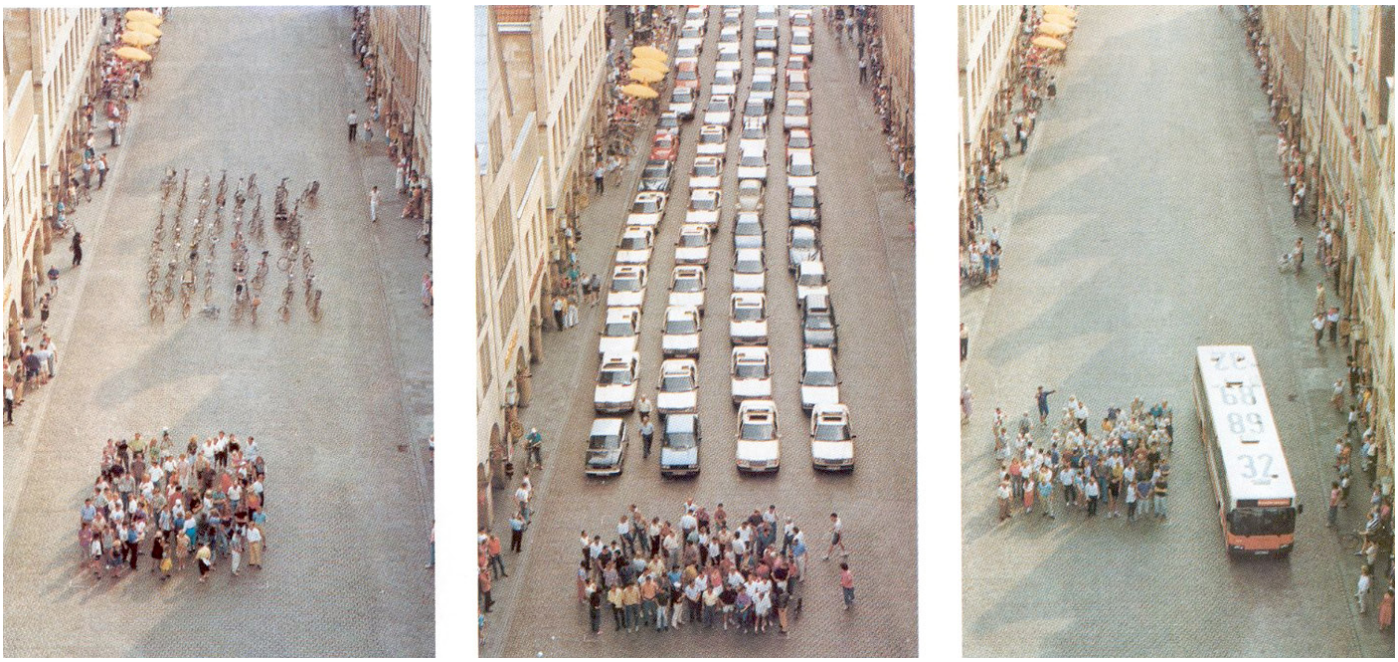


Figure 2.2: Relative space for different travel modes. In this influential photo, the City of Münster, Germany demonstrates the relative space required to move the same number of people by bicycle, car and bus.[7]

TRANSPORTATION INFRASTRUCTURE BENEFITS OF INCREASED CYCLING

+ Less traffic congestion
+ Greater efficiency: more people can travel in less space
+ Less wear and tear on our roads
+ Less consumption of petroleum resources
+ Fewer costly crashes and property damage
+ Less need for additional roads, travel lanes, and parking areas

HEALTH BENEFITS[8]

+ Reduced air and noise pollution for everyone.
+ Improved health and well-being through regular exercise. Numerous studies have shown a positive link between exercise and health in a wide range of areas, notably cardiovascular health, weight control, mental health, cholesterol, hypertension, stress, and other diseases.
+ Providing regular exercise opportunities for children. Children need a lot of movement for their physical and mental well-being. With school systems reducing time for recess and physical education and parents more reluctant to allow their children to play freely outside, U.S. children get less exercise now than they did 20 years ago. At the same time, there has been a rise in childhood obesity and related diseases like Type 2 diabetes. In addition, lack of physical activity has been associated with ADD-type behavior.
+ Even after adjustment for other risk factors, including leisure time physical activity, those who did not bicycle to work experienced a 39% higher mortality rate than those who did.[9]

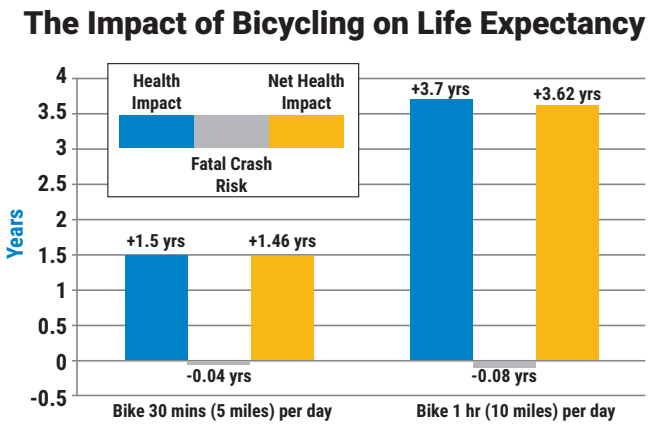


Figure 2.3: Bicycling has positive impacts on life expectancy, even with crash risk factored in.[10]

+ People who bicycle to work are healthier, with fewer sick days per year.[11]

+ On average, the estimated health benefits of bicycling are substantially larger than the risks of bicycling relative to car driving. The benefits to society are even larger because of a reduction in air pollution and eventually — with more bicycling, less driving, and better street design — fewer traffic crashes.[12]

ECONOMIC BENEFITS

+ Bicycling is a low-cost means of transportation that is available to many people regardless of income or age. Estimates of annual costs range from less than $100 to around $300 annually for a modest style bicycle (annualized over 10 years).[13]

+ Even less expensive is a Hubway membership, at $85/year or about $7/month (2015). Estimates for car ownership at this time are about $6,700 - $10,600/year.[14]

+ A quality bicycling environment creates opportunities for people to participate in the social, cultural, and economic life of the community without using a car.

+ When people use bicycles instead of driving, the public saves money on roadway maintenance and other traffic-related services.[16] In Cambridge, approximately a third of households have no car.[15]

+ Retailers benefit from residents who, with easy access to goods, make their purchases locally. The "Buy Local" movement is a strong, growing movement in Cambridge and around the country.

+ Evidence from around the country shows that bicycle or multi-use paths foster new and expanded business.[17]

+ Tourism is an important industry, and a bicycle-friendly environment can attract many riders from elsewhere. A bicycle-friendly environment also allows and encourages tourists to bike as a means of transportation when visiting.

+ Cities with higher bicycling populations have been shown to have lower overall crash rates, which in turn reduces related costs, such as for police, medical care, and insurance.[18] [19] [20]

+ Greater reliance on bicycling and other sustainable transportation modes enables economic growth on a large scale. The Kendall Square area of Cambridge added 4.6 million square feet in a decade and increased commercial and institutional space by 40 percent without a concomitant rise in automobile traffic.

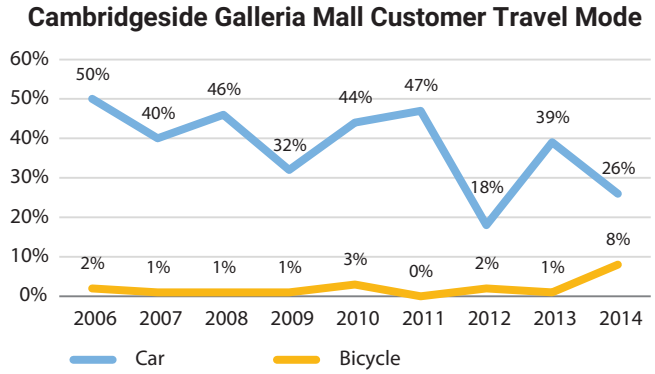


Figure 2.4: Fewer shoppers use cars to reach the Cambridgeside Galleria.[21]

QUALITY OF LIFE AND SOCIAL BENEFITS

The number of people who feel comfortable walking or riding bicycles is a measure of the quality of life in a city. The presence of many people walking and bicycling in a city indicates that there is a strong sense of community, people feel safe being outdoors, social interactions can occur openly, and people of all ages and incomes can have access to public and private facilities.

Safe bikeways help enable school children to bike to school, providing children with much-needed physical activity and reducing the need for busing or automobile trips by parents. Children in cities such as Cambridge are often more mobile than suburban children because they can get around more easily on foot, by bicycle, or by transit. Children who walk and bicycle to school do better academically.[22] [23]

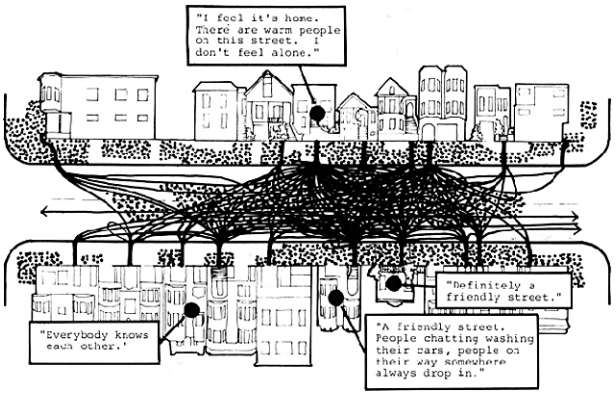
Traffic has a profound impact on community life. A renowned study by University of California, Berkeley professor Donald Appleyard compared three residential streets in San Francisco that were similar except for traffic levels. Published in the influential book "*Livable Streets*," the research showed that residents of the street with the lightest traffic volumes reported having the highest average number of friends and acquaintances on their street when compared to residents of the streets with higher traffic volumes (see Figure 2.5).[24]

Comparison of Social Connections on Streets with Light, Moderate and High Traffic Volumes

Light Traffic

2,000 Vehicles per Day
200 vehicles per peah hour

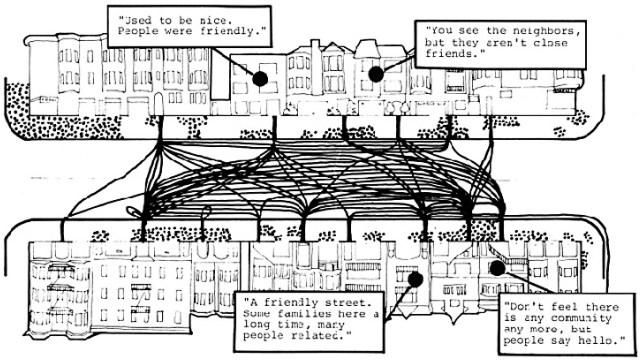
3.0 friends per person
6.3 acquaintances



Moderate Traffic

8,000 vehicles per day
550 vehicles per peak hour

1.3 friends per person
4.1 acquaintances



Heavy Traffic

16,000 vehicles per day
1,900 during peak hour

0.9 friends per person
3.1 acquaintances

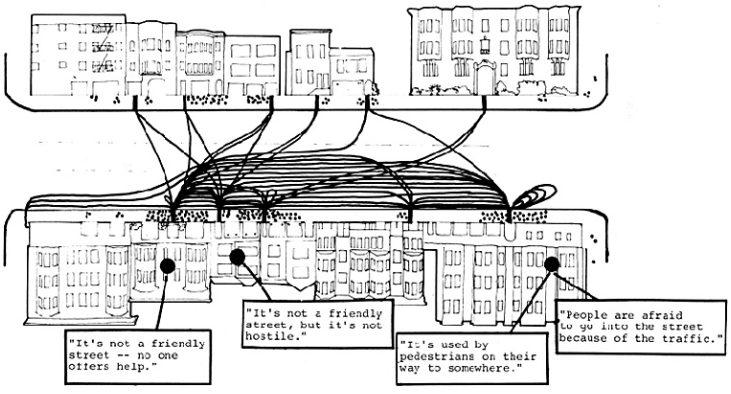


Figure 2.5: Comparison of social connections on streets with light, moderate and high traffic volumes. Lines on the diagram represent social connections. Adapted from the original illustration created by Betty Drake in "*Livable Streets*" and used with permission from Bruce Appleyard.

THE POTENTIAL FOR BICYCLING

Bicycling is an enormously popular activity. In 2009, Americans ages 6 and older went on 2.54 billion bicycling outings, averaging 59 outings per person who rode a bike.[25] People use a bicycle for all sorts of reasons, not just for commuting. Commute trips in general make up less than 20% of all trips.[26] Bicycling gets people to work, to school, to shops, to visit friends, to parks, to soccer practice, to music lessons, to the T, or to see the sights.

MAJOR REASONS PEOPLE BICYCLE

- Primary mode of transportation
- More convenient or faster than other modes of transportation
- Recreation/pleasure
- Fitness
- An activity to do with family or friends
- Concern for the environment
- Less expensive than other modes of transportation
- Many trips are within easy bicycling distance: 40% of all trips nationwide are shorter than two miles, no more than a 10-minute bike ride.[27]
- Any combination of the above

DESIRE AND SUPPORT FOR BICYCLING

In many parts of the country there are structural deficiencies in the environment that pose major obstacles to increasing the rate of bicycling and walking, such as sprawling development and highways that dissect communities. Fortunately, Cambridge already has many of the key elements to support bicycling and walking: compact, with many destinations in close proximity.

No matter where one is, though, numerous studies over decades have shown that:

1. **Most people in the US would like to bicycle more than they do now**
2. **The biggest barrier to bicycling is the lack of safe facilities. More and better bicycling facilities have dramatically increased bicycle share trips in cities without any tradition of cycling for daily travel.[28]**

People also consistently articulate their support for public spending on providing better facilities. In a 2014 survey of US voters, three-quarters wanted to see the level of funding for bicycling and walking facilities maintained or increased.[29]

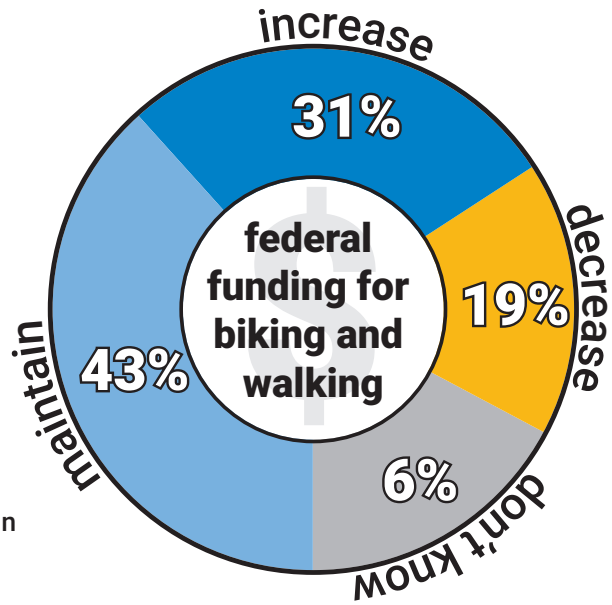


Figure 2.6: 74% of Americans polled want to maintain or increase federal funding for biking and walking.[29]

HOW PEOPLE RELATE TO BICYCLING

In 2006, the City of Portland, OR's Office of Transportation proposed a typology describing differences in the way people relate to riding a bicycle: "Strong and Fearless, Enthused and Confident, Interested but Concerned, and No Way No How".[30]

These categories are in part determined by one's comfort riding a bicycle on different types of bikeways. "Strong and Fearless" bicyclists will ride "regardless of roadway conditions." "Enthused and Confident" people are comfortable riding on a road with automobiles, but prefer to do so operating on bicycle-specific facilities and appreciate efforts made to improve the bikeway infrastructure. "Interested but Concerned" people like to ride on off-road paths or quiet neighborhood streets, but are afraid to do so on most roads and therefore do not regularly ride. Finally, the "No Way No How" people are expected not to be interested in riding a bicycle, "for reasons of topography, inability, or simply a complete and utter lack of interest."

Follow-up research conducted by Portland State University in 2012 indicated that nearly all of the sampled population (908 adults) studied in Portland, OR fit into one of the four categories in a similar proportion. The research found that 56% of the region's population was categorized as "Interested but Concerned," which is considered to be the target market for increasing bicycling for transportation; this population reported the highest level of comfort on separated paths and quiet residential streets, closely followed by riding in separated bike lanes on busy streets (30 to 40 mph), a dramatic improvement over the comfort level reported for striped bicycle lanes or riding in mixed traffic without a facility. The analysis indicated that reducing traffic speeds and increasing separation between bicycles and motor vehicles increases levels of comfort and bicycling rates.

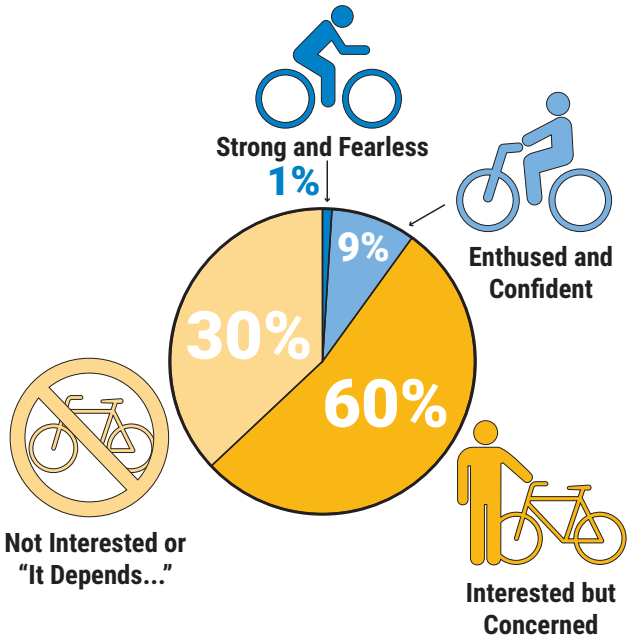


Figure 2.7: Bicyclist Types and Proportions

In the same study, women and the elderly were underrepresented among the more confident adults and those who currently ride bicycle for transportation. Particularly telling was the finding that survey respondents who are categorized as "no way no how" reported that they would feel "comfortable or very comfortable" with a separate bicycle facility.[31] Therefore, the category of "no way no how " needs to be changed; we are calling this group the "Maybe, it depends" group.

The vast majority of people do want to ride, at least sometimes, and supporting everyone who is interested in riding is one of the primary goals of the Cambridge Bicycle Plan.

WHAT IS NEEDED TO SUPPORT PEOPLE OF ALL AGES AND ABILITIES?

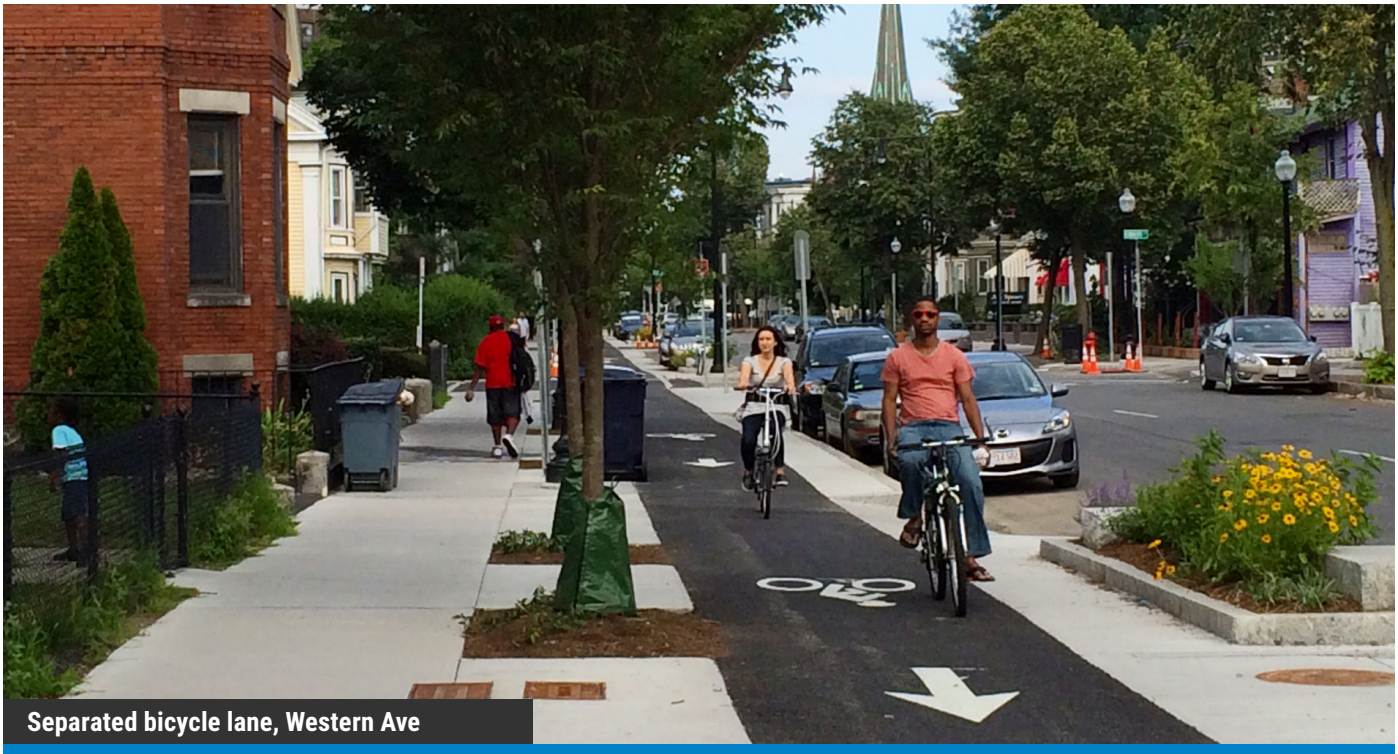
INCREASE SAFETY, COMFORT AND SEPARATION

Since Cambridge began planning for bicycle transportation in earnest in the 1990s, we have consistently seen that the greatest impact comes from creating facilities: people ride where there are places for them to ride.

Many studies conducted locally and across the country have clearly demonstrated that the most significant increases in bicycling rates happen when people are provided with safe, direct, low-stress facilities. Multi-use paths and quiet streets make up an important part of the low-stress bicycle network, but most trips will require some travel along a major street. Therefore, on major streets (arterials and major collector streets), the ideal facility type is a "separated bike lane" (also known as "protected bike lanes" and "cycle tracks").

Separated bike lanes provide an exclusive space for people to ride that is separated from motor vehicle and pedestrian traffic by a vertical element, which can include plastic flexposts, parked cars, curbs, grade separation, and/or landscaping.

Standard bicycle lane, Hampshire Street



Separated bicycle lane, Western Ave

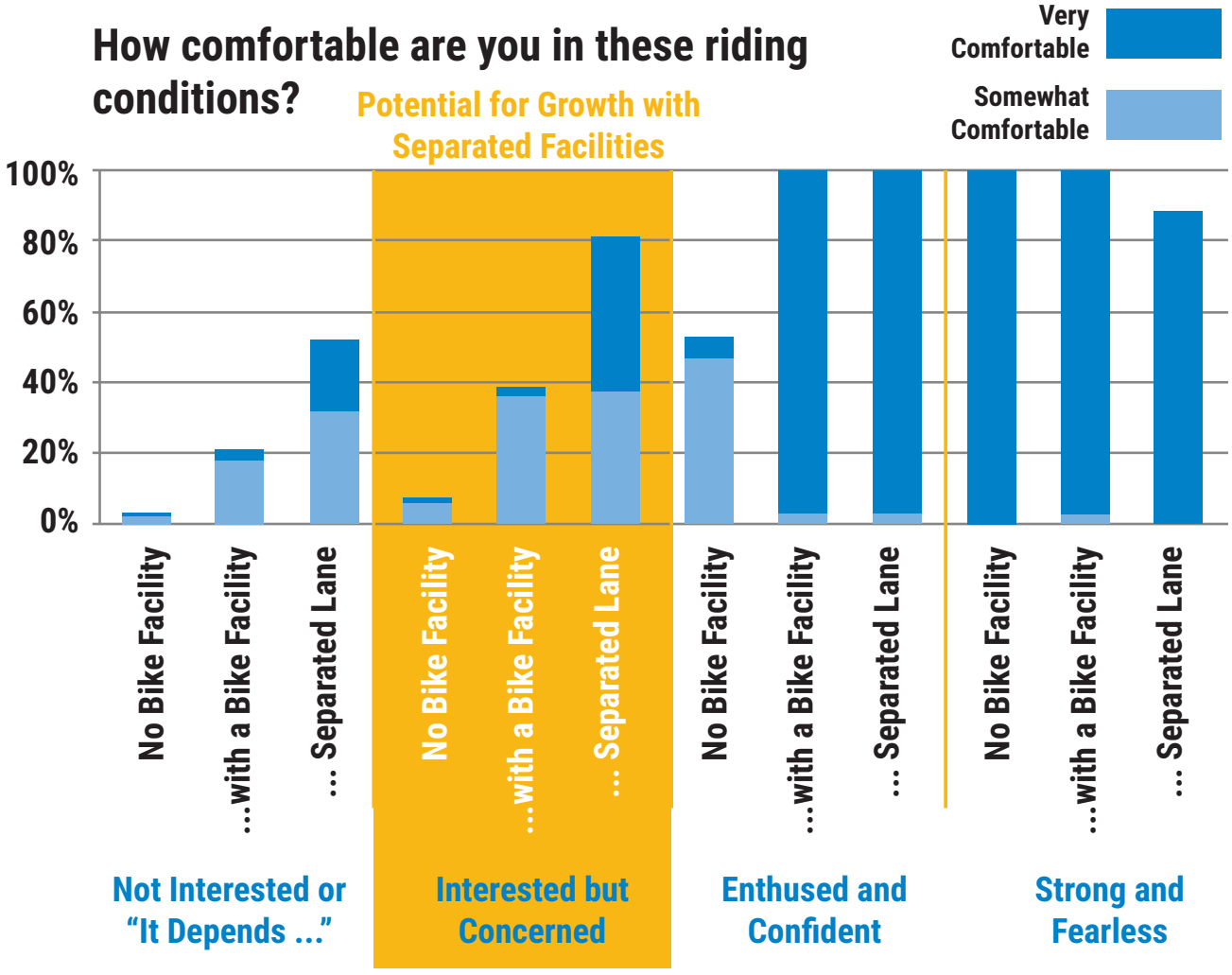
Transitive benefit: more protected facilities > more riders > greater safety

BENEFITS OF SEPARATED BICYCLE LANES:[32]

- + Separated bicycle facilities have been shown to have significant safety benefits
- + Separated bicycle facilities are most comfortable and the preferred facility type on major roads for the vast majority of users
- + Where separated bicycle facilities have been established, marked increases in the number of people riding has been demonstrated
- + Where separated bicycle facilities have been established, there is a dramatic decrease in sidewalk bicycling, thereby improving pedestrian comfort[33]

Separated bicycle lanes enhance the comfort and safety of bicycling on urban streets and encourage people of all ages and abilities to ride.

In a study conducted in Portland, OR, air quality was found to be 8% to 38% better in a separated bike lane than a standard bicycle lane. Researchers also found that the highest differences between the two facilities corresponded with higher traffic volumes, supporting the conclusion that the distance created by a physical barrier between a bicycle facility and moving traffic affects air quality and exposure to ultrafine pollutant particles for people on bicycles.[34]



In a survey of people who travel on a major commercial street, streets with barrier-separation between moving non-motorized and motorized traffic were unanimously found to be the most comfortable for both bicyclists and drivers alike. The survey also indicates that the risk of being hit by a car door is a consistent worry for weekly and daily bicyclists, many of whom have been hit or almost hit in this situation. As parking-related crashes are a substantial portion of crashes in Cambridge (see Chapter 3), this is a significant issue here as well.[35]

SAFE ROUTES TO SCHOOL

In 2005, Congress created the Safe Routes to School (SRTS) program to improve safety and increase the number of children walking and biking to and from school through educational efforts, encouragement programs, and road improvements at or near schools. Research studies indicate that SRTS has increased rates of walking and biking and improved safety. Studies also show the program is an economically sound investment that can decrease health costs and school transport costs.[36]

Average Rates of Walking and Bicycling to School by Length of Participation in Safe Routes to School Program

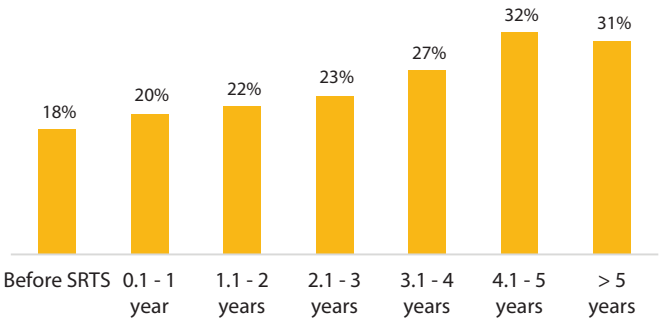


Figure 2.8: Safe Routes to School Programs have been shown to increase walking and biking to school by up to 78% after five years.[37]

In 2015, a research review was done based on the published evidence on four aspects of the SRTS program: impact of SRTS on children's health, impact on walking and biking rates, improved safety following implementation, and the economics of implementing SRTS programs. Key findings are:

- **Actively commuting to and from school could improve mental and physical health**
- **SRTS has increased the number of students who walk or bike to and from school**
- **Unsafe routes make it harder for students to walk or bike to and from school. SRTS has made it safer for students to walk or bike to or from school**
- **SRTS can lower health care and transportation costs for school districts and families[38]**

In 2015, Cambridge launched a Safe Routes to School initiative in to support and encourage children's use of active transportation. Details on this program are provided in Chapter 6.

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