

How to Increase Cycling for Daily Travel: Lessons from Cities across the Globe

Joint Webinar for the Institute of Transportation Engineers and the Active Living Research
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John Pucher, Jennifer Dill, Susan Handy, and Ralph Buehler



Photo: Paul Krueger



Photo: Greg Raisman

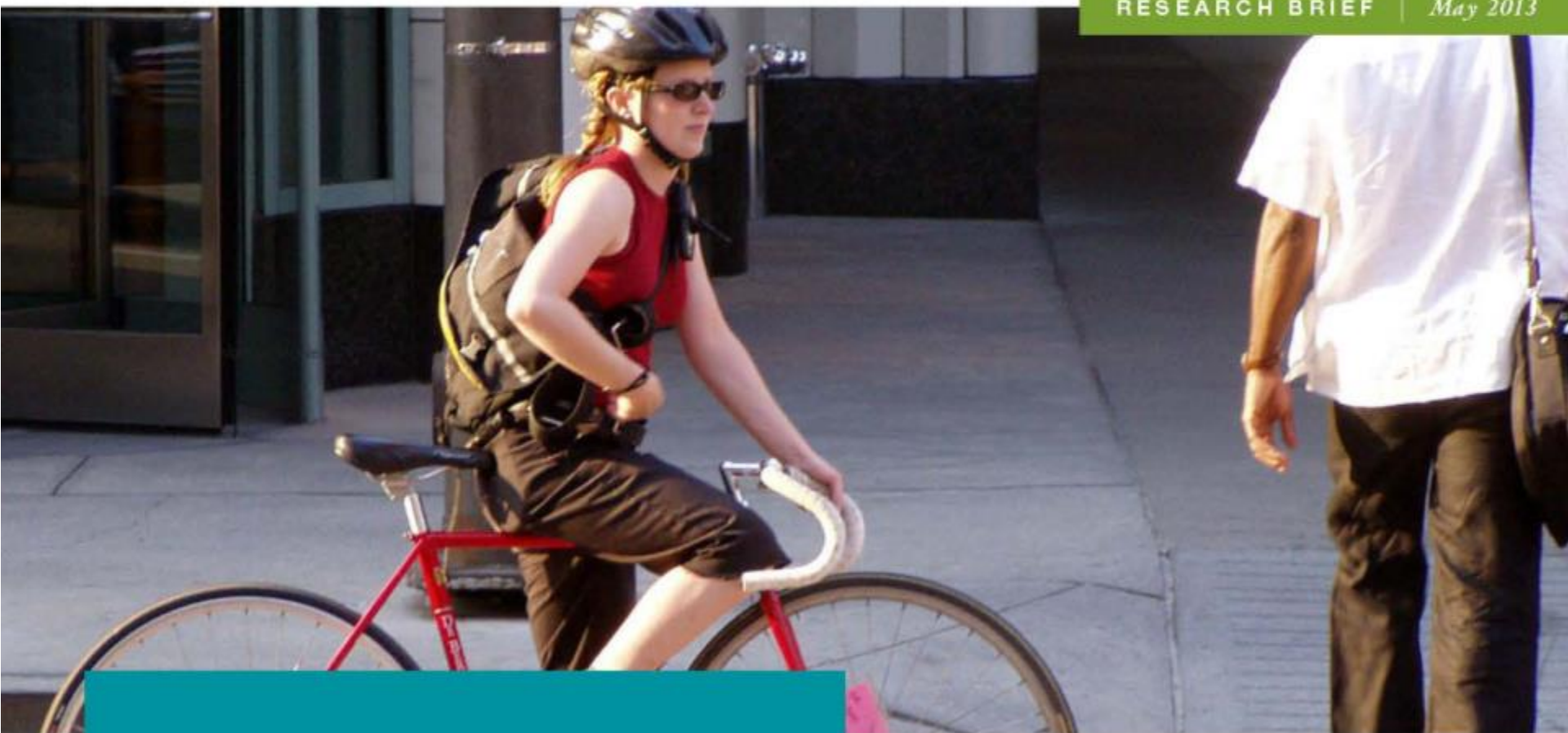
Active Living Research

Building Evidence to Prevent Childhood Obesity and Support Active Communities

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RESEARCH BRIEF

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How to Increase Bicycling
for Daily Travel



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Review

Infrastructure, programs, and policies to increase bicycling: An international review

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ABSTRACT

Objectives. To assess existing research on the effects of various interventions on levels of bicycling. Interventions include infrastructure (e.g., bike lanes and parking), integration with public transport, education and marketing programs, bicycle access programs, and legal issues.

Methods. A comprehensive search of peer-reviewed and non-reviewed research identified 139 studies. Study methodologies varied considerably in type and quality, with few meeting rigorous standards. Secondary data were gathered for 14 case study cities that adopted multiple interventions.

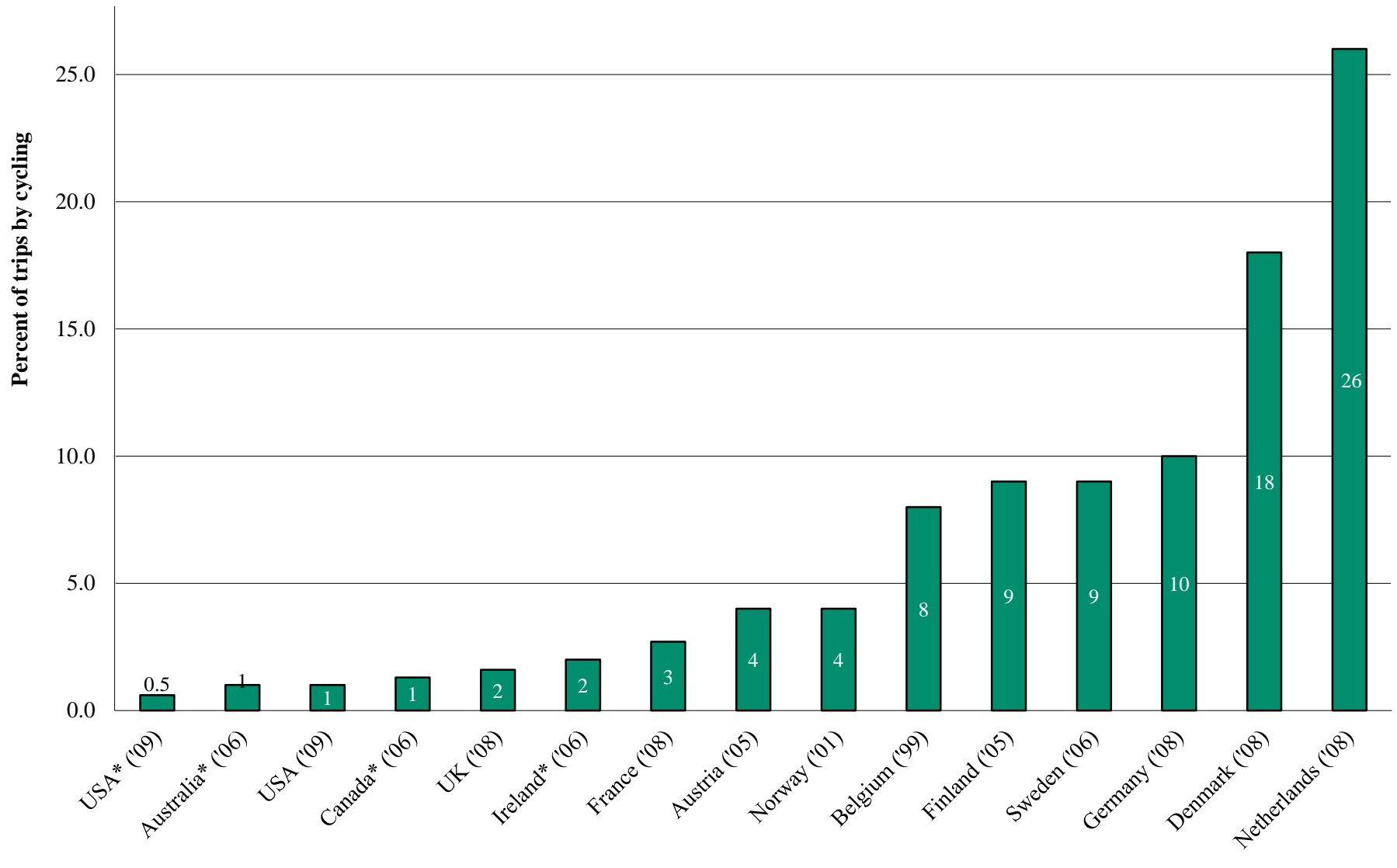
Results. Many studies show positive associations between specific interventions and levels of bicycling. The 14 case studies show that almost all cities adopting comprehensive packages of interventions experienced large increases in the number of bicycle trips and share of people bicycling.

Conclusions. Most of the evidence examined in this review supports the crucial role of public policy in encouraging bicycling. Substantial increases in bicycling require an integrated package of many different, complementary interventions, including infrastructure provision and pro-bicycle programs, supportive land use planning, and restrictions on car use.

Advantages of Cycling:

- **Economical**: Affordable by everyone, requiring minimal costs for individuals and governments
- **Good for business**: Generate retail sales and profits from tourism
- **No pollution**: Clean and quiet
- **Energy-efficient**: Use up calories we need to burn off from eating too much
- **Healthy**: Many studies report on physical, social, mental health benefits
- **Fun**: Getting out into the fresh air with family and friends

Cycling Share of Daily Trips in Europe, North America, and Australia, 1999-2009



Source: Pucher and Buehler (eds.) *City Cycling*. Cambridge, MA: MIT Press, 2012

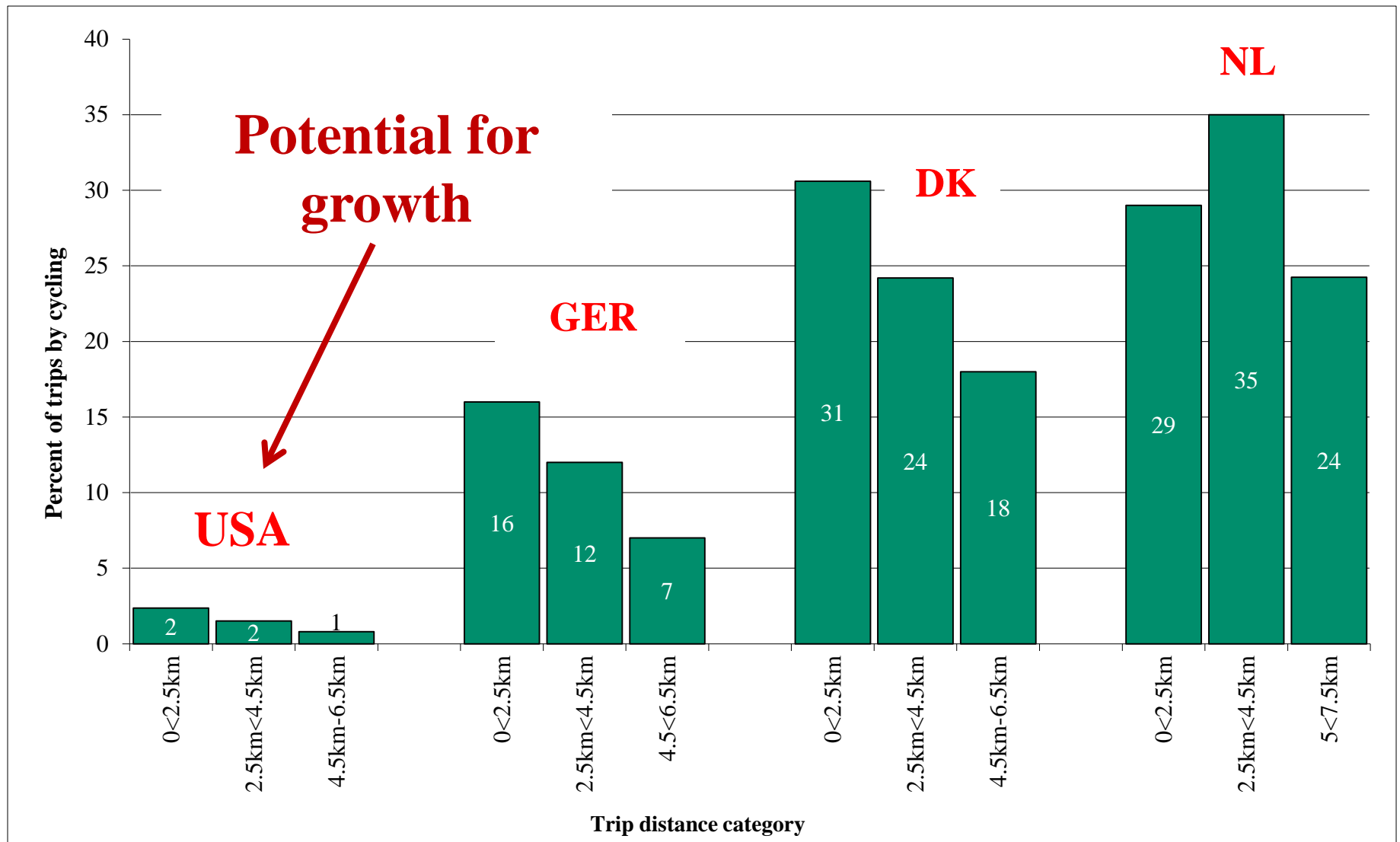
Lots of Potential for Increased Cycling:

Many daily trips in American urban areas are short enough to walk or bike!

- **~27% of all trips in the U.S. were a mile or shorter in 2009**
- **~41% of all trips were shorter than two miles**

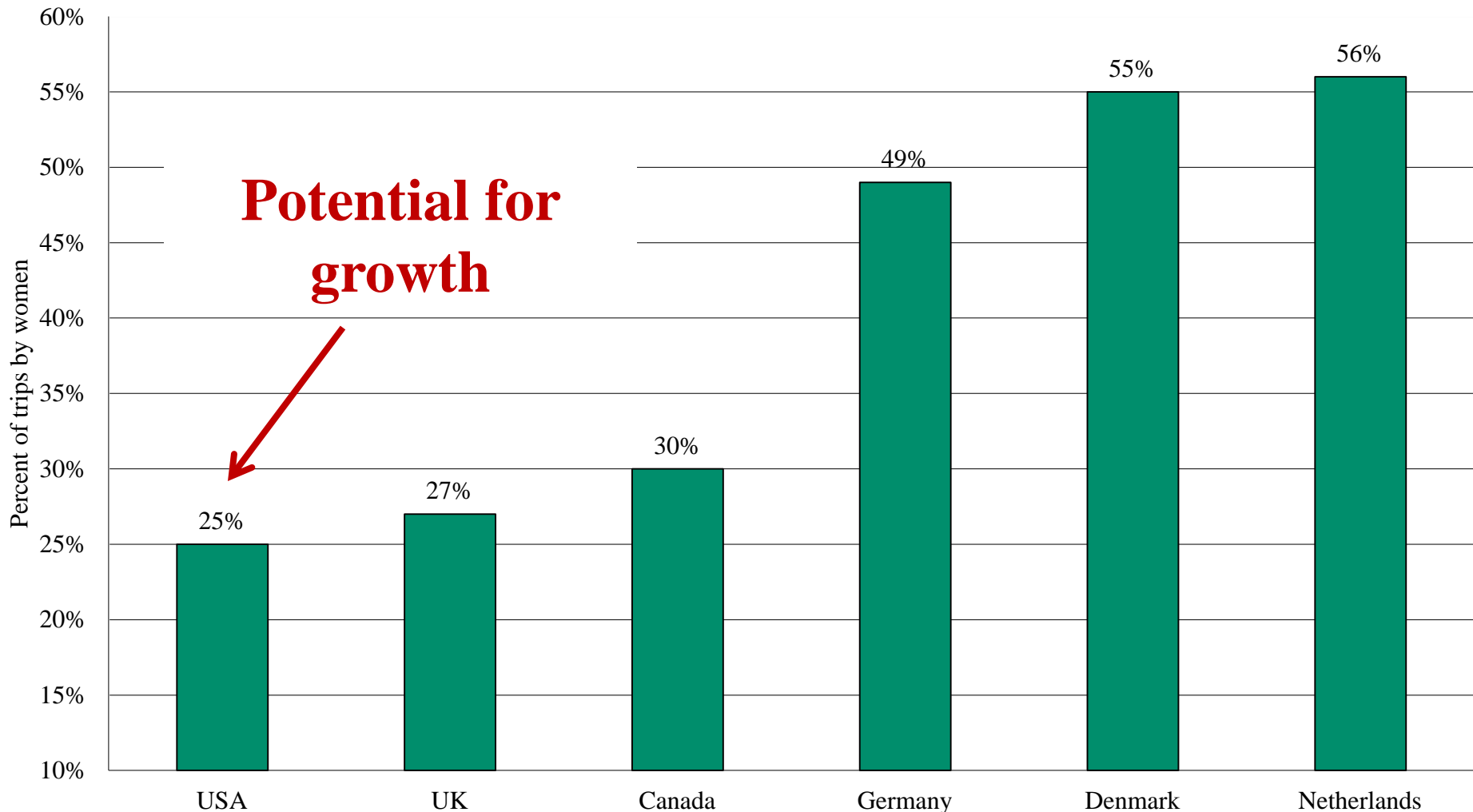
Source: USDOT, 2009 National Household Travel Survey

Share of Cycling for Short Trips



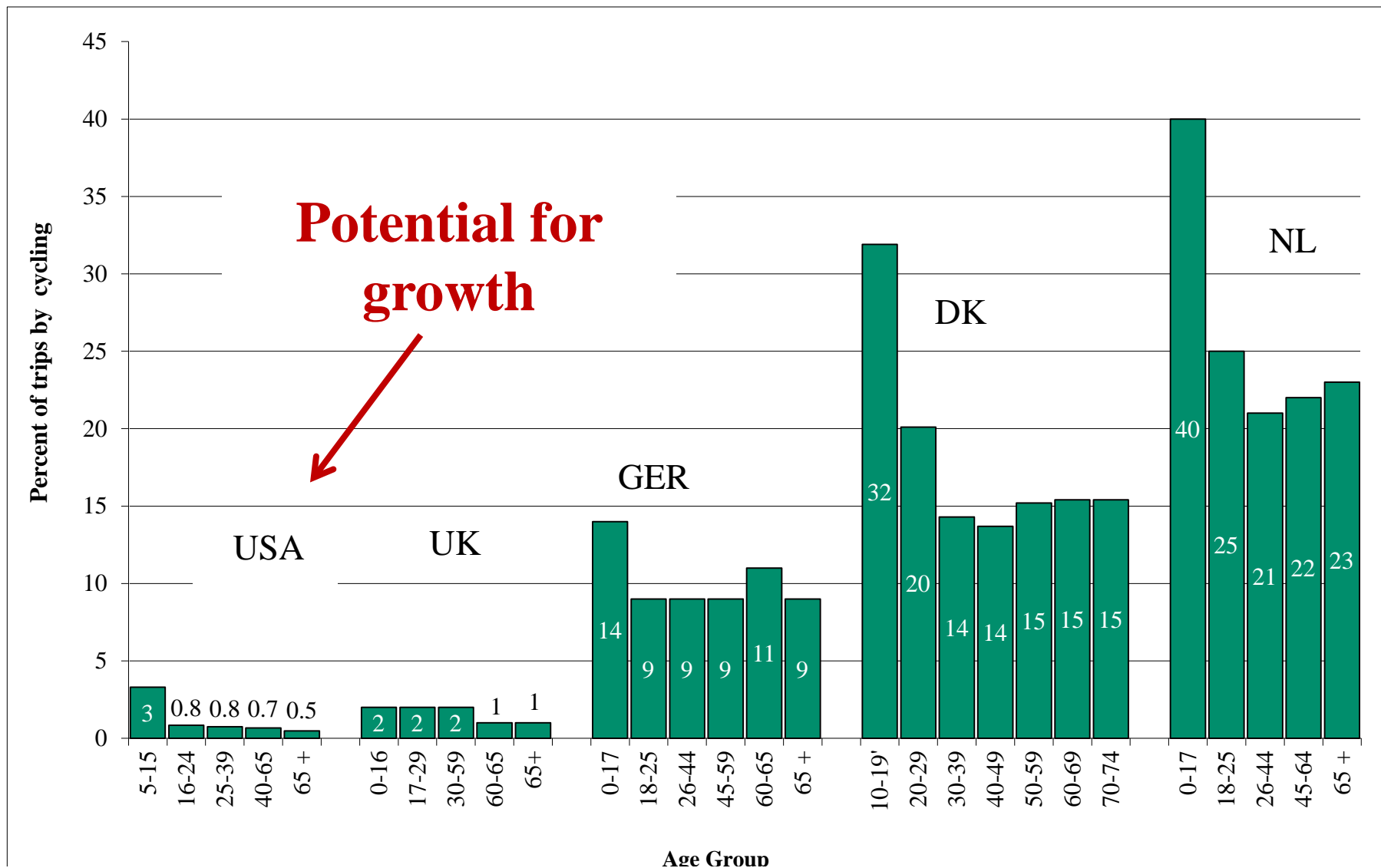
Source: Pucher and Buehler (eds.) *City Cycling*. Cambridge, MA: MIT Press, 2012

Women's Share of Bike Trips in Europe and North America



Source: Pucher and Buehler (eds.) *City Cycling*. Cambridge, MA: MIT Press, 2012

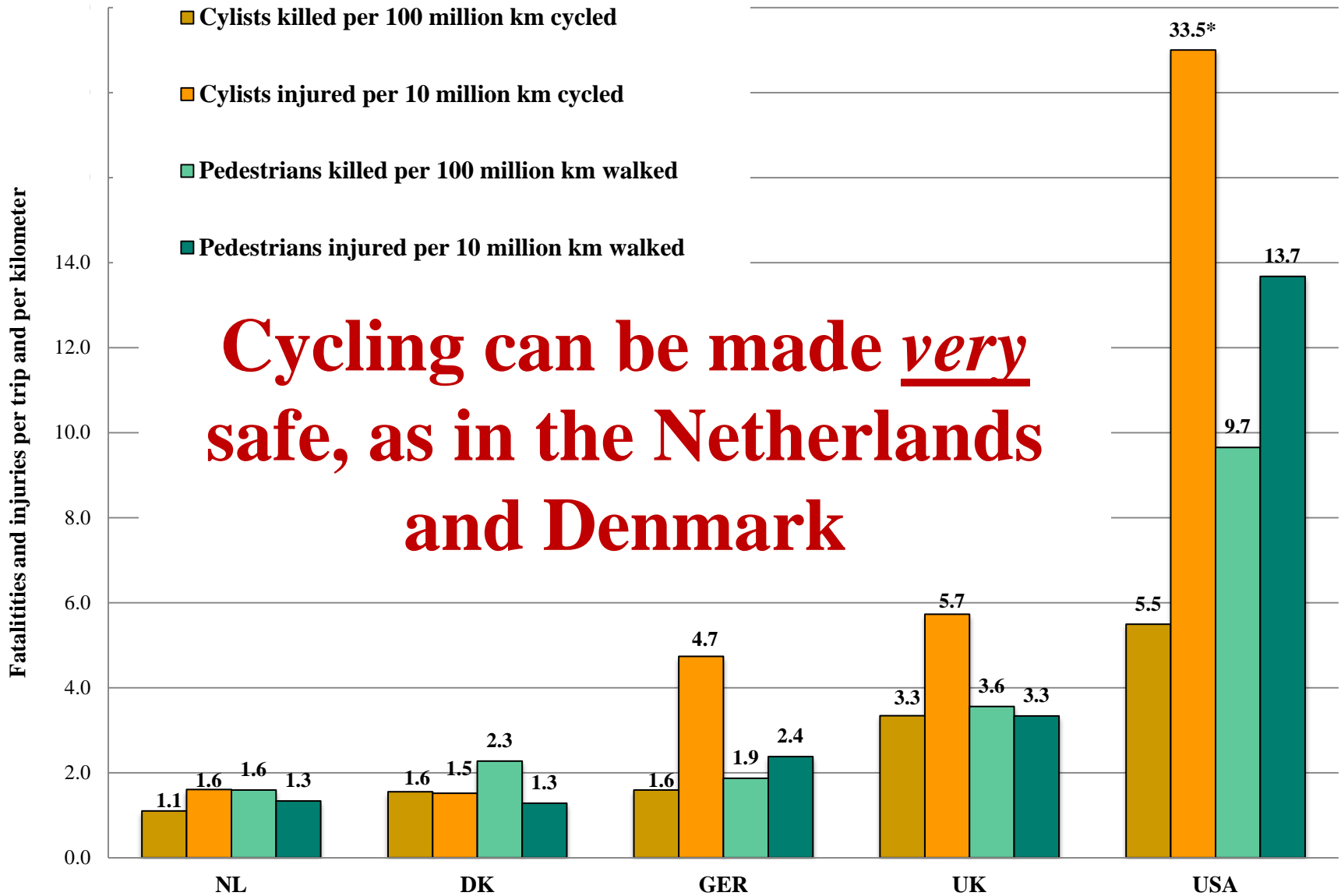
Bike Share of Trips by Age Group



Source: Pucher and Buehler (eds.) *City Cycling*. Cambridge, MA: MIT Press, 2012

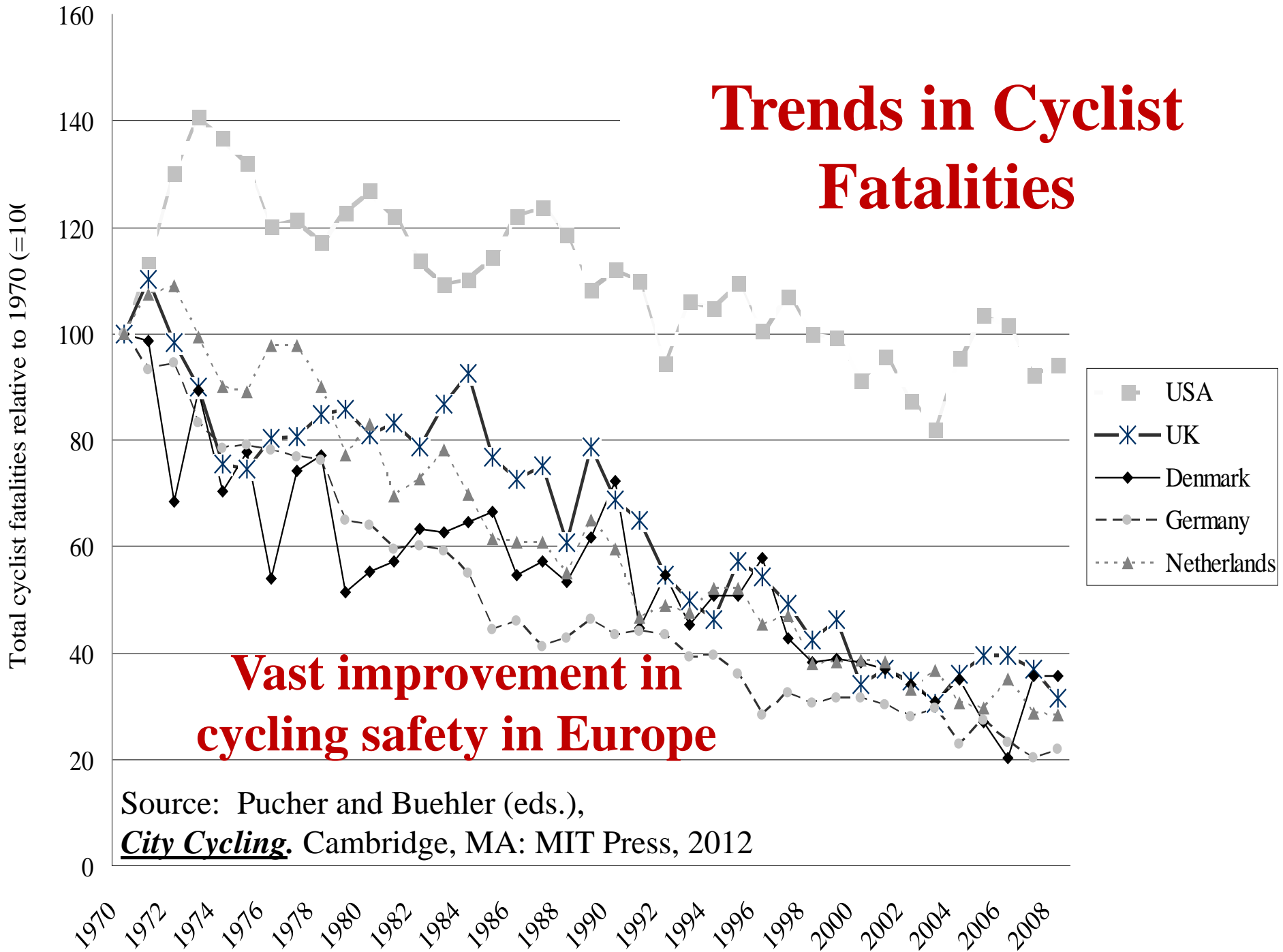
Cycling Safety Crucial

- **Especially important for the young, the old, for anyone with disabilities, for the timid or risk-averse**
- **Women more sensitive to safety than men**
- **Safety of cycling in the Netherlands, Denmark, and Germany helps explain high levels of cycling there**



Source: Pucher and Buehler (eds.), *City Cycling*. Cambridge, MA: MIT Press, 2012

Trends in Cyclist Fatalities



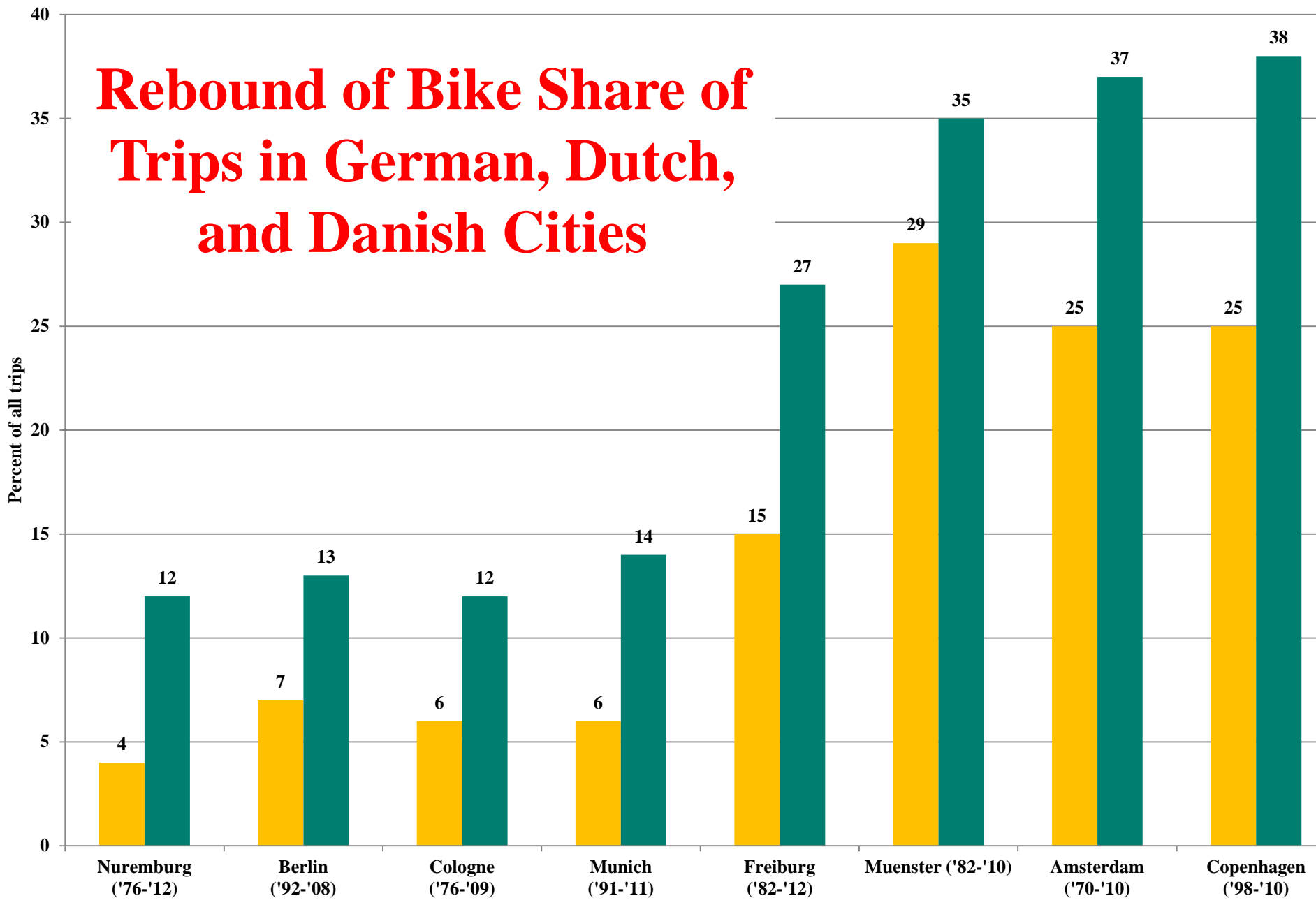
Vast improvement in cycling safety in Europe

Source: Pucher and Buehler (eds.), *City Cycling*. Cambridge, MA: MIT Press, 2012

Reversal in Public Policies in Germany, Denmark, and the Netherlands in 1970s

- **Pro-car policies in European cities in 1950s and 1960s caused huge decline in cycling and walking**
- **Dramatic policy turn-around since 1970s to limit car use and promote cycling, walking, and public transport in Dutch, Danish, and German cities**

Rebound of Bike Share of Trips in German, Dutch, and Danish Cities

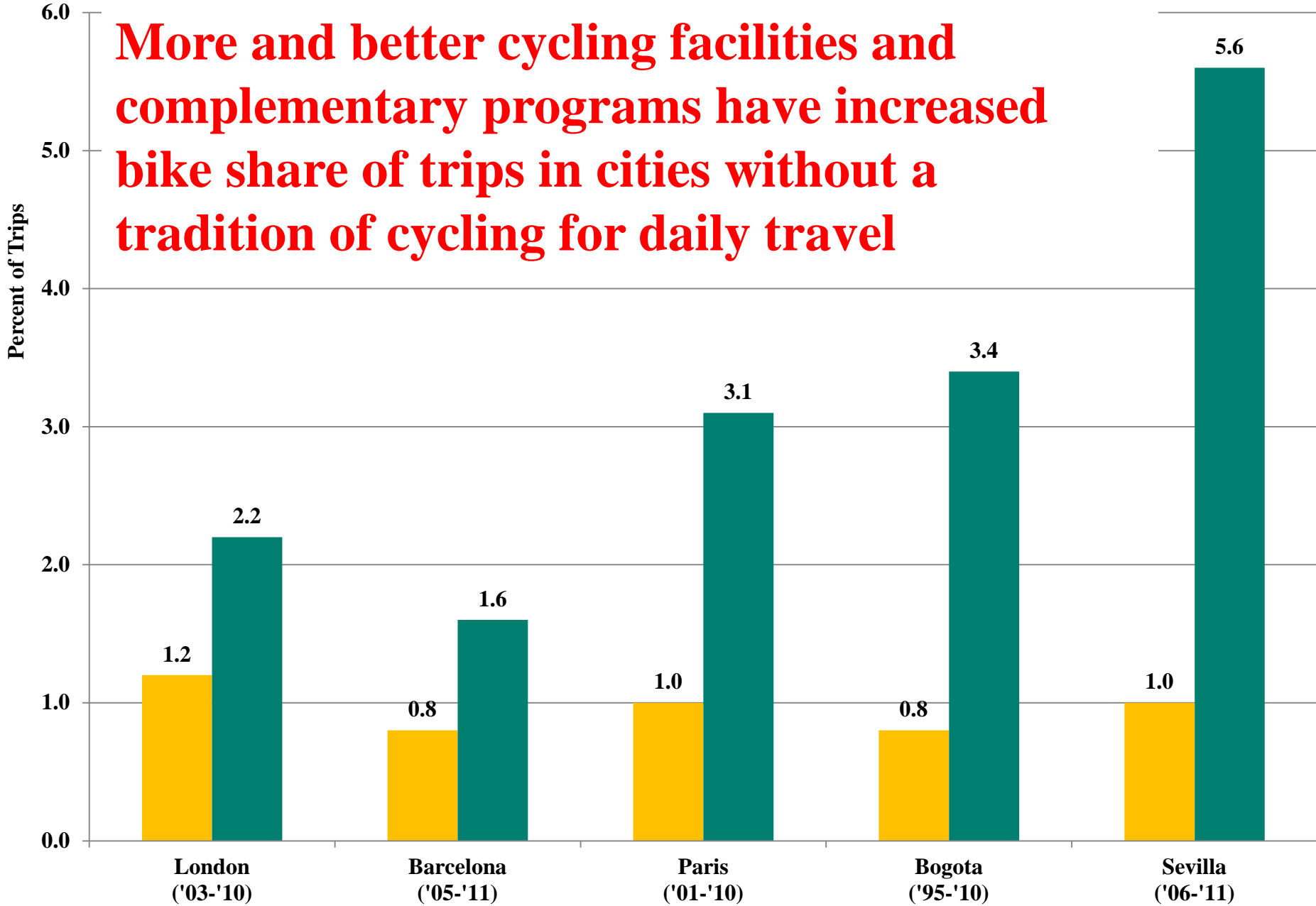


Source: Pucher, Dill, and Handy, "Infrastructure, Programs, and Policies to Increase Bicycling," *Preventive Medicine*, Jan 2010, Vol. 50, S.1, pp. S106-S125.

Recent Boom in Pro-Bike Policies in Many Cities

- **Especially since 2000, European and North American cities without a tradition of cycling for daily travel have dramatically raised cycling levels**
- **Improved cycling infrastructure and many other measures to encourage cycling**

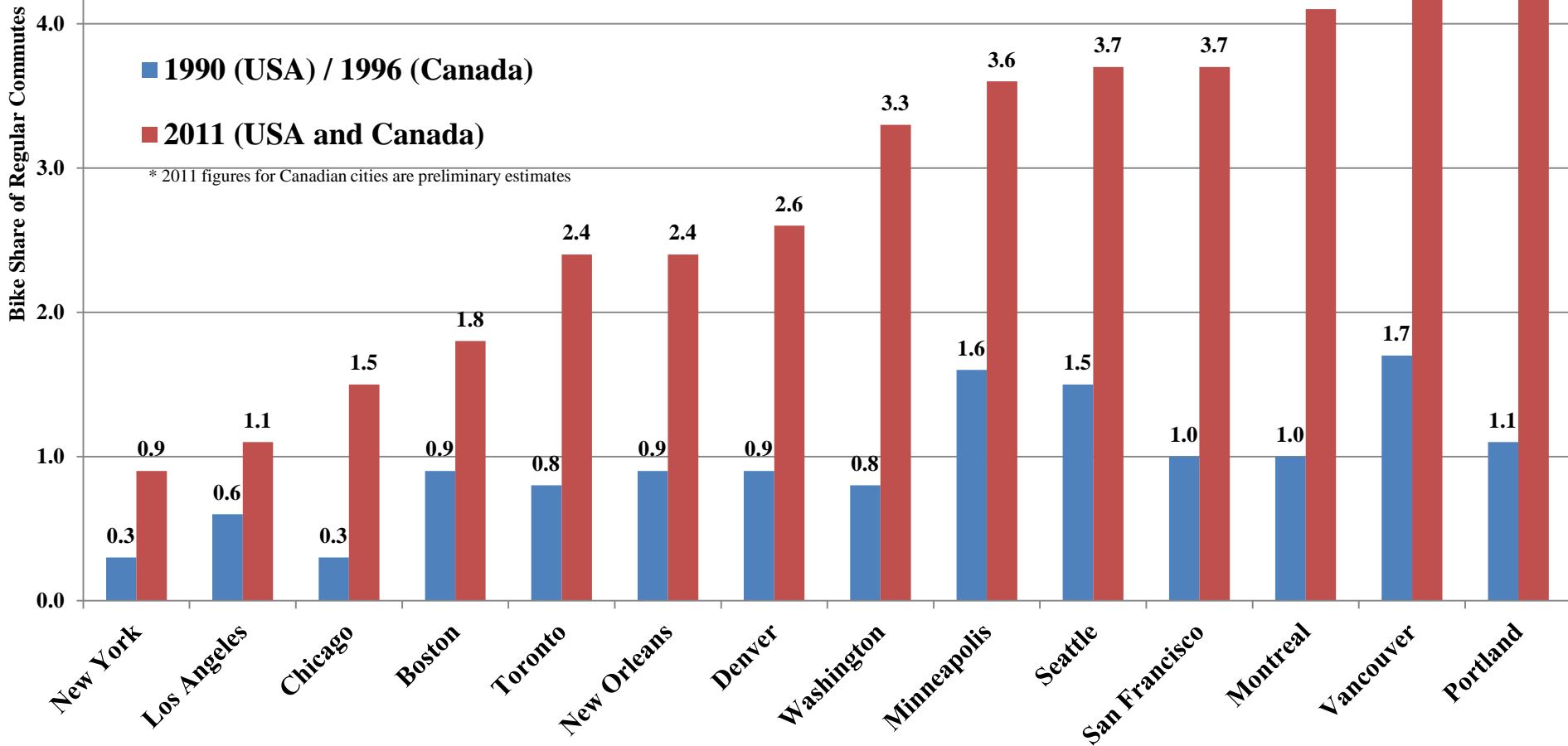
More and better cycling facilities and complementary programs have increased bike share of trips in cities without a tradition of cycling for daily travel



Source: Pucher, Dill, and Handy, “Infrastructure, Programs, and Policies to Increase Bicycling,” *Preventive Medicine*, Jan 2010, Vol. 50, S.1, pp. S106-S125.

Boom in Cycling to Work in 14 Large US and Canadian Cities

Source: Pucher, J. and Buehler, R. *City Cycling*, MIT Press, Cambridge, Mass, 2012.



How to Encourage More Cycling while Improving Safety

- **Better cycling facilities**
- **Integration of cycling with public transport**
- **Traffic calming of residential neighborhoods**
- **Mixed-use zoning and improved urban design**
- **Restrictions on motor vehicle use**
- **Traffic education and Safe Routes to School**
- **Traffic regulations and enforcement**



**Most
European
cities have
extensive car-
free districts
ideal for
walking and
cycling**

Cycling is perfect for getting around
car-free college campuses such as here
at UC Santa Barbara



Photo: Ralph Fertig

A photograph of a scenic coastal path in Santa Barbara, California. The path is paved and runs parallel to a road on the left and a beach on the right. It is lined with tall palm trees and other greenery. In the foreground, a person in a light blue shirt is riding a bicycle away from the camera. Further down the path, another person in a white shirt is also riding a bicycle. To the right of the path, a few pedestrians are walking. The background shows a clear blue sky and distant mountains.

**Santa Barbara coastal path:
Safe and attractive both for
cyclists and pedestrians**

**Conversion of two
car lanes to bike
path and wider
sidewalk**

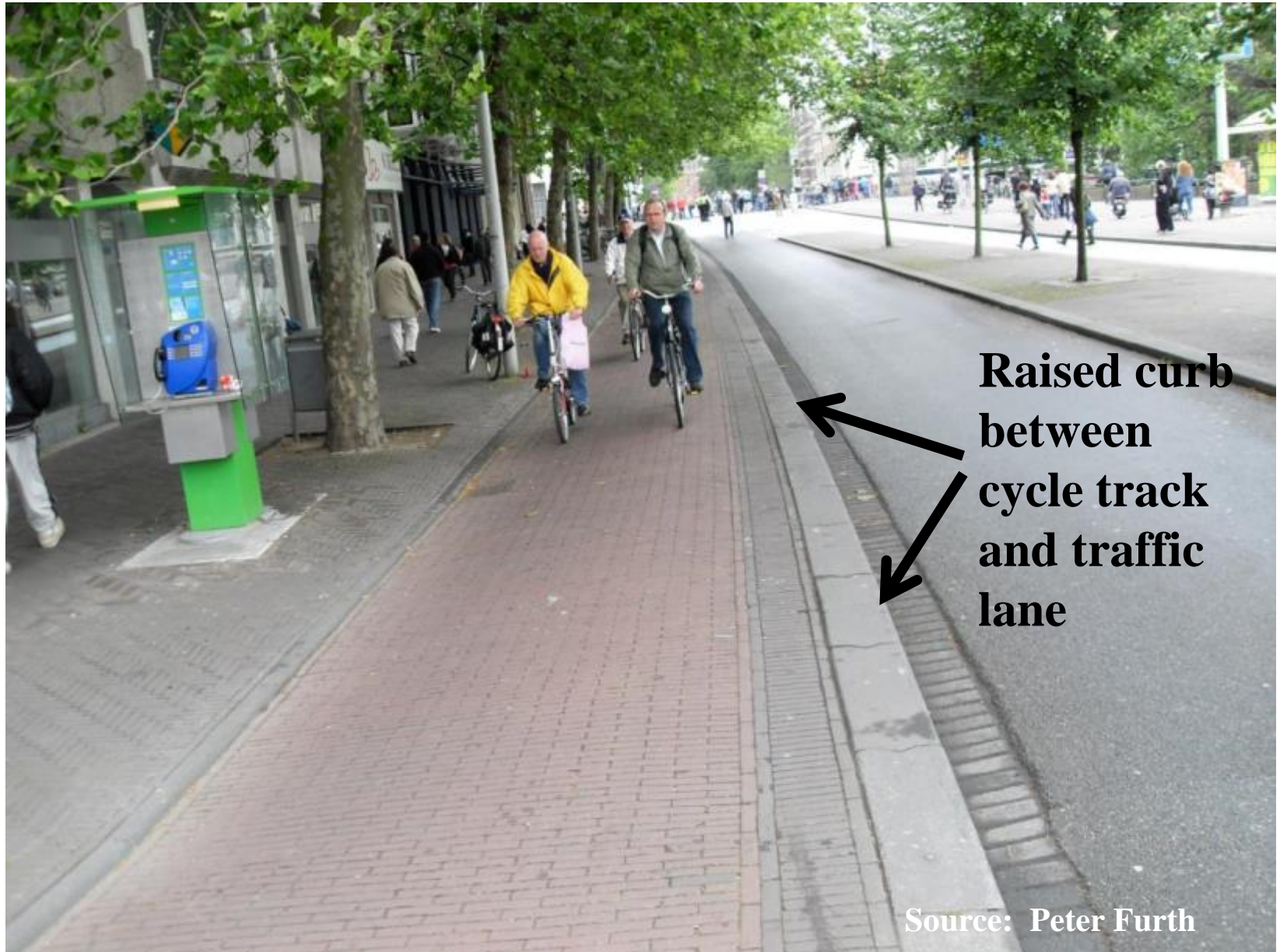
Source: Ralph Fertig



**Bike paths in Dutch cities
make it safe and
comfortable for all to bike:
including women, children,
and seniors**

Source: Warren Salomon

One-way cycle track in The Hague



**Raised curb
between
cycle track
and traffic
lane**

Source: Peter Furth

Almost 100km of 2-way cycle tracks in Montreal



Provision of cycle track at this key underpass in Montreal

4,10 m
↓

Separation from traffic via concrete barriers AND bollards



For 6 Montreal cycle tracks studied, injury rate averaged 28% lower and usage rate 2.5 times higher than on comparable “reference streets” without facilities (Lusk et al, 2011, Injury Prev)



- 380 mi of new bike lanes and paths since 2000
- Quadrupling in bike trips since 2000
- 74% decrease in serious cyclist injuries and fatalities per million bike trips
- Biggest increases in cycling on protected bike lanes (cycle tracks)

Photo: NYC DOT

Traffic-protected cycle track on 9th Avenue, NYC

Economic benefits of this cycle track exceed costs by over three-to-one!



Cycling has doubled in Sydney, Australia since installation of its cycle track network

Photo: Fiona Campbell

Increased Bicycling on Protected Bike Lanes

(% growth in bike trips relative to pre-installation levels)

- Buffered bike lanes on Spruce and Pine Streets in Philadelphia: **+266%**
- Buffered median bike lanes, DC, Pennsylvania Ave: **+200%**
- Cycle track, Kinzie St., Chicago: **+55%**
- Cycle track, NYC, Prospect Park West: **+190%**
- Cycle track, NYC, Columbus Avenue: **+56%**
- Cycle track, SF, Market St: **+115%**
- Cycle track, Vancouver, Canada, Dunsmuir St: **+54%**
- 6 cycle tracks in Montreal: **2.5 times** more cyclists on cycle tracks than on comparable “reference streets” without facilities
- New system of 164km of cycle tracks in Sevilla, Spain led to over a **6-fold increase** in number of daily bike trips from 2006 to 2011

Are Protected Bike Lanes Safer?

- **3 cycle tracks in NYC, decrease in total cyclist injuries**
 - **9th Ave: -57%; 8th Ave: -30%; Prospect Pk West: -62%**
- **Sevilla, Spain: Construction of 164km of cycle tracks led to halving in cyclist serious injury rate per 100,000 trips from 2006 to 2010**
- **Study of 19 cycle tracks in USA: Avg. injury rate per million bike km much lower on cycle tracks (2.3) than on roads without cycling facilities (range of 4-54 in other published studies). (Lusk et al., 2013, *Am J of Public Health*)**
- **Montreal, 6 cycle tracks: Avg. cyclist injury rate 28% lower than on nearby “reference streets.” (Lusk et al, *Injury Prevention*, 2011)**
- **Vancouver and Toronto: Cycle tracks had only 11% the injury rate of cycling on busy roads without bike facilities (Teschke et al., *Am J of Public Health*, 2012)**

200%
increase in
bike trips
after
installation

Buffered median bike lanes on Pennsylvania Avenue in Washington



Photo:
Ralph Buehler



**Construction
and
maintenance
financed by
private
foundation**

Photos: Ralph Buehler



**Cultural
Heritage
cycle track in
Indianapolis**

**Tripling in cycling in
Indianapolis since 2000**



Photo: Paul Krueger



Photo:
Paul
Krueger

Transformation of Hornby Street in Vancouver with installation of first-class cycle track

Photo: Warren Salomon



← Raised crossing for both cyclist and cars, with special pavement and markings

Improving safety of cycle tracks at road crossings



Photo: Velo Quebec

Safe cycle track crossing at busy intersection in Montreal

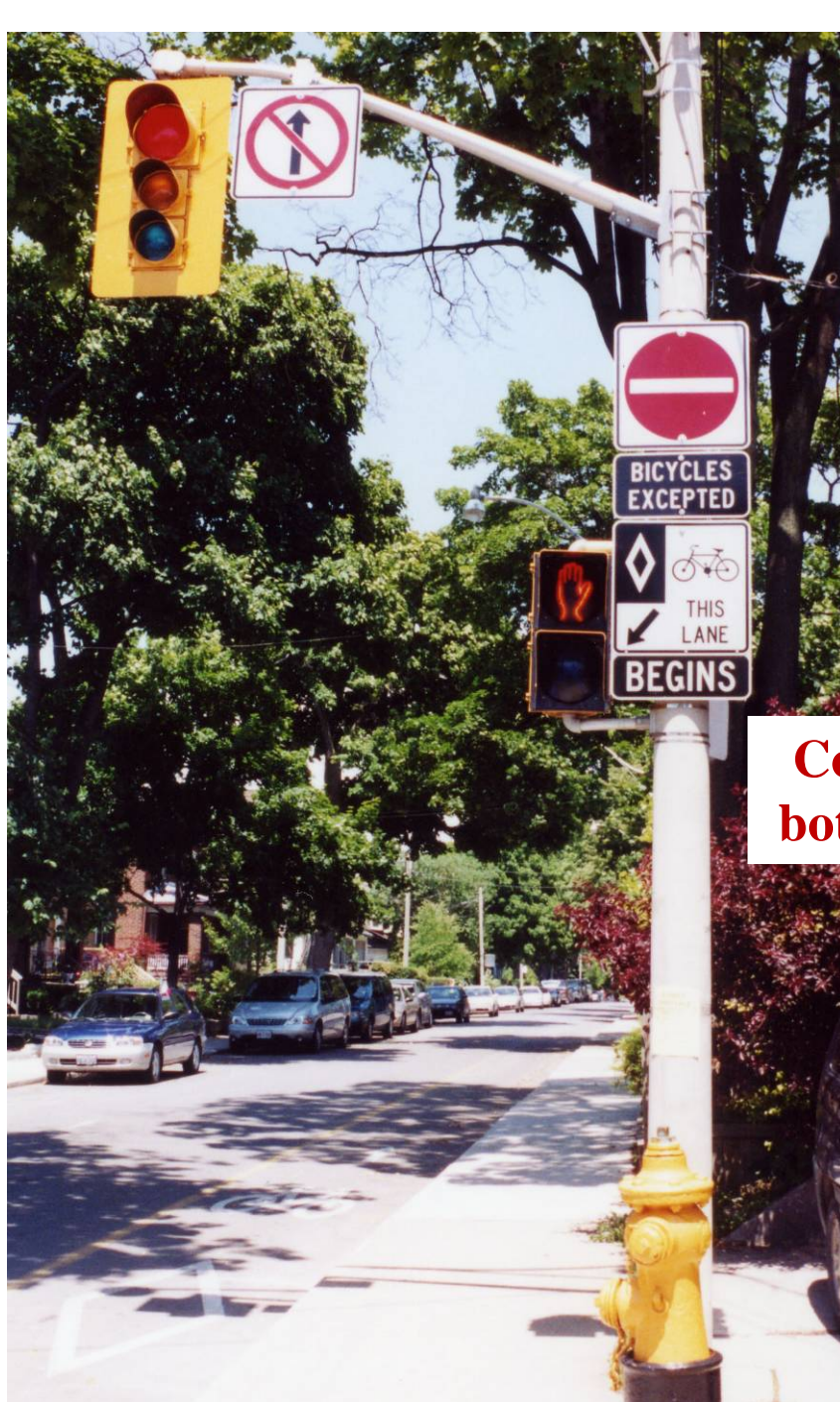
Bike lanes are much more typical in US cities



Photo: Ralph Fertig



Photo: Lewis Thorwaldson



Contra-flow lanes facilitate bike travel in both directions on one-way streets for cars



But bike lanes are definitely better than no separate bike facilities, but they do not provide nearly as much protection of cyclists from motor vehicles as cycle tracks



Bike lanes used for car parking



Bike lanes used for truck deliveries



Dooring of cyclists

265% increase in bike trips (2009-2012)

111% increase in bike trips (2008-2012)

Spruce St, Philadelphia



Photo: Kyle Gradinger

South St Bridge, Philadelphia



Photo: Kyle Gradinger

Installation of these buffered bike lanes in Philadelphia improved safety and greatly increased cycling levels

Bridge connections crucial for an integrated cycling network

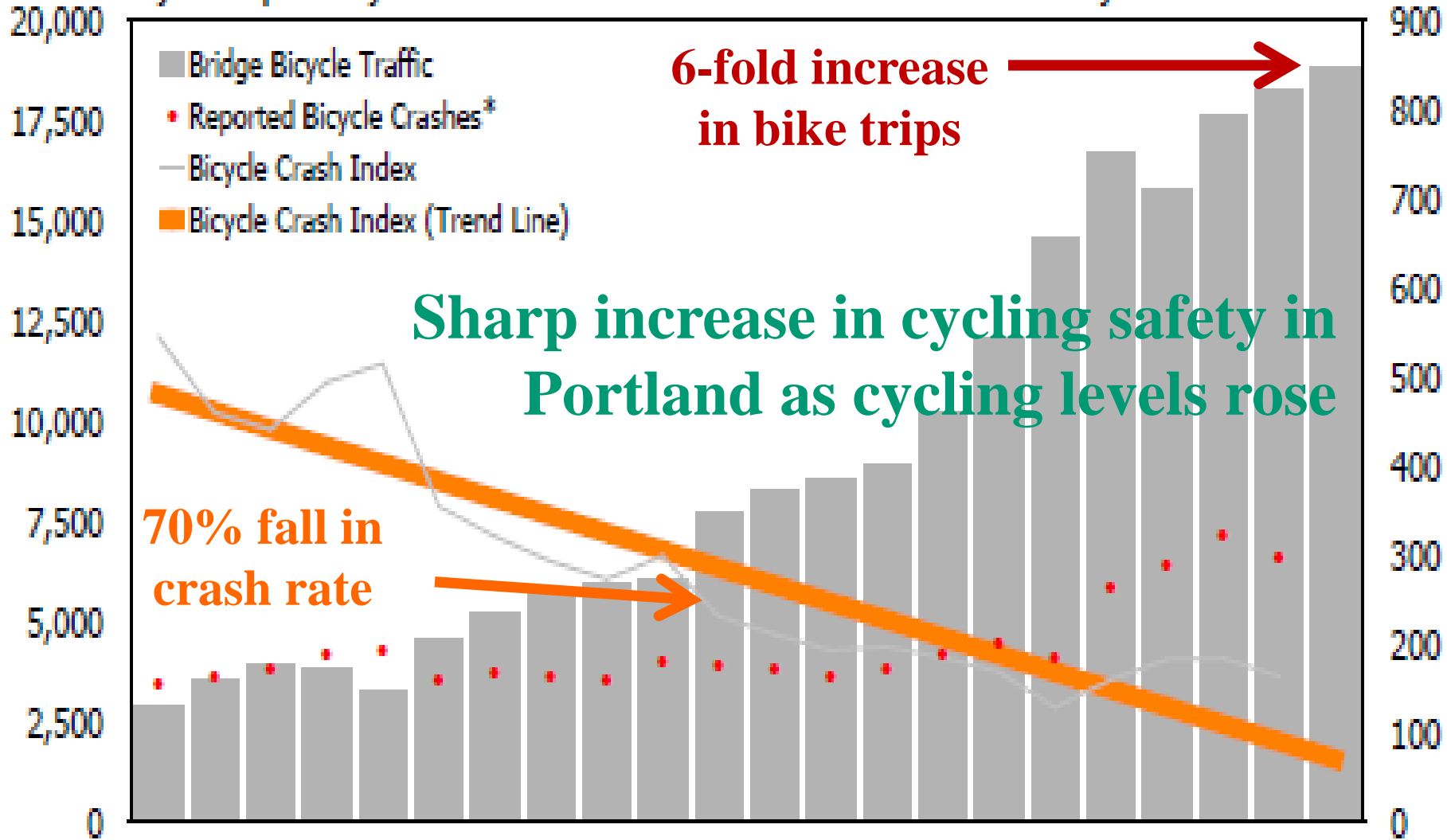


Almost 20,000 daily bike trips
over Portland bridges

Photo: Greg Raisman

Cyclists per Day

Crashes and Bicycle Crash Index



1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012

Bridge Bicycle Traffic	2,850	3,555	3,885	3,830	3,207	4,520	5,225	5,690	5,910	6,015	7,688	8,280	8,582	8,875	10,162	12,046	14,563	16,711	15,764	17,576	18,257	18,764
Reported Bicycle Crashes*	155	163	171	189	195	160	167	166	161	179	175	173	164	174	188	203	186	265	287	321	297	*
Bicycle Crash Index	544	459	440	493	514	354	320	292	272	298	230	210	192	196	184	168	128	159	182	183	163	*
Bicycle Fatalities	2	0	4	3	2	1	5	3	0	0	5	0	4	1	4	0	6	0	4	0	2	2

Source: City of Portland (2013)

Year



Bike paths on the four East River bridges provide crucial connections from Brooklyn and Queens to Manhattan

Source: Transportation Alternatives NYC



**Bike
boxes
in
Seattle
also**

Photo: Seattle DOT



Photo: Gord Price



Photo: Gord Price

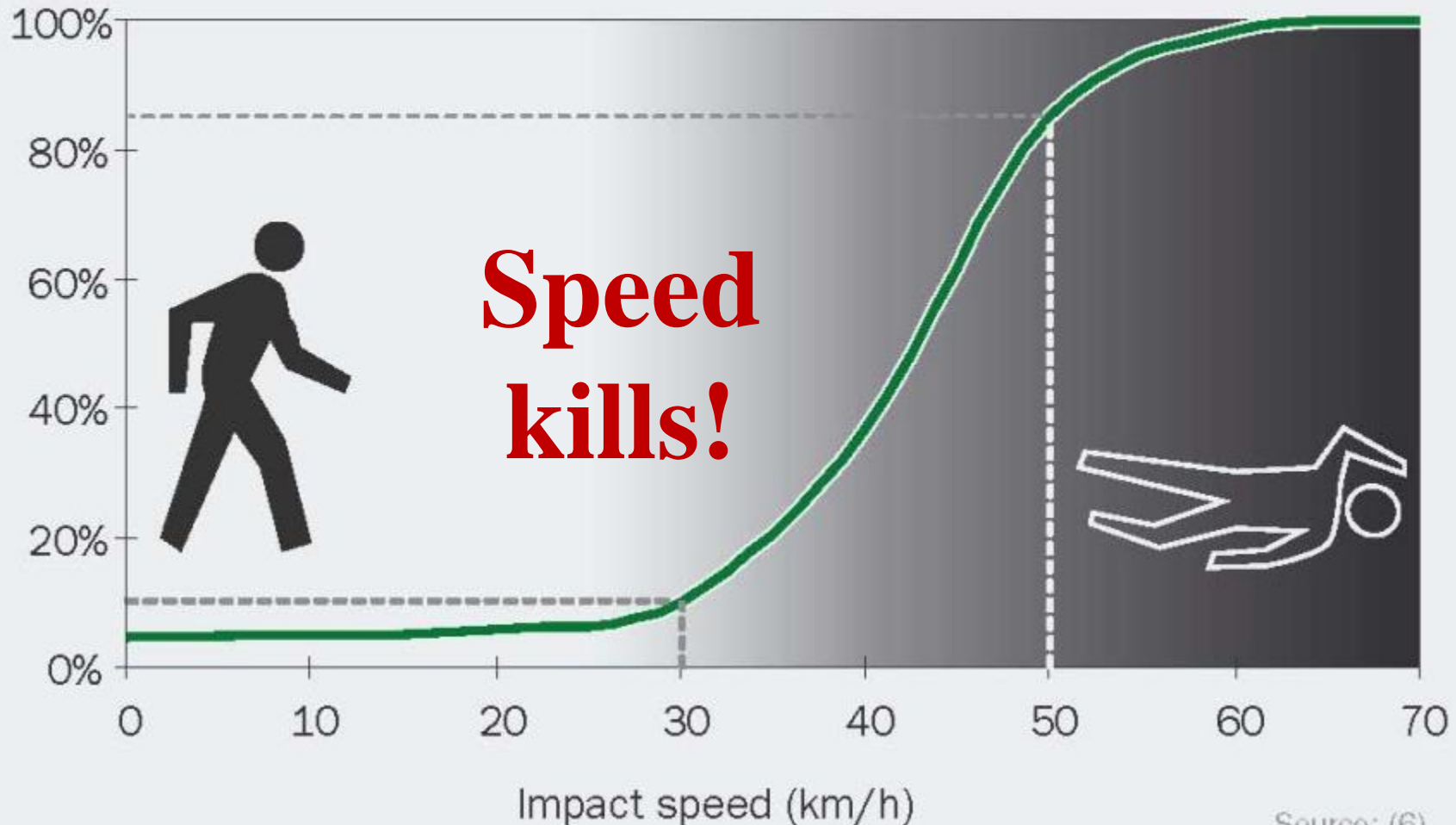
Bike boxes in Vancouver



Photo: Rich Drdul

Why Traffic Calming Saves Lives

Figure 1.1 Probability of fatal injury for a pedestrian colliding with a vehicle



These streets are, in effect, bike boulevards, neighborhood greenways, and local street bikeways

**3,800 km of traffic-calmed streets in Berlin:
ideal for cycling: 78% of ALL streets in Berlin!**



**7 km/hr speed
limit**

Shared streets: Typical
traffic calming in new
German suburbs



Shared street in Indianapolis



Photo: Ralph Buehler



Photo by Peter Berkeley

Blockage of through car and truck traffic but convenient cut-through for cyclists and pedestrians



Traffic calming in Quebec City and Montreal

Photo: Transports Viables



Cheap, easy, and very
effective traffic diverters

Photo: Velo Québec

**Bollard
blocks
passage of
cars**



Traffic diverter in
Berkeley which
provides a through
connection for two bike
boulevards



Photo: Paul Krueger



Photo: Paul Krueger



**152km of bike
boulevards in
Vancouver**

Photo: Paul Krueger



Photo: Paul Krueger

Cut-thrus along bike boulevards in Vancouver



Photo: Paul Krueger



Photo: Paul Krueger

Photo: Richard Drdul



Photo: Paul Krueger



Photo: Paul Krueger

**Traffic calming in
Vancouver that creates
bike boulevards**

Dutch bicycle facility selection matrix

Lane Configuration	Average daily traffic (vehicles / day)	Street type and speed limit			
		Urban local street 30 km/h (19 mph)	Urban through street 50 km/h (31 mph)	Rural local road 60 km/h (37 mph)	Fast traffic road 70+ km/h (44+ mph)
2-way traffic with no centerline	≤ 2500	mixed traffic ¹	bike lane ² or cycletrack ³	advisory bike lane ⁴	cycle track or low-speed service road
	2000 to 3000			bike lane ² or cycle track ⁵	
	3000 to 5000				
	> 4000	bike lane or cycle track	bike lane or cycle track ³		
2 lanes (1+1)	any	bike lane or cycle track	bike lane or cycle track ³		
4 lanes (2 + 2) or more	any	(does not exist)	cycle track or low speed service road		

Source: Peter Furth, "Cycling Infrastructure," in Pucher and Buehler, eds. *City Cycling*, MIT Press, 2012.

Photo: Peter Berkeley



Photo: Translink

BIKE TRANSIT INTEGRATION



Photo: Translink



Over 50,000 buses in the USA now come equipped with bike racks, as here in Santa Barbara



Source: Ralph Fertig

Bike on LRT in NJ and Minneapolis



Photo: John Boyle



Photo: Metro Transit



Capacity: 3,500 bikes

Bike Station next to main train station in Muenster, Germany

Capacity: 150 bikes

Bike Station next to Union Station in Washington, D.C.





T Commuter Bike Parking
WEST CAGE

300 bike parking spaces in two bike cages at northern terminus of subway line in Boston



Bike-transit integration at Alewife Station on Red Line in Boston

Photo: David Loutzenheiser

Bikes on Caltrain in San Francisco



Photo: San Francisco Bicycling Coalition

Bi-directional cycle track and bike sharing near metro station in Montréal



Metro station

BIXI bike docking station

Cycle track

Source: Vélo Québec



72% average increase in overall cycling by bikesharing users (Shaheen et al., 2013)



Hubway Bikeshare in Cambridge, Boston, Somerville, and Brookline



Nice Ride in Minneapolis

Over 50 bike sharing systems in North America by end of 2013



Capital Bikeshare in Washington, DC

PRICE \$6.99

JUNE 3, 2013

THE NEW YORKER



Citi Bike in New York

- Launched May 27, 2013
- 6,000 bikes
- 330 bike stations
- Over 30,000 daily users

Which is the cheaper and more sensible way to get exercise?



Photo: Alta Planning



Photo by Susan Handy

Innovative directional signs and bike trip counters in Denmark



Photo by Susan Handy

Photo: Paul Krueger



Convenient, free air pumps for bikes on local neighborhood bikeways in Vancouver



27 bike corrals in San Francisco



Good bike parking benefits merchants



97 bike corrals in Portland



Safe Routes to Schools

Photos: Bike Texas





Photo: Fiona Campbell

**After installation of this
cycle track in Sydney,
Australia, over a third of
children now bike to school!**

Photos: Ralph Buehler

Cycling training and testing course in Berlin

Most German and Dutch children take cycling lessons by the 3rd or 4th grade and must pass a police-administered cycling safety test!



Source: NJ Bike Walk Coalition



Bike Training for Children in New Jersey



Photo: Bonnie Fenton

Cycling training course for adults



Photo: Amy Walker



Source: Troels Andersen

Guided Bicycle Tours for Seniors

Bike to Work Day in San Francisco



Source: San Francisco
Bicycle Coalition

GIVE EMPLOYEES FREE BIKES!



**The perfect zero
emissions vehicles!**

Photo: Troels Andersen

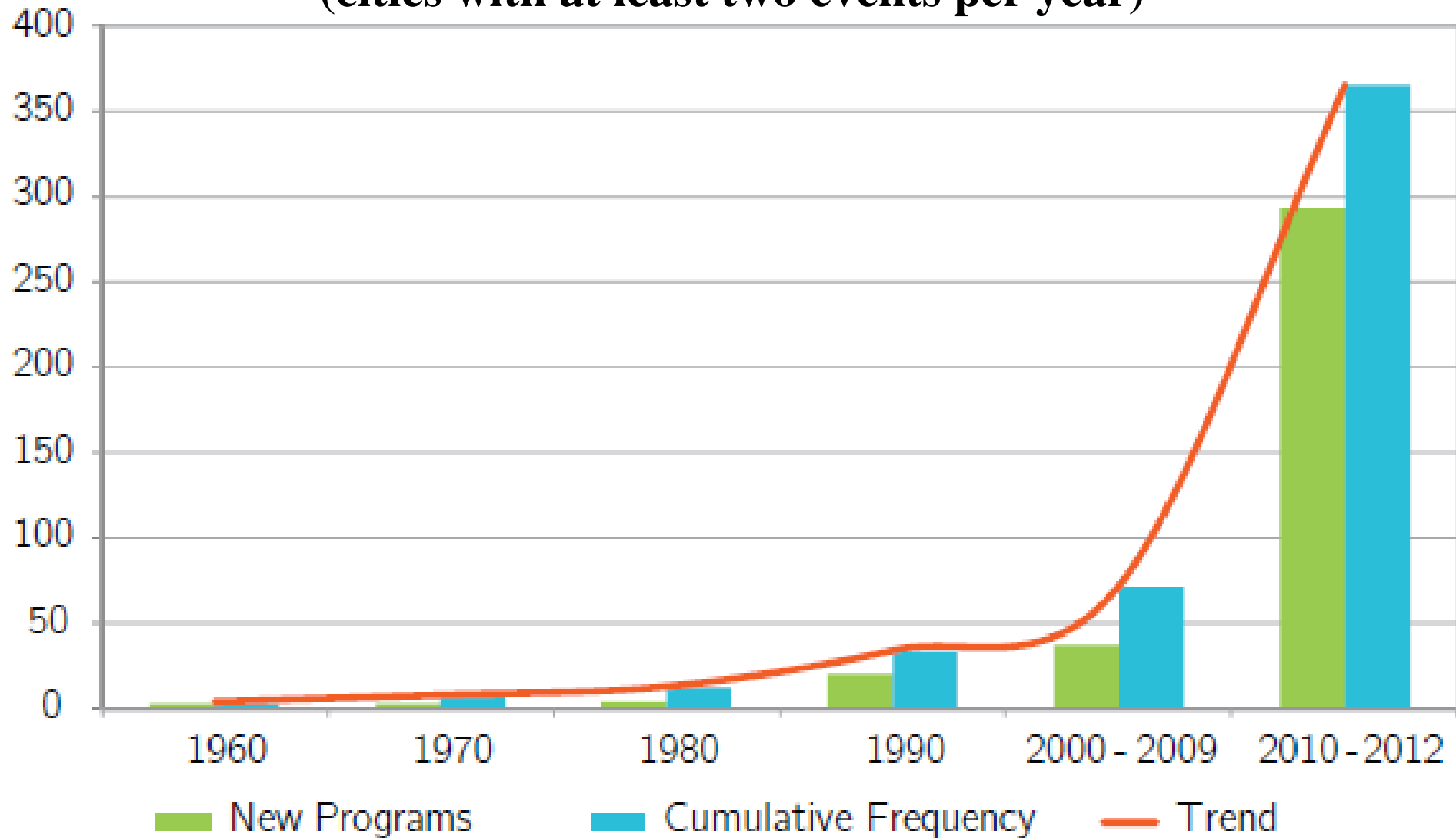
A large group of cyclists is riding on a city street during the CicLAvia event. The cyclists are wearing various casual clothing and some are wearing helmets. The street is lined with buildings and traffic lights, and there are other people walking on the sidewalks. The scene is bright and sunny, suggesting a clear day.

Over 100,000 participants at LA's fourth annual CicLAvia in October 2012

Source: Ryan Snyder

CicLAvia: 9 miles of car-free streets in Los Angeles

Expansion of Open Streets (Ciclovias) in the Americas (cities with at least two events per year)



Source: Sarmiento et al. (2013). *Open Streets: A Healthy Epidemic*. Bogota, Colombia: Universidad de los Andes. Financed by Centers for Disease Control and Prevention

New book with MIT Press

<http://citycyclingbook.wordpress.com>

About the authors:

<http://policy.rutgers.edu/faculty/pucher/>

<http://ralphbu.wordpress.com>

City Cycling

edited by John Pucher
and Ralph Buehler



CONCLUSIONS

- *Many economic, environmental, social, and health benefits of cycling*
- *Even in North America, many local trips are short enough to cover by cycling*
- *Many cities throughout the USA and Canada are vastly improving their cycling facilities*
- *But much more could be done, and there are many ways to do it.*

QUESTIONS?
