

Making Walking and Cycling Safer: Lessons from Europe

The neglect of pedestrian and bicycling safety in the United States has made these modes dangerous ways of getting around. Pedestrian fatalities are 36 times higher than car occupant fatalities per kilometer (km) traveled, and bicycling fatalities are 11 times higher than car occupant fatalities per km. Walking and bicycling can be made quite safe, however, as clearly shown by the much lower fatality rates in The Netherlands and Germany. Pedestrian fatalities per billion km walked are less than a tenth as high as in the United States, and bicyclist fatalities per billion km cycled are only a fourth as high. The Netherlands and Germany have long recognized the importance of pedestrian and bicyclist safety. Over the past two decades, these countries have undertaken a wide range of measures to improve safety: better facilities for walking and bicycling; urban design sensitive to the needs of nonmotorists; traffic calming of residential neighborhoods; restrictions on motor vehicle use in cities; rigorous traffic education of both motorists and nonmotorists; and strict enforcement of traffic regulations protecting pedestrians and bicyclists. The United States could adopt many of the same measures to improve pedestrian and bicycling safety here. The necessary technology and methods are already available, with decades of successful experience in Europe.

by John Pucher and Lewis Dijkstra

In many ways, walking and cycling are ideal ways to get around cities. These nonmotorized travel modes cause virtually no noise or air pollution. The only energy they require is provided directly by the traveler, and the very generation of that energy offers valuable cardiovascular exercise. Neither walking nor cycling requires much space. Moreover, they are quite economical, costing much less than the auto and public transport, both in direct user costs and public infrastructure costs. Some might add that pedestrians, in particular, enhance the liveliness of urban environments, making both business districts and residential neighborhoods safer and more interesting.

Unfortunately, public policies in the United States have done little to promote walking and cycling. On the contrary, over time our transportation and land-use policies have made walking and cycling less feasible, less convenient, and more dangerous. Federal funding for bicycling and pedestrian facilities has increased somewhat over the past decade, thanks to the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the Transportation Equity Act for the 21st Century (TEA-21).¹ That funding, however, is still a negligible percentage of total transport funding. Moreover, most other policies discourage nonmotorized travel. Land-use and housing policies that promote

low-density sprawl, for example, generate long trip distances that make walking and cycling impractical. High-speed roadways, narrow or nonexistent sidewalks, inadequate street crossings, and the absence of bike lanes obviously discourage walking and cycling.

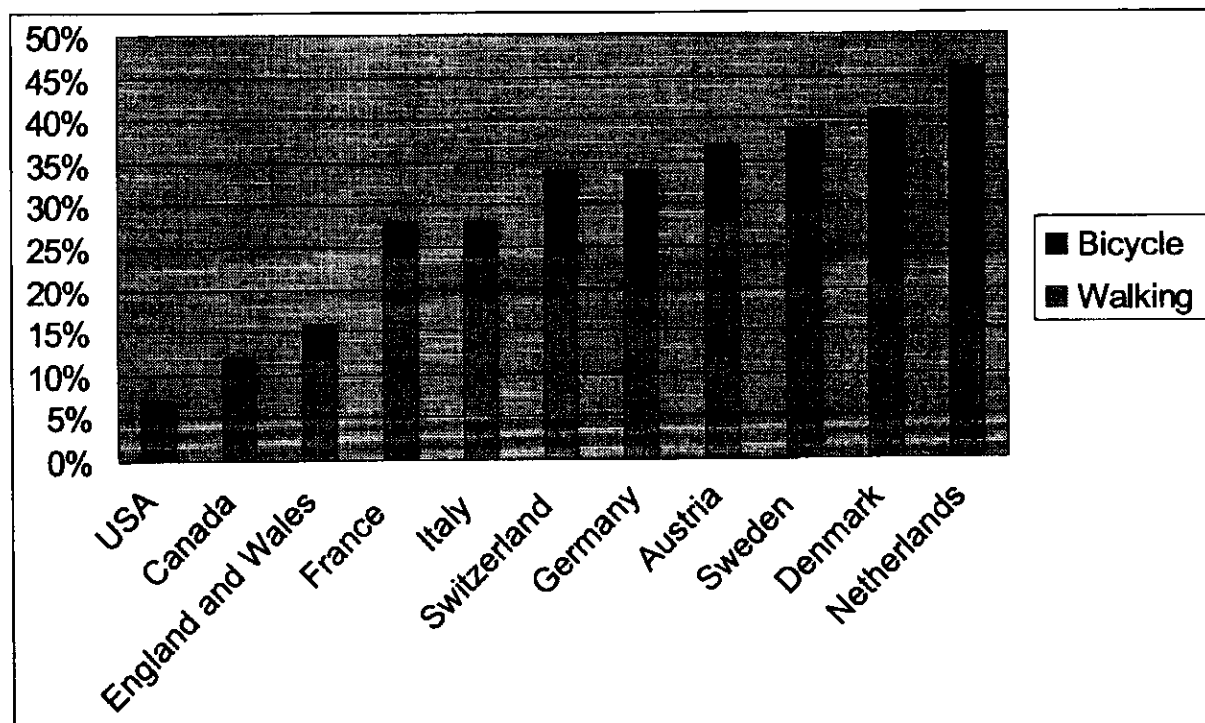
Trends in local travel in the United States confirm that walking and cycling account for only a small percentage of trips and an even smaller percentage of distance traveled. From 1977 to 1995, walking's share of urban trips fell from 9.3% to only 5.5%. Bicycling's share of urban trips rose slightly, from 0.6% to 0.9%, but still accounts for less than 1% of trips. Together, the nonmotorized share of trips fell from roughly 10% in 1977 to 6% in 1995, and nonmotorized

share of distance traveled fell from about 1% to only half a percent.²

Current levels of walking and cycling in American cities are far lower than in many other countries. Exhibit 1, for example, shows the modal split shares of walking and cycling in the United States, Canada, and nine European countries. Even Canada has almost twice the percentage of nonmotorized trips as in the United States. Most European countries have at least a fourth of their urban trips by walking or cycling, and a few countries—like Denmark and The Netherlands—report over 40% for nonmotorized travel.

There are many reasons for the higher levels of walking and cycling in Europe. The more compact land-use pat-

EXHIBIT 1: Modal Shares of Walking and Bicycling in Europe and North America, 1995



Source: Ministries of transport and departments of transportation in various countries.

Note: Modal split distributions for different countries are not fully comparable due to differences in trip definitions, survey methodologies, and urban area boundaries. The distributions here are intended to show the approximate differences among countries and should not be used for exact comparisons.

MAKING WALKING AND CYCLING SAFER

terns in European cities explain at least some of the difference in travel behavior. The average density of European cities is triple that of American cities; conversely, average trip lengths in European cities are roughly half as long.³ Since walking and bicycling become less feasible as trip distance increases, the longer trips in American cities and suburbs obviously discourage nonmotorized modes.

Nevertheless, even in the sprawled metropolitan areas of the United States, 49% of all trips are shorter than 3 miles, 40% are shorter than 2 miles, and 28% are shorter than 1 mile.⁴ Bicycling can easily cover all these distances, and most people can walk up to a mile. Thus, the extraordinarily low level of walking and cycling in the U.S. cannot be attributed solely to long trip distances.

Other reasons for the low walking and cycling modal shares in the United States include:⁵

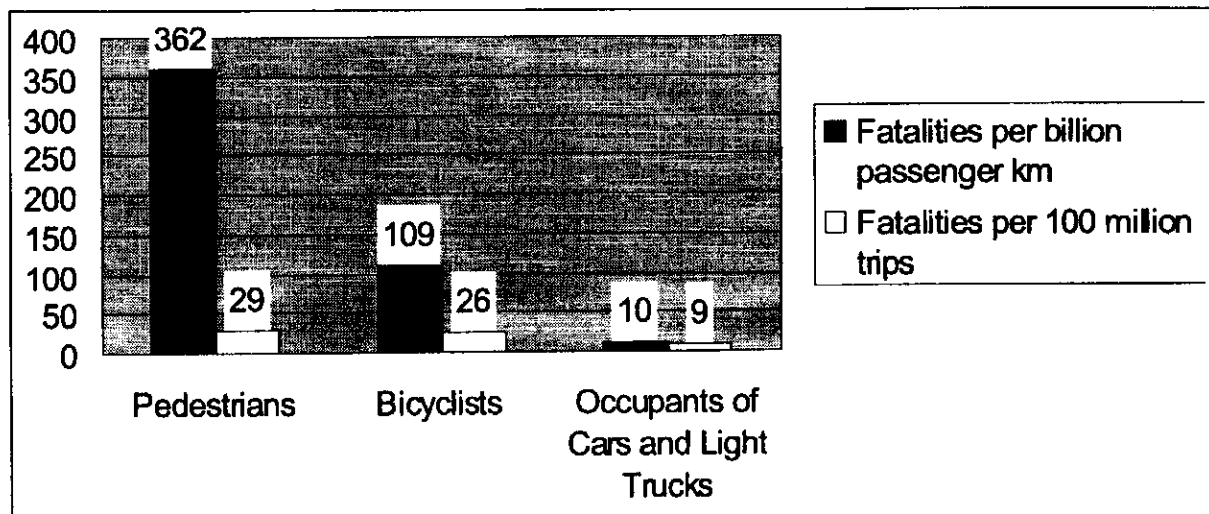
- The much lower cost of auto ownership and use compared to Europe

- The ease, low cost, and young age for obtaining a driver's license
- The lack of appropriate facilities for cycling and walking
- American culture and lifestyle, which are almost entirely oriented to the car, and which require extremely high levels of mobility with maximum possible comfort, ease, convenience, and speed
- The real or perceived danger of cycling and walking in American cities

It is that last factor that is the focus of this article. As many researchers have already noted, almost every survey finds that the perceived danger of cycling, in particular, is one of the major deterrents to increased bicycle use in the U.S.⁶ While cycling is widely viewed as dangerous, walking entails many hazards as well.

Consider, for example, Exhibit 2, which shows the traffic fatality rates for walking and cycling in the United States compared to the rates for occupants of motor vehicles. These rates were calcu-

EXHIBIT 2: Fatality Rates for Pedestrians, Cyclists, and Car and Light Truck Occupants in the USA in 1995 (per trip and per kilometer traveled)



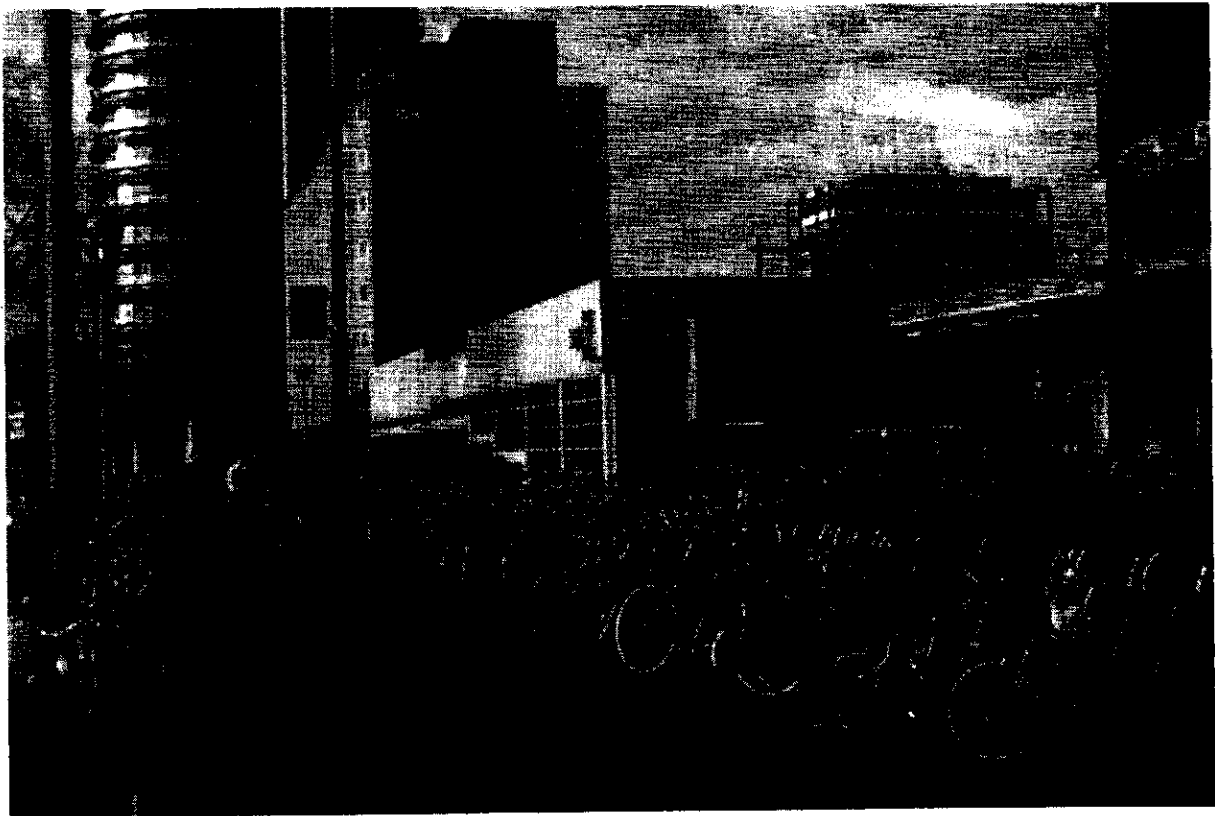
Sources: U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts*; and U.S. Department of Transportation, Federal Highway Administration, *Nationwide Personal Transportation Study and Highway Statistics*.

lated on the basis of official statistics from the U.S. Department of Transportation.⁷ On a per trip basis, walking and cycling are roughly three times as dangerous as riding in a car. In 1995, there were 29 pedestrian fatalities, 26 cyclist fatalities, but only 9 car occupant fatalities per 100 million person trips. Walking and cycling appear even more dangerous when these fatality rates are calculated on the basis of distance traveled. Per kilometer traveled, walking is 36 times more likely to result in fatal injury than riding in a car; cycling is 11 times more likely to result in death (see Exhibit 2). In short, the dangers of walking and cycling in America are not just perceived; they are real.

These large differences may seem almost unbelievable, but they can be explained by two sets of underlying statistics. On the one hand, walking and

cycling accounted for less than 7% of all person trips and only half a percent of person-kilometers traveled in the United States in 1995, but for 16% of all traffic fatalities nationwide and 25% of fatalities in urban areas. Conversely, occupants of cars and light trucks accounted for 88% of person trips and 94% of person kilometers traveled, but for only 76% of total traffic fatalities. In short, walking and cycling are much more dangerous than riding in a car and thus account for a higher percentage of total fatalities than their share of total trips or person km of travel. Exhibit 2 dramatizes that safety gap.

Pedestrian and bicyclist injuries and deaths are a serious public health problem that has been largely ignored in the United States. In contrast, pedestrian and bicyclist safety has been central to transportation and land-use planning in



Indicative of the importance of bicycling in The Netherlands, important destinations (such as this train station in Amsterdam) are often surrounded by thousands of parked bikes. To accommodate some of the overflow, a special bike parking garage is located just to the left of the station, as indicated by the sheltered bike parking sign.

MAKING WALKING AND CYCLING SAFER

Europe.⁸ That emphasis on promoting the safety of nonmotorized travel has paid off. Many European countries have sharply reduced pedestrian and cyclist deaths by implementing a wide range of measures: better facilities for walking and cycling; traffic calming of residential neighborhoods; urban design oriented to people and not cars; restrictions on auto use; expanded education and training programs; and stricter enforcement of traffic laws. In some European countries, fatality rates for pedestrians and cyclists have fallen to less than a fifth of the American level. Given the striking success of European efforts, it is essential that American planners and policymakers examine what we can learn from Europe to reduce the serious dangers that Americans face every time they walk or cycle.

This article focuses on The Netherlands and Germany, which have been particularly successful at improving pedestrian and cyclist safety. We compare trends in walking and cycling fatalities and fatality rates in The Netherlands, Germany, and the United States. Most importantly, we examine

the policies and programs that have successfully improved traffic safety for nonmotorists in Europe, and consider how the United States might adapt those programs to improve the safety of pedestrians and cyclists here.

Trends in Walking and Cycling

Exhibit 3 shows comparative trends for the United States, Germany, and The Netherlands. Over the period 1978 to 1995, walking's share of trips declined in all three countries, but the decline was negligible in The Netherlands (from 18% to 17% of all trips). Both Germany and the U.S. experienced roughly 50% declines. Nevertheless, in 1995 Germans still made 22% of their trips by walking, almost four times higher than walking's share in the United States (6%). The Dutch walking share is almost three times higher than in the U.S. (17% vs. 6%).

As with walking, The Netherlands displays stability in the bicycle's share of total trips, rising from 26% in 1978 to 27% in 1995, thus maintaining the highest bike share in Europe. Bicycling

EXHIBIT 3: Trends in Walking and Bicycling Share of Travel in The Netherlands, Germany, and the United States, 1978-1995
(as percentage of all trips by all modes)

Country	Year					
	1978	1983	1987	1990	1992	1995
Walking						
Netherlands	18*	19	19.0	17.4	17.1	17.1
Germany	34	30**	26		23	22
USA	9	9		7		6
Bicycling						
Netherlands	26*	29	26.5	28.5	27.1	27.3
Germany	7	10**	12		12	12
USA	0.6	0.8		0.7		0.9

Sources: German Ministry of Transport; U.S. Department of Transportation; and the Central Bureau for Statistics of The Netherlands

Notes: *1977 Data; **1982 Data

enjoyed a boom in Germany during the same period, with an increase in modal share from 7% to 12%—still less than half the Dutch level, but impressive given the rapid growth in auto ownership and use in Germany.⁹ Bicycling's modal share in the U.S. grew considerably in percentage terms (50%), but the absolute rise was only 0.3%. Moreover, bicycling's share of trips in the U.S. (0.9%) remains a minute fraction of the levels in The Netherlands and Germany.

Differences in walking and bicycling among the three countries are even more dramatic when they are disaggregated by age group. As shown by Exhibits 4 through 6, bicycling in the United States is limited mainly to the young, while in The Netherlands and Germany, all age groups make a high

percentage of their trips by bike. Bicycling's share of trips falls in the U.S. from 1% in the age group 16-24 to only 0.2% in the age group over 65. In The Netherlands, by comparison, 30% of trips are by bike in the age group 18-24 years old, and that falls only slightly to 24% for the age category over 75 years old. Roughly a fourth of all trips made by the elderly Dutch are by bicycle! Most Americans would find it inconceivable that people older than 75 could make a fourth of their trips by bike. As the Dutch example clearly shows, however, bicycling can remain a viable way of getting around even for the elderly, provided it is made safe and convenient. The physical limitations that come with aging are not the main reason for the almost non-existent bicycling among the

EXHIBIT 4: Shift in Modal Choice with Increasing Age in The Netherlands, 1998
(as percentage of all trips by all modes)

Mode	Age Group				
	18-24	25-39	40-64	65-74	75+
Private car	36	61	59	51	43
Public transport	16	5	4	4	7
Bicycle	30	19	22	25	24
Walk	12	13	14	19	24

Source: Central Bureau for Statistics of The Netherlands.

EXHIBIT 5: Shift in Modal Choice with Increasing Age in Germany, 1995
(as percentage of all trips by all modes)

Mode	Age Group			
	18-44	45-64	65-74	75+
Private car	62	57	35	21
Public transport	10	10	15	24
Bicycle	10	9	11	7
Walk	17	23	39	48

Source: W. Broeg and E. Erl, Kenngrößen fuer Fussgaenger und Fahrradverkehr, Munich, Germany: Socialdata Institut fuer Verkehrsforschung und Infrastrukturforchung, 1999.

MAKING WALKING AND CYCLING SAFER

EXHIBIT 6: Shift in Modal Choice with Increasing Age in the USA, 1995
(as percentage of all trips by all modes)

Mode	Age Group			
	16-24	25-39	40-64	65+
Private car	87	89	92	91
Public transport	3	2	2	2
Bicycle	1	0.5	0.3	0.2
Walk	7	5	4	6

Source: J. Pucher, T. Evans, and J. Wenger, "Socioeconomics of Urban Travel," *Transportation Quarterly*, Vol. 52, No. 3, summer 1998, pp. 15-34, based on the *Nationwide Personal Transportation Survey* of the U.S. Department of Transportation.

elderly in the United States. Germany provides yet more evidence on this point. The bicycle's share of trips in Germany also falls only slightly with age, from 10% in the 18-24 category to 7% for those older than 75.

The differences between Europe and the United States are even more dramatic for walking. In The Netherlands, walking accounts for twice as high a percentage of trips for the elderly as for those in the age group 18-24 (24% vs. 12%). In Germany, walking accounts for almost three times as high a percentage of trips for the elderly as among those 18-44 (48% vs. 17%). In the United States, the percentage of trips made by walking remains low at every age, and declines slightly from 7% in the 16-24 age group to 6% in the over-65 group.

It is noteworthy that the Dutch and German elderly make half their trips by either walking or cycling (48% in The Netherlands, 55% in Germany), while the American elderly make only 6% of their trips that way. Without question, the transport systems and land-use patterns in European cities enable the elderly to gain valuable physical exercise and to remain mobile even when they can no longer drive a car. By comparison, American elderly must do without the regular exercise they would get from

walking and cycling for daily travel. Moreover, they lose mobility and independence when they can no longer drive a car.

Although there are many reasons for the low levels of walking and cycling among the American elderly, the danger of walking and cycling in our cities and suburbs clearly is an important factor. It is highly unlikely that the elderly Dutch would make a fourth of their trips by bike if they had to venture onto busy streets without separate rights of way. Moreover, it is likely that the American elderly would bicycle more if they had the comprehensive system of bike paths and lanes found in Dutch cities. As shown below, the fatality rate for cycling in The Netherlands is dramatically lower than in the United States. Not surprisingly, the Dutch elderly feel it is safe to cycle, while the American elderly do not.

Before examining in detail the statistics on traffic safety, we note here one more interesting difference among the countries: the purpose of bicycle trips. As shown in Exhibit 7, bikes are more than twice as likely to be used for work trips in The Netherlands and Germany as in the United States (24% and 20% of bike trips vs. only 9%). Likewise, bikes are far more likely to be used for school trips and shopping trips in The

EXHIBIT 7: Purpose of Bicycle Trips in The Netherlands, Germany, and the USA
(percentage distribution of trips by trip purpose)

Bicycle Trip Purpose	USA (1995)	The Netherlands (1998)	Germany (1995)
Work Commuting	9.0	24	20
Shopping	12.7	19	26
Social or Recreational	69.5	40	36
School	8.8	17	15

Sources: Ministries of transport and departments of transportation in each country. The distribution for the U.S. was estimated from the 1995 *Nationwide Personal Transportation Survey*.

Note: Trip purpose categories are not exactly comparable across countries since trip purpose definitions vary. The category "social or recreational" also includes some "personal business" trips for the USA and Germany. The category "other" was zeroed out so that each column would add to 100%.

Netherlands and Germany. By comparison, over two-thirds of bike trips in the United States are for recreation and not for daily, utilitarian trips. That may have important consequences when comparing fatality rates, since most recreational cycling is on weekends in rural areas with little traffic, while most utilitarian cycling is on weekdays in cities with heavy and potentially dangerous motor vehicle traffic.

The dramatically lower fatality rates for The Netherlands and Germany are all the more astounding, since their bicycle use is mainly utilitarian and within cities, where one might expect more collisions with motor vehicles. Likewise, the large proportion of elderly pedestrians and bicyclists in The Netherlands and Germany raises the risk of fatalities in any collision, since the elderly are more susceptible to dying from their injuries. Yet both countries have much lower fatality rates than the United States. Thus, the dangers of walking and cycling in the United States may be more serious than is suggested by the comparative statistics presented in the following section. If American cities had the same high level of walking and cycling by the elderly as in The Netherlands, fatality rates would probably be even higher than they are now.

Trends in Traffic Safety

Not only are walking and bicycling safer in The Netherlands and Germany, but their overall transportation systems are also safer. As shown in Exhibit 8, the rate of total traffic fatalities per capita in the United States in 1997 was twice as high as in The Netherlands (15.7 vs. 7.5 fatalities per 100,000 population) and about 50% higher than in Germany (15.7 vs. 10.4). Moreover, both The Netherlands and Germany have made much more progress than the USA in lowering traffic fatality rates. From 1960 to 1997, the fatality rate fell by 56% in The Netherlands, by 60% in Germany, but by only 26% in the United States.

The situation is much more dramatic when the comparison is limited to walking and bicycling. As shown in Exhibit 9, the rate of pedestrian fatalities per billion km walked is over 10 times as high in the United States as in The Netherlands and Germany. The rate of bicyclist fatalities per billion km cycled is roughly four times higher in the United States than in The Netherlands and Germany. Some might prefer to compare fatalities on a per trip basis instead of a per km basis. As Exhibit 10 shows, that basis of comparison also shows that walking and cycling are

MAKING WALKING AND CYCLING SAFER

EXHIBIT 8: Trends in Overall Traffic Fatality Rates in the Netherlands, Germany, and the USA (traffic deaths per 100,000 inhabitants)

Country	Year				
	1960	1970	1980	1990	1997
Netherlands	16.9	24.5	14.2	9.2	7.5
Germany	26.0	31.6	23.7	12.6	10.4
USA	21.2	26.8	22.9	23.4	15.7

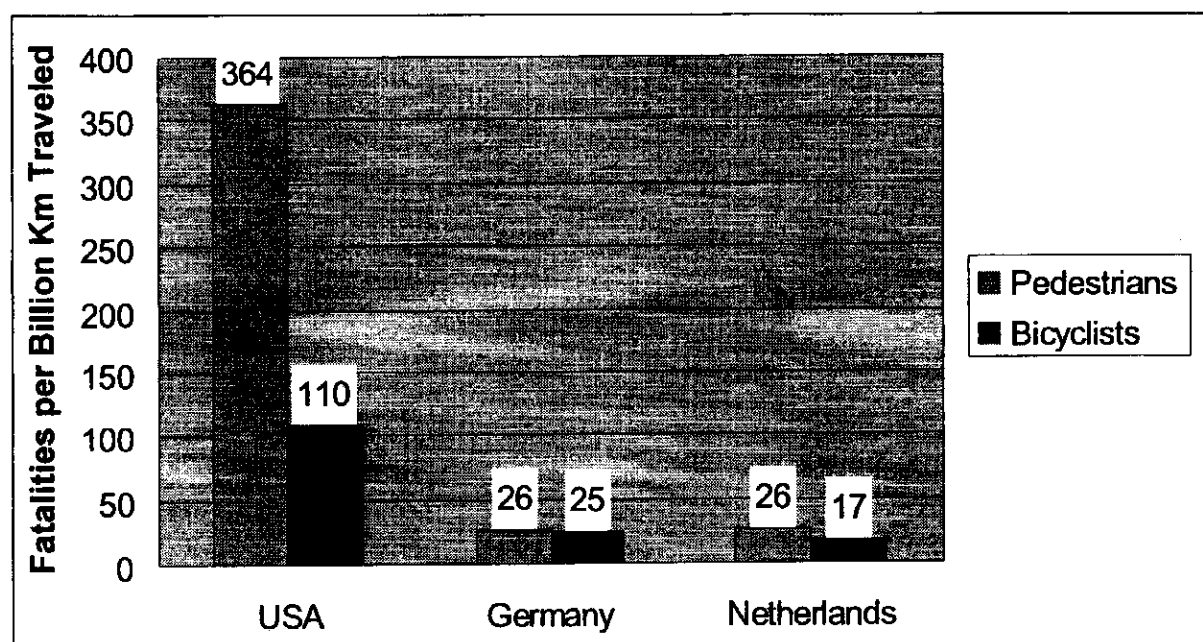
Sources: Bundesanstalt fuer Verkehrswesen (German Federal Institute of Traffic Systems); U.S. Department of Transportation, National Highway Traffic Safety Administration; Central Bureau for Statistics of The Netherlands.

much safer in The Netherlands and Germany than in the USA.

Even looking at the absolute number of fatalities, the records of The Netherlands and Germany are far better than the United States. From 1975 to 1998, the total number of pedestrian fatalities fell by 72% in The Netherlands

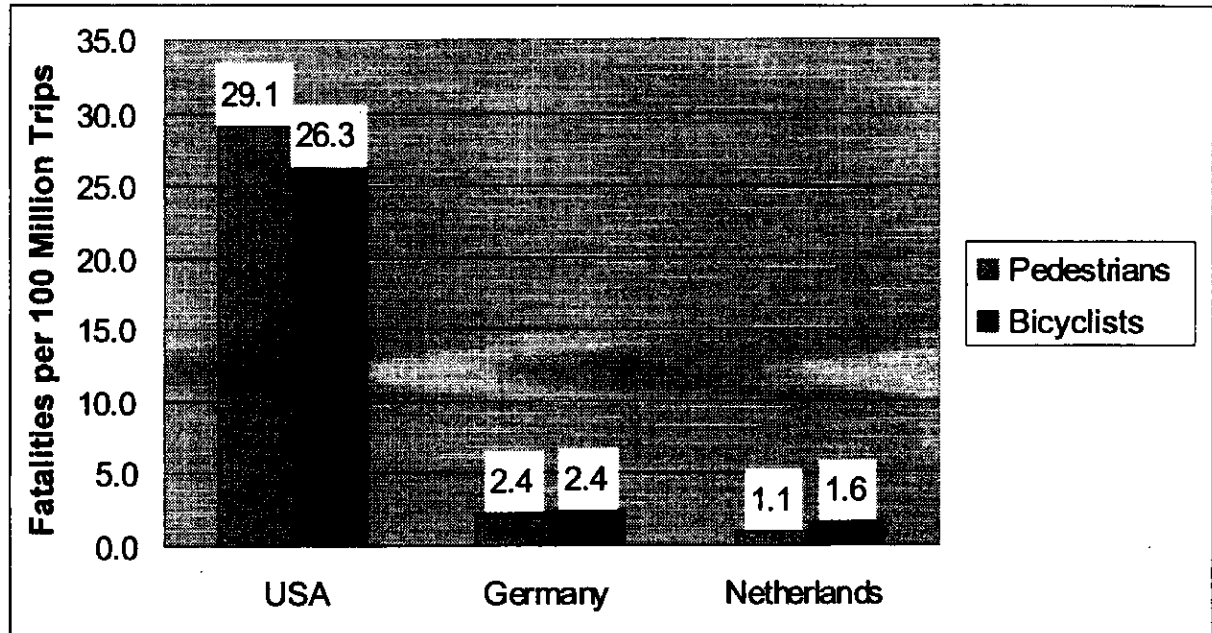
and by 79% in Germany, compared to a decline of only 31% in the United States (see Exhibit 11). Over the same period, the total number of bicyclist fatalities fell by 57% in The Netherlands and by 66% in Germany, compared to a decline of only 24% in the United States (see Exhibit 12).

EXHIBIT 9: Fatality Rates per Billion Km Traveled for Pedestrians and Bicyclists, 1995



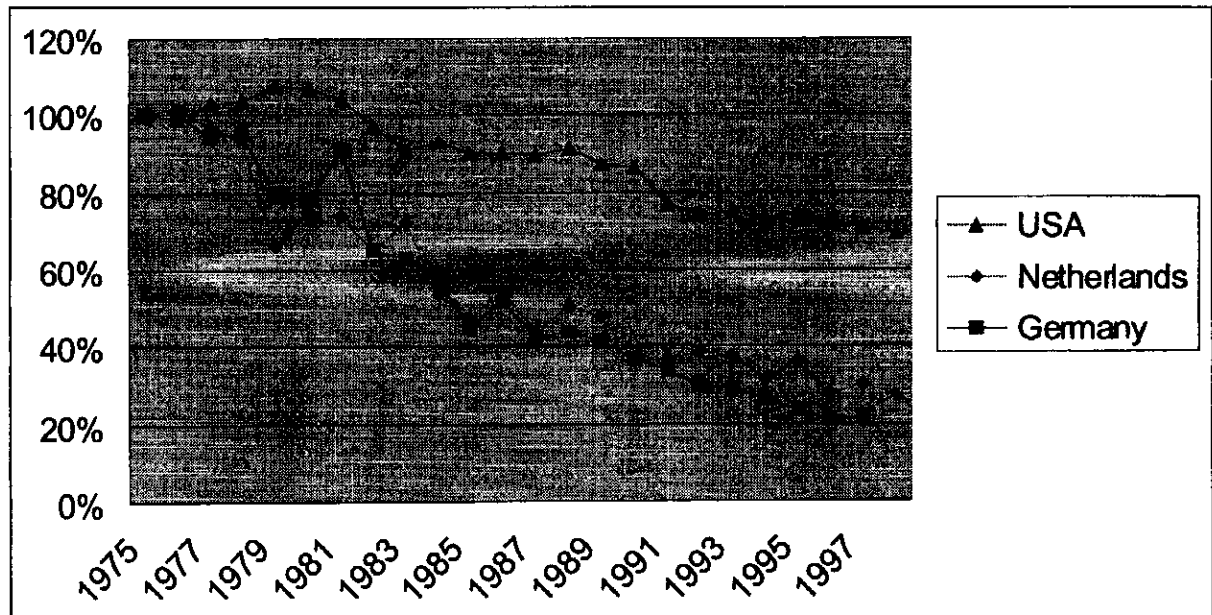
Sources: U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts*; and U.S. Department of Transportation, Federal Highway Administration, *Nationwide Personal Transportation Study and Highway Statistics*; German Institute of Road Traffic, German Ministry of Transport, and German Federal Statistical Office; Central Bureau for Statistics of The Netherlands.

EXHIBIT 10: Per Trip Fatality Rate for Pedestrians and Bicyclists, 1995



Sources: U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts*; and U.S. Department of Transportation, Federal Highway Administration, *Nationwide Personal Transportation Study and Highway Statistics*; German Institute of Road Traffic, German Ministry of Transport, and German Federal Statistical Office; Central Bureau for Statistics of The Netherlands.

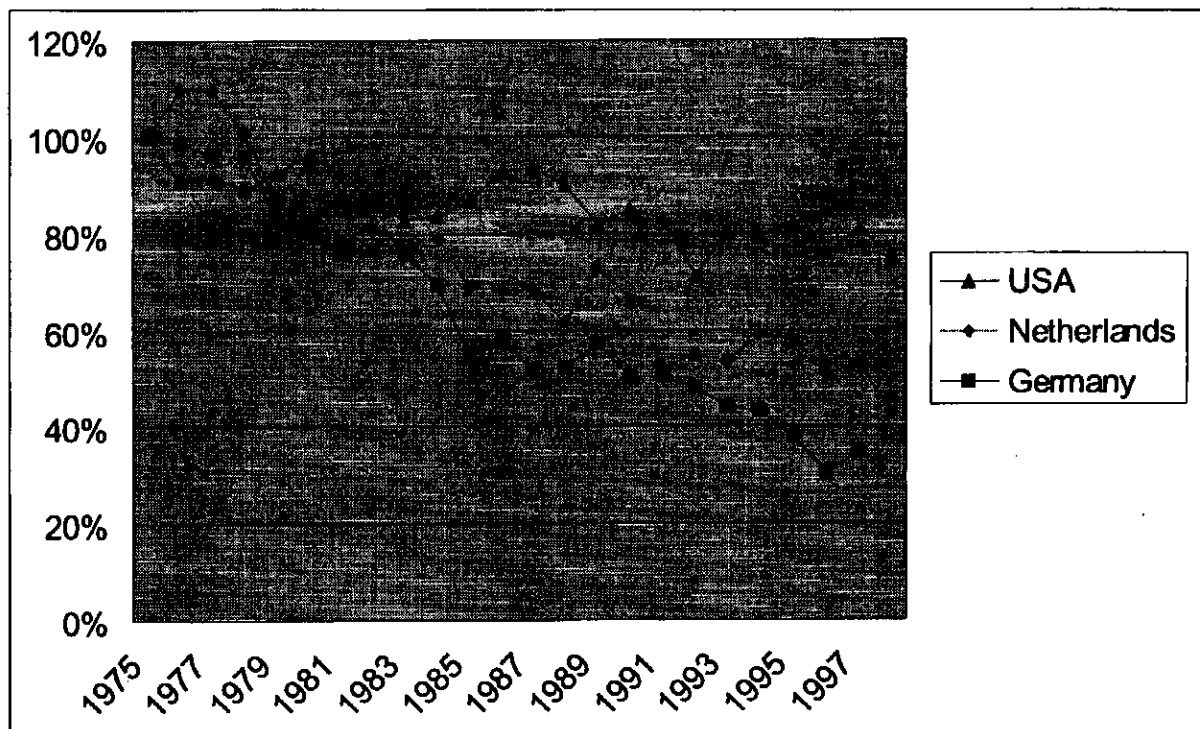
EXHIBIT 11: Trends in Pedestrian Fatalities in The Netherlands, Germany, and the United States, 1975-1998 (1975=100%)



Sources: U.S. Department of Transportation, National Highway Traffic Safety Administration; German Institute of Road Traffic, German Ministry of Transport, and German Federal Statistical Office; Central Bureau for Statistics of The Netherlands.

MAKING WALKING AND CYCLING SAFER

EXHIBIT 12: Trends in Bicycling Fatalities in The Netherlands, Germany and the United States, 1975-1998 (1975=100%)



Sources: U.S. Department of Transportation, National Highway Traffic Safety Administration, *Traffic Safety Facts*; and U.S. Department of Transportation, Federal Highway Administration, *Nationwide Personal Transportation Study and Highway Statistics*; German Institute of Road Traffic, German Ministry of Transport, and German Federal Statistical Office; Central Bureau for Statistics of The Netherlands.

It is noteworthy that the dramatic reduction in bicycling fatalities in Germany occurred during a boom in bike use, with a 50% growth in bike modal split share and a doubling of total bicycle trips.¹⁰ By contrast, the decline in bike fatalities in the United States is due to a sharp fall in children's cycling. The perceived danger of bicycling has caused many parents to discourage their children from cycling at all.¹¹ That has reduced child bike fatalities, but it has also reduced the mobility and independence of children. By comparison, fatalities among adult bicyclists in the United States almost doubled from 1976 to 1997 (from 302 to 560).¹²

The focus here has been on traffic fatalities, but traffic injuries are obviously a serious problem as well. Indeed,

some sources estimate the number of injuries at a hundred times the number of fatalities. For example, the Centers for Disease Control and Prevention (CDC) and the U.S. Consumer Products Safety Commission (CPSC) report an increase in bicycling injuries in the United States from 503,594 in 1980 to 597,284 in 1998, including all injuries requiring visits to a hospital emergency room.¹³ The National Highway Traffic Safety Administration (NHTSA), by comparison, reports only a tenth as many injuries because it only includes collisions of bikes with motor vehicles on roadways.¹⁴ Thus, it estimates only 58,000 bicyclist injuries in 1997, which misses about 90% of all cyclist crashes. NHTSA even finds a 23% decline in bike injuries from 1988 to 1997 compared to

a 5% increase in injuries over the same period as measured by the CDC and CPSC. Similarly, NHTSA underestimates pedestrian injuries because it only reports those occurring on roadways. For 1998, it estimated 69,000 pedestrian injuries, over 10 times the level of pedestrian fatalities (5,220). These fragmentary, unreliable, and contradictory statistics on injuries in the United States make analysis of injury data impossible.

Just as there are discrepancies in defining, measuring, and reporting statistics in the United States, other countries have different ways to define and report bicycling and pedestrian injuries. Whether an injury is reported in official statistics depends on the type of injury, where it occurs, whether it involves a motor vehicle, and whether it requires emergency medical assistance or a hospital visit. That makes injury data rather incomparable across countries. Nevertheless, it is important to note that most countries report pedestrian and bicyclist injuries at least 50 times the number of fatalities. In Germany, for example, there were 52,750 cyclist injuries in 1996 (compared to 761 deaths), and 31,059 pedestrian injuries (compared to 844 deaths). In The Netherlands, there were 53,214 cyclist injuries in 1996 (compared to 233 deaths) and 5,432 pedestrian injuries (compared to 109 deaths).¹⁵

Although Germany and The Netherlands have done much to improve pedestrian and cyclist safety, deaths and injuries in traffic crashes clearly remain an important problem. At least those two countries have long recognized the problem and have drastically revised public policies to improve the situation. Unfortunately, pedestrian and bicyclist traffic safety has been largely ignored in the United States although the problem is far more severe here than in either Germany or The Netherlands. As Western

Europe has shown, there is a great deal that can be done to improve pedestrian and cyclist safety. In the following section, we describe six categories of measures that German and Dutch cities have implemented with great success.

How to Improve Pedestrian and Bicycling Safety

Over the past two decades, The Netherlands and Germany have implemented a range of policies to make walking and bicycling safer. Entire books have been written about some of these safety measures, but we can only briefly summarize them here.¹⁶ Data limitations make it impossible to undertake rigorous statistical analysis to isolate the impact each measure has had on safety improvements. Moreover, most of the measures have been implemented simultaneously and in combination with each other, which makes separating out the individual effects even more difficult. Nevertheless, virtually all of the existing literature, government documents, and interviews with experts in Germany and The Netherlands indicate that the factors listed below have contributed significantly to the dramatic decline in pedestrian and bicyclist traffic fatalities.¹⁷

Improved Facilities for Walking and Bicycling

Clearly, one emphasis of Dutch and German policies has been to improve the transportation infrastructure used by pedestrians and bicyclists: auto-free pedestrian zones, clearly marked crosswalks, sidewalks on both sides of all streets, pedestrian and bicycle traffic lights, intersection modifications, bicycle streets, bike lanes and bike paths. All of these measures require some degree of physical change to the transportation environment.¹⁸



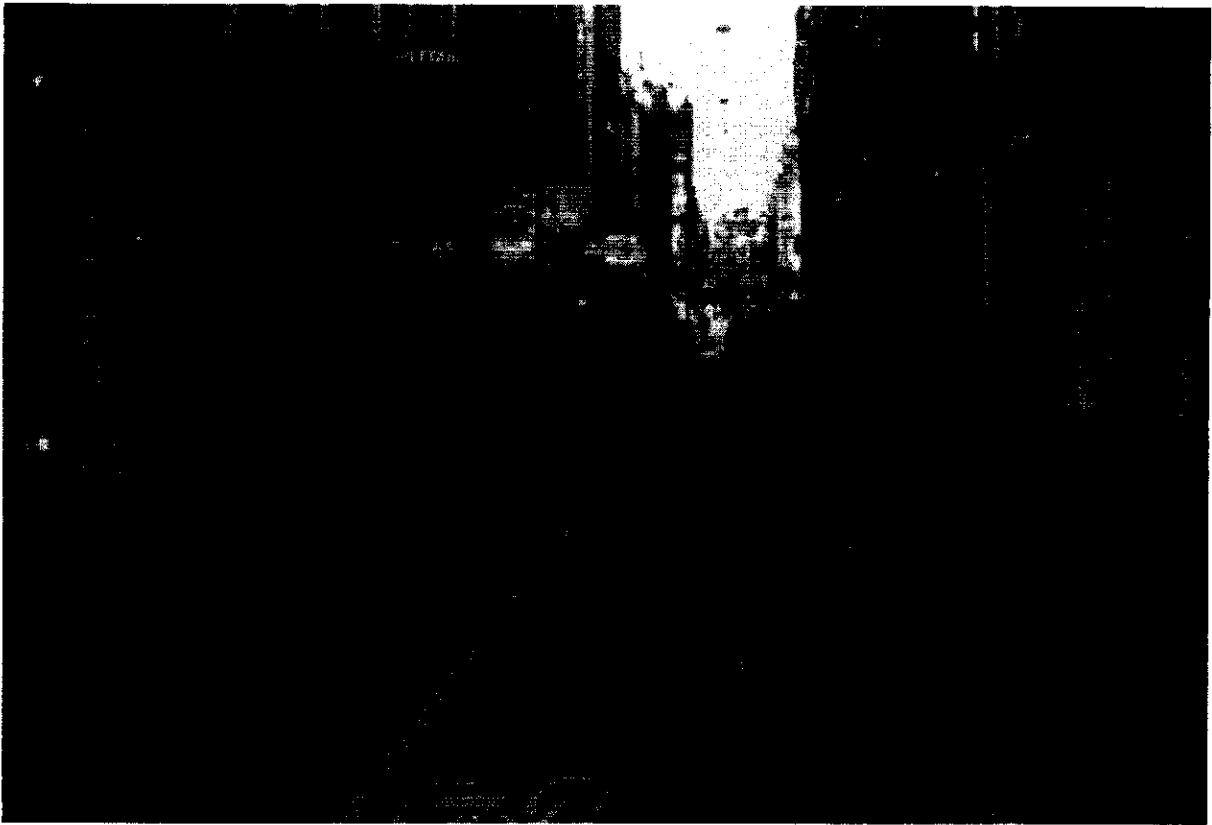
Pedestrian zone in Amsterdam, with cyclists required to dismount and walk their bicycles at times of heavy pedestrian traffic.

Pedestrian infrastructure: Pedestrian zones have become so widespread that they can now be found in virtually every Dutch and German city. In larger cities, such zones often encompass much of the city center, providing a large area where pedestrians have their own right of way. Bicyclists are often allowed in pedestrian zones, but they are required to reduce speeds and yield to pedestrians. Other measures to enhance pedestrian safety and convenience include:

- Zebra crosswalks (sometimes raised and extra wide) with highly visible striping, usually with special overhead illumination and sometimes with flashing yellow lights to alert motorists
- Pedestrian-activated crossing signals, both at intersections and at mid-block crosswalks

- Pedestrian refuge islands for crossing wide streets
- Wide, well-lit sidewalks, often furnished with benches for resting

Bicycling infrastructure: German and Dutch cities have invested heavily to expand and improve facilities specifically for bicycling; many of these investments have focused on increased safety. The most obvious symbol of this investment is the already massive and ever-expanding network of bike lanes and bike paths, which provide completely separate rights of way for cyclists. Unlike the fragmented cycling facilities in the United States, the bike paths and lanes in The Netherlands and Germany form a truly integrated, coordinated network covering both rural and urban areas. Dutch and German bikeway systems serve practical destinations for everyday travel, not just recreational



Auto-free street in Amsterdam with separate rights of way for bicyclists and pedestrians.

attractions, as most bike paths in the United States. The comprehensive route system in Germany and The Netherlands helps insulate cyclists to various degrees from motor vehicles, which are involved in over 95% of bicyclist deaths. In The Netherlands, the network of bike paths and lanes more than doubled in length in less than 20 years: from 9,282 km in 1978 to 18,948 km in 1996.¹⁹ The German bikeway network almost tripled in length: from 12,911 km in 1976 to 31,236 km in 1995.²⁰

The German and Dutch efforts to increase cycling safety are by no means limited to building more bike paths and lanes. Many other measures enhance the safety advantages and greater comfort of separate rights of way:

- Special bicycle streets which permit car traffic but give bicyclists strict right-of-way priority over the entire breadth of the street, with

cars prohibited from rushing bicyclists or otherwise interfering with them

- Streets that are one-way for cars but two-way for bikes
- Reserved bus lanes that can be used by bicyclists but not by cars
- Street networks with deliberate dead ends and circuitous routing for cars but direct, fast routing for bikes, including special "cut-through" shortcuts off the road network altogether
- Permission for bicyclists to make left and right turns where prohibited for motor vehicles. In addition, bicyclists can usually make right turns on red, while motorists cannot
- Special bike lanes leading to intersections that allow bicyclists to pass waiting cars and proceed directly to the front, while cars



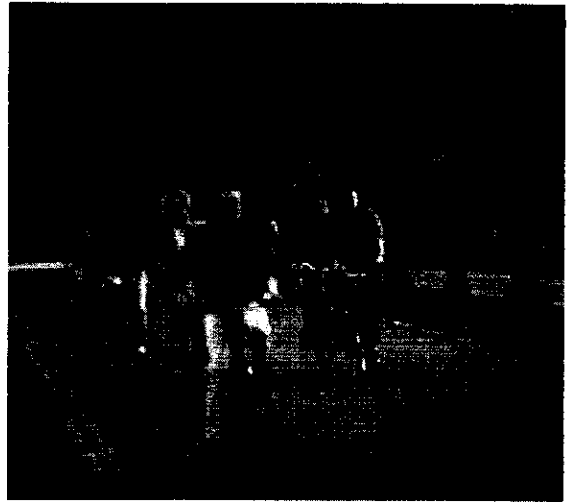
The main street of Muenster, Germany, is off-limits to cars but shared by pedestrians, bicyclists, and buses. Continuous arcades on both sides of the street provide shelter and interesting window-shopping for pedestrians.

must wait at a considerable distance from the intersection. Bicycles then fill up the roadway space between the intersection and the stop line for cars. Since bicyclists also get an advance green light, they can clear the intersection before the cars get started (see the cover photo and caption).

- Special traffic lights for bicyclists at intersections, usually with priority signaling for bikes
- Special bicyclist-activated traffic signals at key intersections

Traffic Calming of Residential Neighborhoods

Traffic calming limits the speeds of motor vehicle traffic, both by law—30 km per hour (19 mph) or less—and



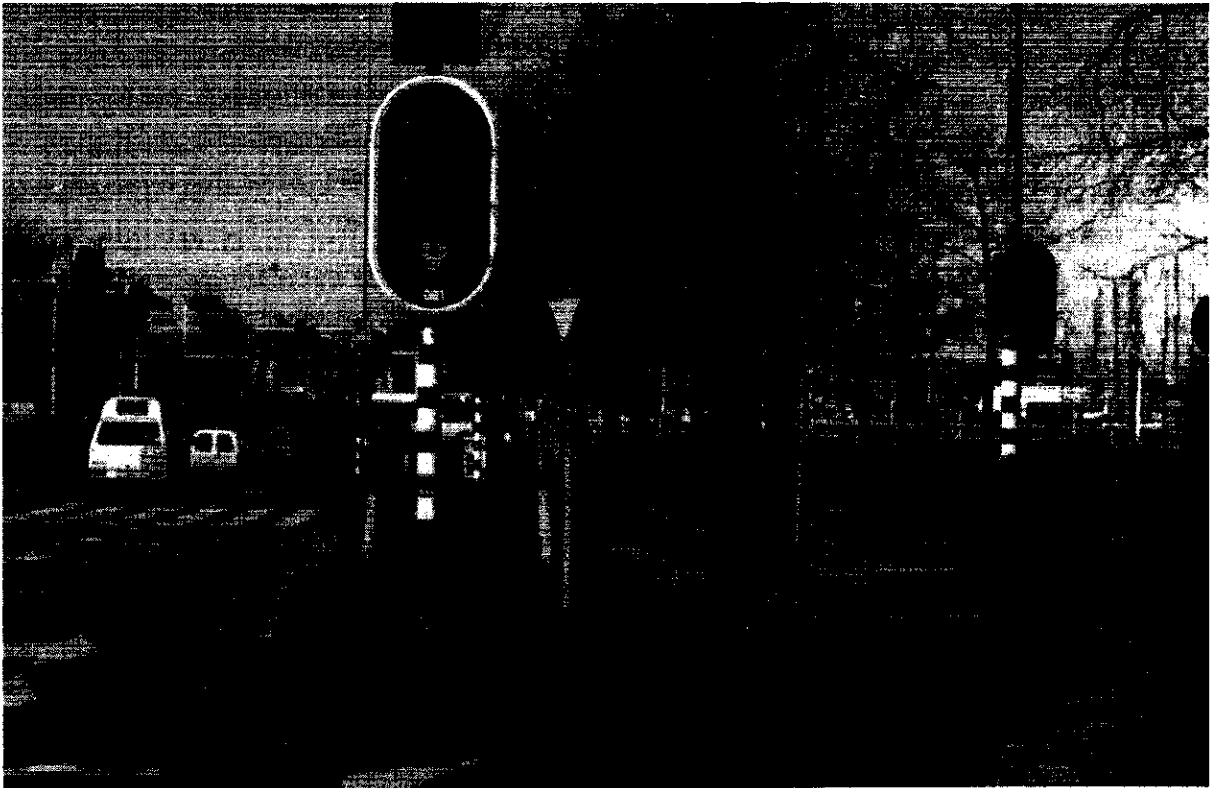
The bicycle expressway in Muenster, Germany, extends 6 km and encircles the central city along the route of the medieval city wall. Pedestrian paths flank the bicycle path on both sides, with a hard walking surface (asphalt) on one side and a soft walking surface (course sand) on the other side. Such complete separation of rights of way avoids conflicts between pedestrians and cyclists.

through physical barriers such as raised intersections and crosswalks, traffic circles, road narrowing, zigzag routes, curves, speed bumps, and artificial deadends created by mid-block street closures. The most advanced form of traffic calming—the *woonerf* in Dutch cities and its German equivalent—imposes even more restrictions, with cars required to travel at walking speed. Generally, traffic calming gives pedestrians, bicyclists, and playing children as much right to use residential streets as motor vehicles; indeed, motor vehicles are required to yield to these other users. In both The Netherlands and Germany, traffic calming is area-wide and not for isolated streets. That ensures that faster through-traffic gets displaced to arterial routes designed to handle it and not simply shifted from one local road to another.

The most important safety impact of traffic calming is the reduced speeds of motor vehicles. That is crucial not only to the motorist's ability to avoid hitting



On-street bike lanes are available on most Dutch streets without grade-separated bike paths. This bike lane in Amsterdam facilitates safe travel for the entire family.



This bike path in Amsterdam swerves to the right several meters to increase cyclist safety when crossing the intersection. The increased distance between the main road and the bike path crossing gives motorists more time to see cyclists. In addition, the traffic island forces a sharp turning radius, requiring cars to turn slowly.

MAKING WALKING AND CYCLING SAFER



Bicycling is so important in some German and Dutch cities that traffic signals often have more lights for bikes than for cars. Bicyclists almost always get an advance green light, allowing cyclists to cross intersections before cars.

pedestrians and bicyclists but also to the survival of nonmotorists in a crash. The British Department of Transport, for example, finds that the risk of pedestrian death in crashes rises from 5% at 20 mph to 45% at 30 mph and 85% at 40 mph.²¹

Areawide traffic calming in Dutch neighborhoods has reduced traffic accidents by 20% to 70%.²² Traffic calming in German neighborhoods has reduced traffic injuries overall by 20% to 70% and serious traffic injuries by 35% to 56%.²³ A comprehensive review of traffic calming impacts in Denmark, Great Britain, Germany, and The Netherlands found that traffic injuries fell by an average of 53% in traffic-calmed neighborhoods.²⁴ There can be no question whatsoever that traffic calming greatly reduces the danger of traffic deaths and injuries in residential neighborhoods. Traffic calming, of course, has improved

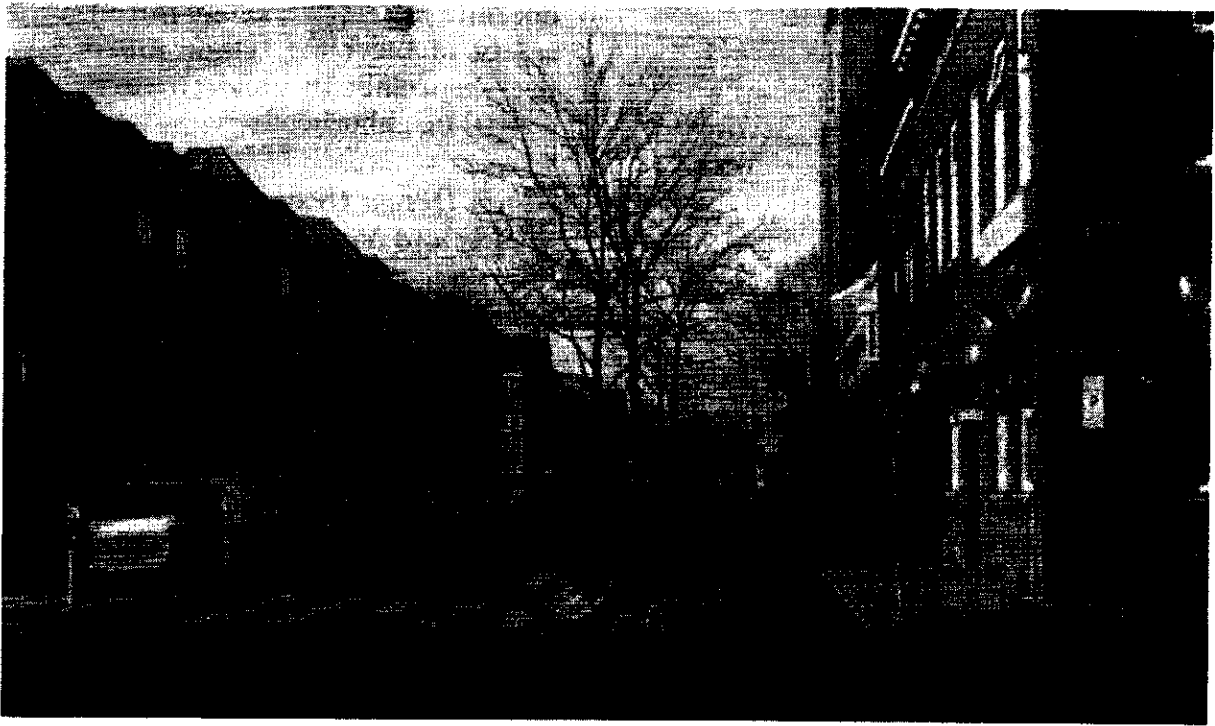
not only pedestrian safety but also the safety of bicycling, since much bike use—especially by children—is in residential neighborhoods.²⁵

Urban Design Oriented to People and Not Cars

New suburban developments in The Netherlands and Germany are designed to provide safe and convenient pedestrian and bicycling access. Residential developments almost always include other uses such as cultural centers, shopping, and service establishments that can easily be reached by foot or bike. New residential areas are located adjacent to town centers, connected by a fine mesh of local streets. The proximity to town makes trips shorter, while the finer grain of the road network allows pedestrians and bicyclists to choose quieter, less heavily traveled streets over busier, more dangerous roads.

In The Netherlands and Germany, even new suburban commercial developments have sidewalks and bicycle paths to serve nonmotorists. Parking lots almost never surround buildings, as in the United States; instead, they are built next to or behind buildings, thus permitting easy access to pedestrians and bicyclists. When an obstacle such as a highway, railroad, or river must be traversed, Dutch and German cities usually provide safe and attractive pedestrian and bicyclist crossings. By comparison, strip malls in American suburbs are difficult and dangerous to reach by foot or bicycle, and most bridges lack provisions for pedestrians and bicyclists.

In the United States, the separation of residential from commercial land uses increases trip distances and makes the car a necessity. Suburban cul-de-sacs further discourage walking and bicycling by making trips circuitous and excessively long. Residential roads often



A traffic-calmed sidestreet in Amsterdam, with limited roadway space due to wide sidewalks, a bike path, and two rows of parked cars and bicycles. Concrete bollards at the curb protect pedestrians and cyclists from intrusions by cars.

feed directly into high-speed traffic arteries, increasing the danger of any trips outside the neighborhood. The lack of sidewalks in most American suburbs further exacerbates the problem of getting around without a car.

Restrictions on Motor Vehicle Use

In sharp contrast to the United States, German and Dutch cities—as well as many other West European cities—have imposed a range of restrictions on motor vehicle use to promote both walking and bicycling. Such measures make walking and cycling safer, more pleasant, more convenient, and faster, while making auto use slower, less convenient, more frustrating or even impossible in some locations. These auto-restrictive policies often overlap with the infrastructure policies listed above, since they are part of a coordinated overall strategy to encourage walking and bicycling but to discourage auto use, especially in city

centers. For example, pedestrian zones obviously restrict auto use since cars are not allowed in them. Similarly, zebra crosswalks, pedestrian-activated traffic signals, priority traffic signals for bicyclists, turn restrictions and directional restrictions for cars all reduce the speed and convenience of car use. The very essence of traffic calming is to restrict auto use in residential neighborhoods. A few other restrictions on auto use are also worthy of note:

- Even residential neighborhoods that are not traffic-calmed usually have a speed limit of 30 km per hour (19 mph), while the overall speed limit for cities is 50 km per hour (31 mph), far lower than the corresponding speed limits in most American cities.
- Truck traffic and through-traffic of any kind is prohibited on many roads.

- Unlike the United States, motor vehicles cannot make right turns on red. As suggested by several studies, turns on red can pose considerable danger for pedestrians and cyclists.²⁶
- Most Dutch and German cities have reduced the supply of parking for cars in city centers. Parking decks are situated on the edges of downtown to discourage auto travel into the core of the city. Moreover, parking rates have risen considerably over the past two decades. Both off-street parking in decks and on-street metered parking in city centers can be quite expensive (about \$3 per hour in Munich). Special limited-time parking meters in most residential neighborhoods discourage long-term parking by commuters, and as a further disincentive, residential parking permits are increasingly required for non-metered, on-street parking.

Traffic Education

Driver training for motorists in The Netherlands and Germany is much more extensive, thorough, and expensive than in the United States. Dutch and German drivers are required to take a minimum number of hours of driving instruction with private firms, usually costing at least \$1,500. Moreover, they cannot get their licenses until the age of 18, two years older than in most American states. A crucial aspect of driver training in The Netherlands and Germany is the need to pay special attention to avoiding collisions with pedestrians and cyclists. It is assumed that pedestrians and cyclists will make unsafe (and illegal) moves in traffic. Car drivers are required to anticipate such unsafe moves by carefully noting the presence of pedestrians and cyclists anywhere along their route so that they

can react quickly to avoid hitting them. This ability to anticipate potentially dangerous moves by pedestrians and cyclists is actually tested in the driving portion of the license exam and can easily result in failure. Motorists are trained to drive in a way that minimizes the risk of injury for pedestrians and cyclists even if they are jaywalking, cycling in the wrong direction, ignoring traffic signals, or otherwise behaving contrary to traffic regulations.

Traffic education of children has high priority in both The Netherlands and Germany. Every school provides comprehensive programs to educate children to walk and bicycle safely. The exact timing varies from city to city, but by the age of 10, every child has received extensive instruction on safe walking and bicycling practices. They are taught not just the traffic regulations but how to walk and bicycle defensively, to anticipate dangerous situations, and to react appropriately. Throughout Germany, schoolchildren in the third and fourth grades are required to take bicycling courses, often taught by special traffic police, with a concluding exam. Children are tested by real police officers in special "traffic parks" with simulated streets, intersections, traffic signals, and possible dangers. Children take the traffic courses seriously and compete with each other for the best grade. Even bike safety inspections are a special event. Pupils gather in the schoolyard as traffic police inspect the children's bikes and issue the coveted safety stickers so proudly displayed on bikes. That sort of safety education is completely lacking in the United States.

Traffic Regulations and Enforcement

Traffic regulations in Germany and The Netherlands strongly favor pedestrians and bicyclists.²⁷ Even in cases where an accident results from illegal moves by

pedestrians or cyclists, the motorist is almost always found to be at least partly at fault. When the accident involves children or the elderly, the motorist is usually found to be entirely at fault. In almost every case, the police and the courts find that motorists should anticipate unsafe and illegal walking and cycling. Having the right of way by law does not excuse motorists from hitting pedestrians and cyclists.

The Netherlands and Belgium have taken this one step further. In collisions between pedestrians or cyclists and motorized vehicles, the insurance company for the motorized vehicle automatically pays the damages, regardless of guilt. The only exceptions are cases where the pedestrian or cyclist can be proved to have deliberately caused the accident.

In addition, German and Dutch police are far stricter in ticketing motorists, pedestrians, and cyclists who violate traffic regulations. Thus, walking against the light is not allowed in any German city and can easily result in a ticket and fine. Likewise, cyclists caught riding in the wrong direction, running red lights, making illegal turns, or riding at night without functioning lights can expect at least a warning notice and possibly a ticket and fine. Cyclists are also expected to obey traffic laws in The Netherlands, but pedestrians have been permitted to jaywalk legally since 1997. That has not resulted in any increase in pedestrian injuries or deaths, suggesting that pedestrian accidents are not primarily due to jaywalking.

Neither The Netherlands nor Germany has laws requiring bicyclists to wear safety helmets, not even for child cyclists. Indeed, helmet use is almost non-existent among adult cyclists (less than 2% of cyclists in both Germany and The Netherlands).²⁸ Thanks to a concerted campaign in the schools and the media, however, helmet use has

been increasing among children. A recent study found that 32% of German children up to the age of 10 years now wear a safety helmet when bicycling. Nevertheless, it is clear that the dramatically lower fatality rates in Germany and The Netherlands are not due to safety helmets.

The most significant contrast with the United States is the much stricter enforcement of traffic regulations for motorists in Germany and The Netherlands. Penalties can be high even for minor violations. Not stopping for pedestrians at zebra crosswalks is considered a serious offense and motorists can get ticketed for non-compliance, even if pedestrians are only waiting at the curb and not actually in the crosswalk. What a contrast that is to the United States, where crosswalks in many cities have become almost meaningless.²⁹ Few American motorists bother to stop for pedestrians waiting to enter crosswalks without traffic signals.³⁰ Unless pedestrians are actually hit, the police almost never issue summonses for crosswalk violations. Similarly, red traffic signals still mean "stop" in Germany and The Netherlands. In most American cities, motorists increasingly run red lights for the first few seconds. That puts pedestrians crossing at the intersection in danger, since the "walk" signal falsely suggests that it is safe to cross. Some intersections in German and Dutch cities have cameras that automatically photograph cars running red lights and stop signs. Guilty motorists receive tickets by mail together with photos of themselves "in the act," even if the police do not catch them on the spot. The greater likelihood of getting caught for violations obviously increases the motivation for motorists to obey the law.

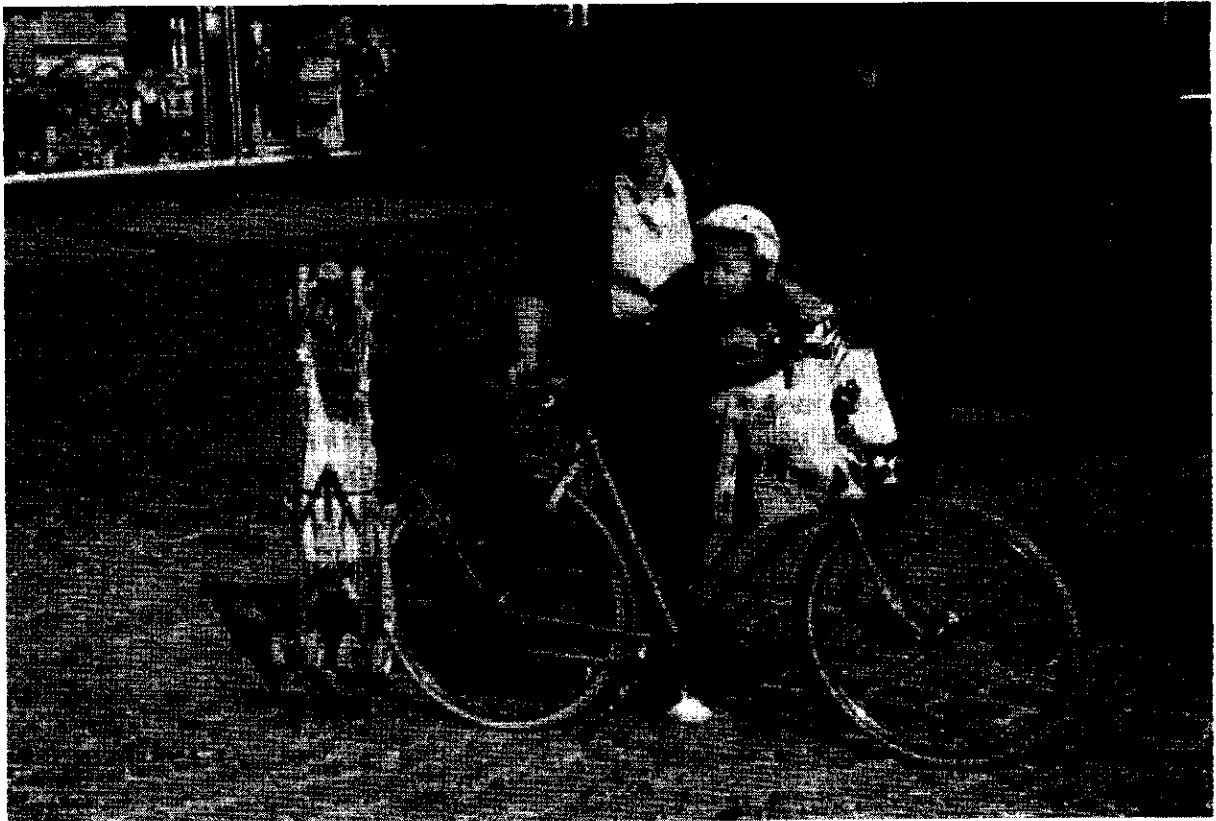
Finally, the punishment for traffic violations by motorists is far more severe in The Netherlands and Germany

MAKING WALKING AND CYCLING SAFER

than in the United States. The extremely lenient treatment of American motorists is documented in *Killed by Automobile*, an analysis of 1,020 pedestrian and bicyclist fatalities in New York City from 1994 to 1997. Using police records, the authors found that "drivers were largely or strictly culpable in 74% of cases where sufficient information existed for culpability coding, and were largely, strictly, or partly culpable in 90% of the known cases. Hit and run, turning into pedestrians at crosswalks, and speeding were the top three driver faults in killing pedestrians and cyclists."³¹ Incredibly, the police cited motorists for traffic violations in only one-fourth of pedestrian and bicyclist fatalities, although motorists were involved in almost all these fatalities and were unquestionably at fault in at

least half. In only 1% of fatalities did the police issue summonses to motorists specifically for violating pedestrian and bicyclist rights of way (such as failing to yield in crosswalks or driving in bike lanes). Studies published in the public health literature also find a high percentage of motorist negligence in pedestrian fatalities.³²

Whereas motorists in Germany and The Netherlands are presumed to be at fault in such accidents and get punished accordingly, the police and courts in the United States reflect the opposite view. Perhaps it is not too extreme to describe the American situation as motorists getting away with murder or at least negligent homicide. Clearly, such leniency with even the most deadly of driving behavior only encourages more of it and puts pedestrians and



Bicycling in Muenster is so safe and convenient that mothers can get around with two children on the same bike, as well as a stroller and shopping bags. Although virtually no adults wear bicycle helmets, about a third of children under 10 years of age now wear helmets in Germany.

bicyclists at much higher risks in the United States than in Germany or The Netherlands.

Lessons for the United States?

The neglect of pedestrian and bicycling safety in the United States has made these modes dangerous ways of getting around. Pedestrian fatalities are 36 times higher than auto occupant fatalities per km traveled, and bicycling fatalities are 11 times higher than auto occupant fatalities per km (see Exhibit 2). Walking and bicycling can be made quite safe, however, as clearly shown by the much lower fatality rates in The Netherlands and Germany. Pedestrian fatalities per billion km walked are less than a tenth as high as in the United States, and bicyclist fatalities per billion km cycled are only a fourth as high (see Exhibits 9 and 10). Moreover, the safety gap has been widening. Over the past two decades, pedestrian deaths fell by 72% in The Netherlands and by 79% in Germany, but by only 31% in the United States. Bicyclist fatalities fell by 57% in The Netherlands and by 66% in Germany, but by only 24% in the United States (see Exhibits 11 and 12).

What has the United States been doing wrong, and what have The Netherlands and Germany been doing right? All levels of government in the United States have focused their subsidies, regulations, technological developments, and planning efforts on the safety of auto occupants. Perhaps because walking and bicycling account for such a small percentage of trips in the United States, they have been treated as insignificant modes, and their safety has been woefully neglected, thus further discouraging their use. Federal and state departments of transportation have made a few halfhearted attempts to improve pedestrian and cyclist safety, but all measures stop far short of any-

thing that would cost much money or inconvenience motorists in any way. Those restrictions virtually guarantee little if any progress.

In sharp contrast, The Netherlands and Germany have long recognized the importance of pedestrian and bicyclist safety and have undertaken a wide range of measures in a serious attempt to help pedestrians and bicyclists. These measures can be grouped into six categories:

- More and better facilities for walking and bicycling
- Urban design oriented toward people and not cars
- Traffic calming of residential neighborhoods
- Restrictions on motor vehicle use
- Better traffic education of both motorists and nonmotorists
- Stricter enforcement of traffic regulations protecting pedestrians and bicyclists

There is no reason why the United States could not adopt many of the same measures. The lack of funding certainly cannot be a legitimate excuse. If The Netherlands and Germany can afford them, so can the United States. Moreover, the necessary technology and methods are already available, with decades of successful experience in Europe. Americans need only travel to European cities to see firsthand that safe walking and cycling are possible.

The real problem in the United States is lack of willingness to do anything that infringes on the prerogatives of motor vehicle users. With over 90% of trips here made by private motor vehicles, there is limited political support for any policies that would inconvenience motorists. Comprehensive traffic calming, ubiquitous bike lanes, stringent speed restrictions, and strict enforcement of pedestrian right of way at crosswalks might evoke considerable

opposition from a majority of voters and politicians. Motorists have no objections to off-road bike paths for recreational cycling, but that is because they do not interfere with car traffic on roads. By comparison, motorists object vehemently to road narrowing for wider sidewalks or bike lanes. Unless they are cheap and do not inconvenience motorists, most safety measures have little chance of implementation in the current environment.

Attitudes must change. The American public must be educated about the severity of the pedestrian and bicyclist crash problem and the urgent need to deal with it. The safety issue must be brought home. The neglect of nonmo-

torist safety not only risks the injury and death of family and friends who walk and bicycle, but it also deprives everyone of valuable exercise, mobility options, independence, and even fun. It is important to package and market safety-enhancing policies in a way that dramatizes their benefits to everyone. Instead of being viewed as punitive measures aimed against motorists, they should be presented as new opportunities for all segments of the population. That is precisely the way they are viewed in The Netherlands and Germany, and it is the main reason there is widespread public support for adopting policies that improve safety while providing increased mobility options.

Endnotes

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13. U.S. Consumer Product Safety Commission, *Product Summary Report: Product-Associated Visits to Hospital Emergency Rooms*, Annual, 1980-1998, Washington, D.C.
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17. The measures listed below include only those related specifically to traffic safety, i.e. to preventing accidents. It is certain that at least part of the decline in deaths resulting from traffic injuries is due to the greatly improved medical assistance for accident victims throughout Western Europe and North America over the past two decades. Many victims of traffic crashes have had their lives saved through on-site first aid services and rapid transport to a hospital.
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Acknowledgments

Charles Komanoff and Peter Jacobsen provided valuable information, feedback, and editorial advice at each stage of this article's evolution. Nancy and Joseph Schofer, Martin and Helen Wachs, Robert Cervero, Joel Tarr, Gillian Thomas, Petra Staats, Michael Holzhey, Gerd Hundhausen, Piet Rietveld, Johannes Berner, Erhard Erl, and Paul Schimek made helpful suggestions for improving previous versions of the article. The photos of bicycling in Germany were taken by Martina Guettler, Bicycling Coordinator of Muenster, Germany; the photos from The Netherlands were taken by Lewis Dijkstra.