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Cycling in New York:
Innovative Policies at the Urban Frontier

Youth transport, mobility and security in sub-Saharan Africa:
The gendered journey to school

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Editorial

On Thursday 13th May 2010 a new government in Britain began making its first decisions. Amongst these decisions was the abandonment of a 3rd runway at Heathrow Airport and the cancellation of any new runways at Gatwick and Stansted. The fact that the new government is the first coalition government since the second world war has excited fear and uncertainty as well as hope for a "new politics" but we shall see. The Conservative-Liberal Democrat coalition labelled somewhat unkindly as the "Con-dem" coalition by the Labour Party has enormous potential to get things right so here are a few tips in the best tradition of World Transport Policy and Practice and its 15 years of efforts to inform policy:

Cancel the complete road building programme and motorway widening programme and use the (approx) £10 billion to reduce public expenditure and/or reallocate to highway maintenance so that road conditions improve.

Cancel the complete high speed rail programme. 1% of all trips in the UK are longer than 100 miles and there is no satisfactory rationale for spending £32 billion of public money to encourage rich people to travel faster and more often to and from London.

Implement full internalisation of external cost on domestic aviation through emission charging and implement strict noise and air quality regulations around airports to protect local residents from health damaging environments.

Announce that it is the view of the new coalition government to eliminate domestic aviation apart from those services connecting remote Scottish Islands and similar communities elsewhere in the UK.

Implement system-wide reform in all UK urban areas to deliver a "202020`" vision for cycling - 20% of all trips in all urban areas will be by bicycle by 2020. System-wide reform means general 30kph/20mph speed limits, road closures to reduce rat running and highly connected public services and destinations. All UK cities can be like Freiburg, Basle and Copenhagen. The missing ingredient is political will.

De-commission 50% of car parking spaces in urban areas and reallocate the released land for high quality, car free, affordable housing.

Implement a serious road user hierarchy so that every junction and every highway link delivers absolute consideration for pedestrians and cyclists and puts car users at the bottom of the list. The road user hierarchy is illustrated and described in the Department for Transport Manual for Streets (DfT, 2007).

Introduce land value taxation to produce funds for new public transport infrastructure.

Require a year on year increase in accessibility by foot, bike and public

transport to all health, education, employment and recreational facilities.

Set a target of achieving the rule of one third for urban areas: all efforts will be made to deliver a modal split in urban areas of one third of trips walk/cycle, one third public transport and one third by car.

Set high standards of public transport provision for rural public transport and establish the position that the car is not the default option for rural areas. In case of doubt please will Ministers visit Dornach and Gempen near Basle in Switzerland to see what is meant by "high standards".

This list has been sent to the new Minister of Transport of the new UK government. We await his answer with great anticipation.

John Whitelegg
Editor

DfT (2007) Manual for Streets (para 3.6.8)
http://www.dft.gov.uk/pgr/sustainable/manforstreets/pdfmanforstreets.pdf

Abstracts & Keywords

Cycling in New York: Innovative Policies at the Urban Frontier

John Pucher, Lewis Thorwaldson, Ralph Buehler, and Nicholas Klein

New York has made impressive progress at improving cycling conditions and raising cycling levels in recent years, especially in Brooklyn and Manhattan. The number of bike trips has almost doubled since 2000, thanks to vastly expanded cycling infrastructure, including innovative treatments such as cycle tracks, buffered bike lanes, special bike signals, bike boxes at intersections, and bright green lane markings. Cycling safety has improved, with steady or declining numbers of cyclist injuries and fatalities in spite of rapidly rising cycling volumes. Some serious deficiencies remain, however. Integration of bicycling with public transport is almost non-existent. There is not nearly enough bike parking, and virtually no secure bike parking at all. Moreover, the police and courts in New York have failed to enforce the many traffic laws intended to protect cyclists. Comprehensive traffic calming is needed in New York's residential neighbourhoods to reduce travel speeds and thus encourage more cycling, in particular, by children, seniors, and women. Cycling has come a long way in New York, but it still has a long way to go before it becomes a mainstream way to get around.

Keywords: bicycling, cycle paths, infrastructure, cycling safety, policy, New York City, gender, bike parking, sustainable transport

Youth transport, mobility and security in sub-Saharan Africa: the gendered journey to school

Gina Porter, Kate Hampshire, Albert Abane, Alister Munthali, Elsbeth Robson, Mac Mashiri and Augustine Tanle

This paper draws on empirical data from a three-country study (Ghana, Malawi, South Africa) of young people's mobility to explore the gendered nature of children's journeys to school in sub-Saharan Africa. Gender differences in school enrolment and attendance in Africa are well established: education statistics in many countries indicate that girls' participation in formal education is often substantially lower than boys', especially at secondary school level. Transport and mobility issues commonly form an important component of this story, though the precise patterning of the transportation and mobility constraints experienced by girl schoolchildren, and the ways in which transport factors interact with other constraints, varies from region to region. In some contexts the journey to school represents a particularly hazardous enterprise for girls because they face a serious threat of rape. In other cases girls' journeys to school and school attendance are hampered by Africa's transport gap and cultural conventions which require females to take on this

burden (by pedestrian head loading) before leaving for (or instead of attending) school.

Our evidence comes from a diverse range of sources but, for reasons of space, we draw principally here on a survey questionnaire conducted in each country with approximately 1000 children aged 7-18 years across 8 sites. We aim to draw attention to the diversity of gendered travel experiences across geographical locations (paying attention to associated patterns of transport provision), to explore the implications of these findings for access to education, and to suggest areas where policy intervention could be beneficial.

Keywords: children's journey to school, sub-Saharan Africa, gender, threat, transport, mobility, cultural conventions, education, policy

Cycling in New York: Innovative Policies at the Urban Frontier

John Pucher, Lewis Thorwaldson, Ralph Buehler, and Nicholas Klein

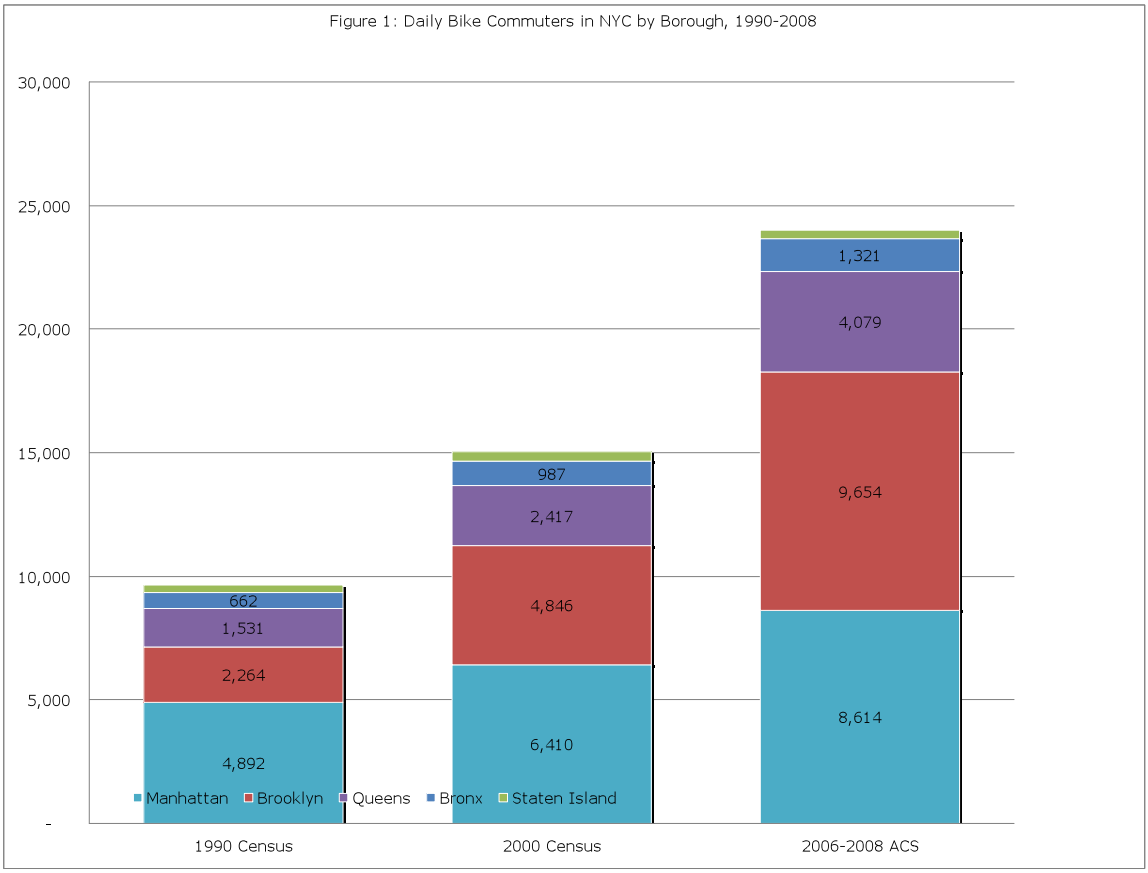
New York's size, density, and public transport orientation make it unique among American cities. Moreover, as the media centre of the USA—and perhaps of the world as well—New York's influence extends far beyond its borders. Trends often start in New York and spread elsewhere. The recent surge in cycling in New York has drawn widespread media attention, with newspapers around the world running stories about the city's innovative bicycling policies. The fate of bicycling in New York is important because it may influence bicycling in other cities. If bicycling can thrive even under the challenging conditions in New York, it might provide momentum for cycling growth elsewhere.

As noted in a previous case study of New York cycling, the city's topography, climate, and land use pattern generally actually favour cycling, and every day New Yorkers make millions of trips short enough to cover by bike (Pucher et al., 1999). Written over a decade ago, the same article lamented the many factors deterring cycling in New York in the 1990s: heavy, dangerous, and stressful traffic; air pollution and noise; torn street pavement and substandard cycling facilities; lack of bike parking; and rampant bike theft. A lot has changed in recent years, but serious obstacles to cycling remain.

This case study of bicycling in New York documents trends in cycling levels and cycling safety over the past two decades and describes the evolution of cycling policies and programs. Our focus is on the period since 2000, when a rapid expansion of New York's bikeway network began. Throughout the discussion, we highlight the many innovative strategies implemented in New York in recent years to promote cycling but also point out deficiencies in the city's overall approach.

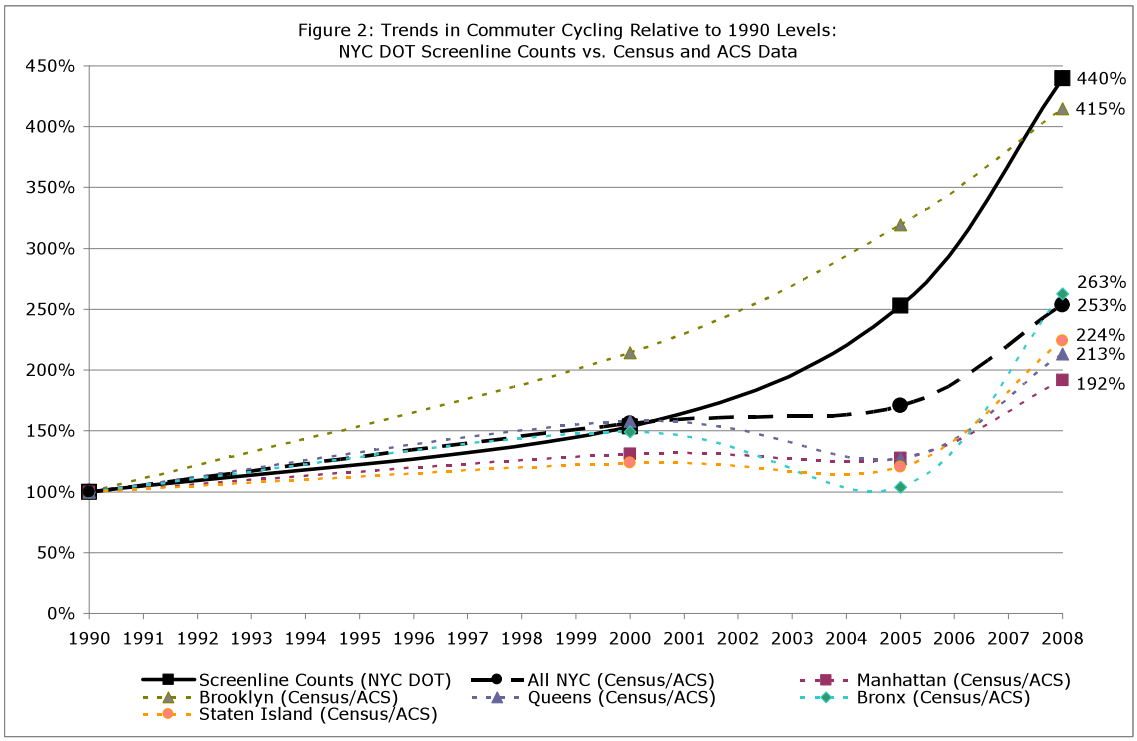
Trends in Cycling

The available indices of cycling levels in New York show considerable growth in cycling since 1990. As shown in Figure 1, the journey to work portions of the decennial Census and the annual American Community Survey (ACS) report an increase in daily bike commuters from 9,643 in 1990 to 24,428 in 2006-2008 (averaged) (U.S. Census Bureau, 2010a, b, c). By far the largest increase was in Brooklyn, which quadrupled its number of bike commuters and overtook Manhattan as the borough with the most residents bicycling to work.



Sources: Calculated by the authors from data in U.S. Census Bureau (2010a, 2010b, 2010c)

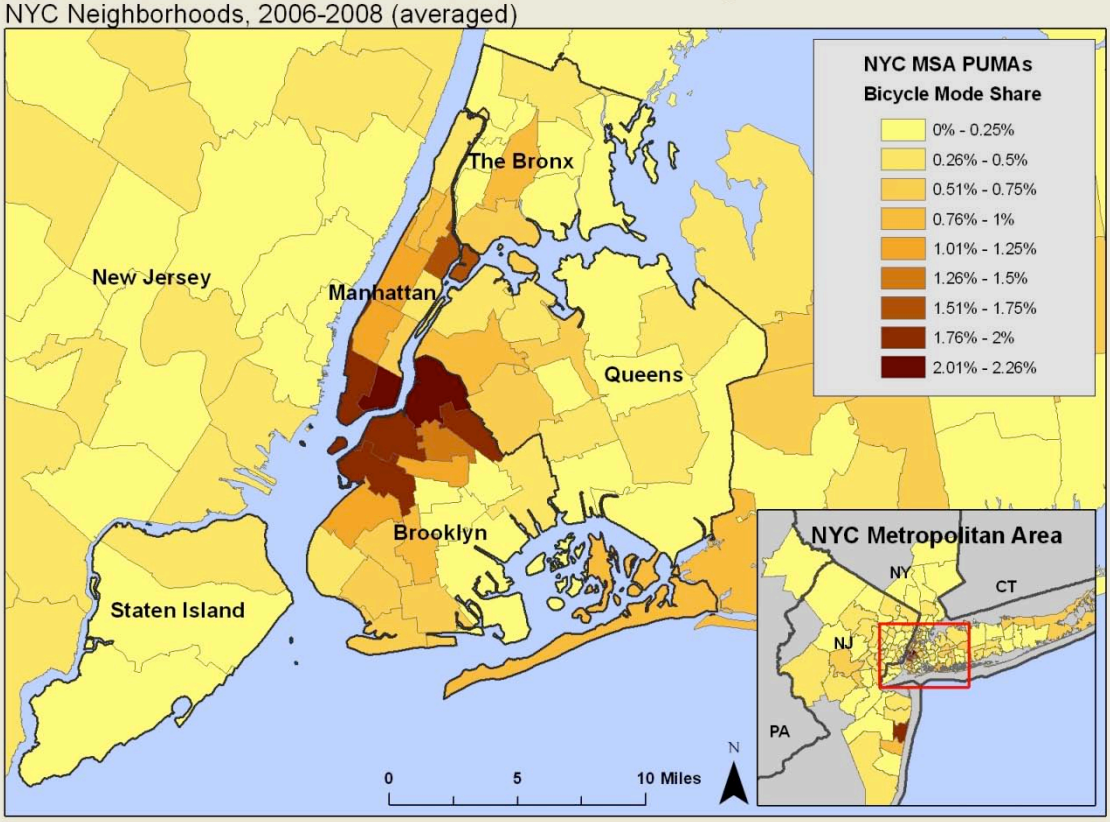
Figure 2 portrays cycling trends as a percentage of 1990 base levels. The U.S. Census Bureau reports a 153% growth in bike commuters between 1990 and 2008 for New York City as a whole, but with large differences between the five boroughs. The fastest growth in cycling was in Brooklyn (315%), followed by Queens (163%). The slowest growth was in Manhattan (92%), albeit from the highest base level in 1990, as shown in Figure 1. The bike share of total work commuters in NYC has doubled over the past two decades, increasing from 0.3% in 1990 to 0.6% in 2008. Although Brooklyn now has the most bike commuters, Manhattan still has the highest mode share of bike commuters (1.0%)—compared to 0.9% in Brooklyn, 0.4% in Queens, 0.3% in the Bronx, and 0.2% in Staten Island (U.S. Census Bureau, 2010c).



Sources: Calculated by authors from data in U.S. Census Bureau (2010a, 2010b, 2010c; NYCDOT, 2010b)

Aside from the U.S. Census, the only other source of data on long-term cycling trends in New York is the NYC Commuter Cycling Indicator of the NYC Department of Transportation (NYCDOT, 2010a). As shown in Figure 2, it reports more than twice as much growth in cycling as the Census over the same period (340% vs. 153%). The two indices are not directly comparable, however. The decennial U.S. Census and annual ACS surveys are representative of the entire City of New York, including the outer portions with the least cycling. The NYC DOT indicator focuses only on trips into and out of the Manhattan CBD on weekdays. The six crossing points surveyed since 2001 have been at the East River Bridges (Brooklyn, Manhattan, Williamsburg, and Queensboro), the Hudson River Greenway at 50th Street, and the Staten Island Ferry. Over 70% of the bike trips counted by the DOT screenline indicator in 2008 were across the East River Bridges from Brooklyn and Queens to Manhattan (NYCDOT, 2010a).

Figure 3: Variation in Bicycle Share of Work Commuters among NYC Neighborhoods, 2006-2008 (averaged)



Source: GIS map created by the authors from data in U.S. Census Bureau (2010c)

The highest bike commuting rates reported by the U.S. Census Bureau are in Lower Manhattan and north-western Brooklyn, with about 1.8% to 2.3% of workers commuting by bike (Figure 3). Rates of cycling to work drop off sharply with distance from that core. In south-eastern Brooklyn, eastern Queens, most of the Bronx, and all of Staten Island, less than 0.3% of workers commute by bike, roughly the same rates as in the New Jersey suburbs. As documented by the NYC DOT Cycling Indicator, 80% of the increase in bike trips to the Manhattan CBD between 2001 and 2008 came over the four East River bridges from Brooklyn and Queens.

The dramatic growth in bike commuting over the East River bridges is partly due to new and/or improved bike paths on those bridges and on access routes to the bridges. The vastly improved cycling facilities across the East River provided the crucial connections necessary to bike the short distance between north-western Brooklyn and the Manhattan CBD, which can be covered by bike in half an hour or less.

In addition to improved bicycle facilities, there have been significant demographic and economic changes in north-western Brooklyn. Over the past four decades, neighbourhoods such as Brooklyn Heights, Cobble Hill, Boerum Hill, Carroll Gardens, Park Slope, Williamsburg, and Greenpoint have been experiencing ongoing gentrification which has brought an influx of young professionals,

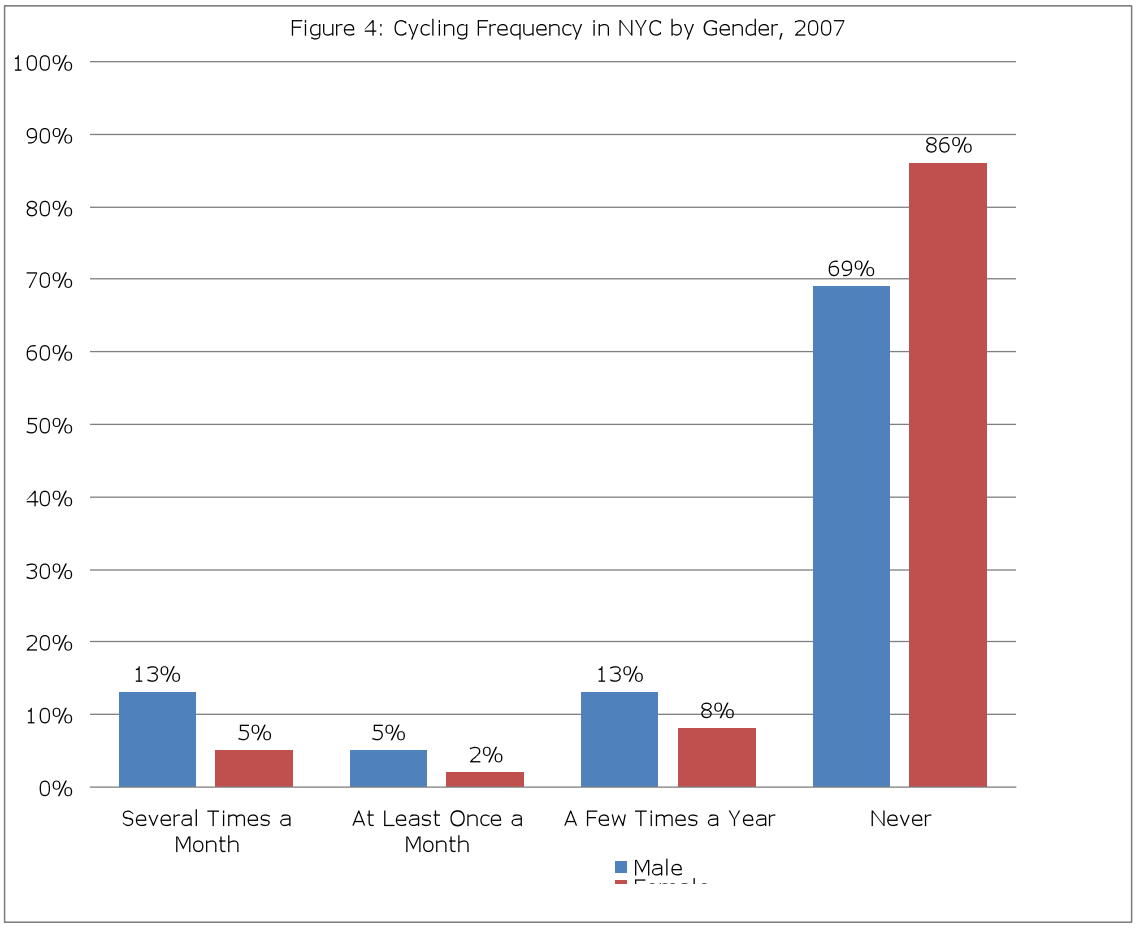
academics, artists, musicians, writers, and 'hipsters' (Curran, 2004; Goworowska, 2008; Lees, 2003; Newman and Wyly, 2006; Slater, 2004). In these gentrifying neighbourhoods, bicycling has become the fashionable or 'hip' way to get around. Many residents view bicycling as more than a utilitarian form of transport: it is also part of their lifestyle and personal identity. All of these factors--improved bicycling facilities, changing neighbourhood demographics, and the increasingly trendy image of bicycling--help explain the growth in bike commuting in Brooklyn. Similarly, many neighbourhoods in Lower Manhattan--especially the Lower East Side--have been gentrifying in similar ways and generating more bicycling for the same reasons.

Since the Census reports work commutation by place of residence, much of the increase in biking to workplaces in Manhattan shows up in the numbers for Brooklyn. Indeed, the Census reports a 315% growth in bike commuters living in Brooklyn—not much less than the 340% growth reported by the screenline counts overall (see Figure 2).

Both the U.S Census data and the NYC DOT indicator show a gradual increase in cycling levels from 1990 to 2000 but accelerated growth after 2000, especially after 2005. As noted later, that spurt in cycling was encouraged by a massive expansion in cycling infrastructure throughout the city but especially in the core areas with the highest cycling levels.

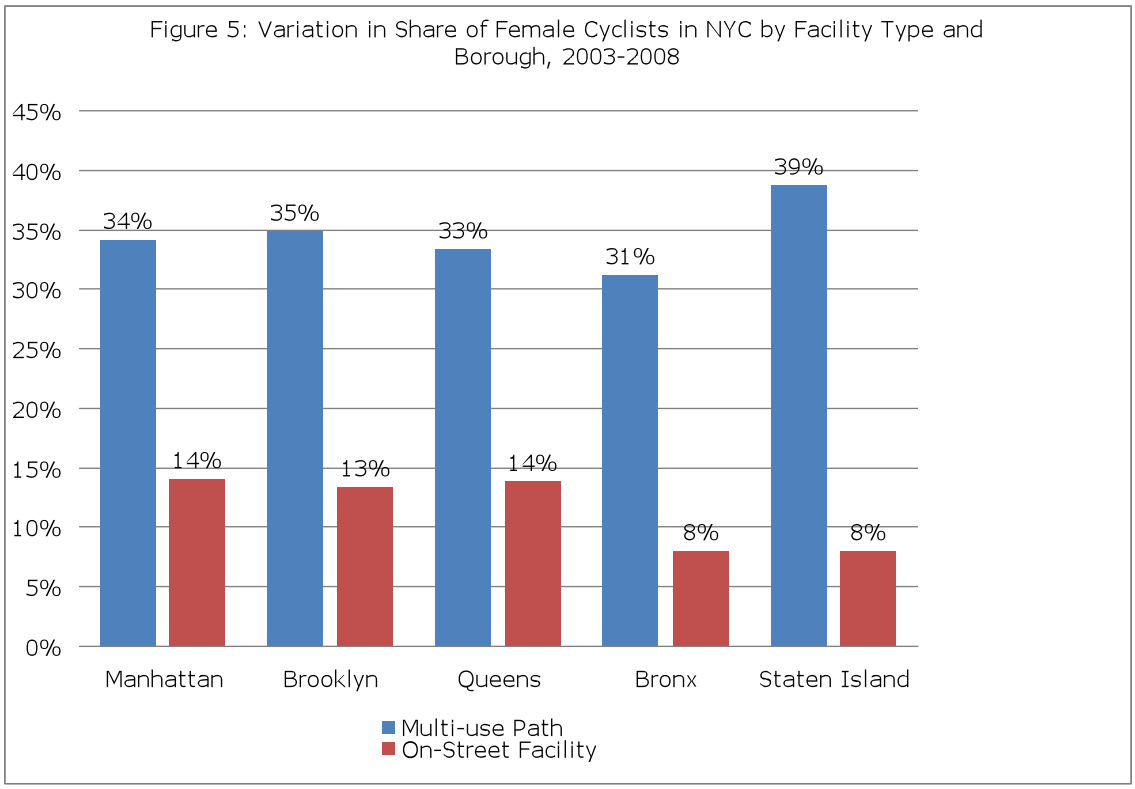
Profile of cyclists

As in the rest of the USA, roughly three-fourths of cyclists in NYC are men (Alliance for Biking and Walking, 2010). The women's share of bike commuters in NYC fell from 25% to 20% from 1990 to 2000 and then rebounded to 24% by 2008 (U.S. Census Bureau, 2010 a, b, c). The predominance of male cyclists is not limited to work commutation but extends to all trip purposes. A 2007 survey of 10,000 New Yorkers by the NYC Department of Health found that men were more than twice as likely to cycle as women (see Figure 4). Only 5% of women cycled several times a month, compared to 13% of men. Conversely, 86% of women never cycled at all, compared to 69% of men (NYCDOH, 2010).



Source: Adapted by the authors from data in NYCDOH (2010)

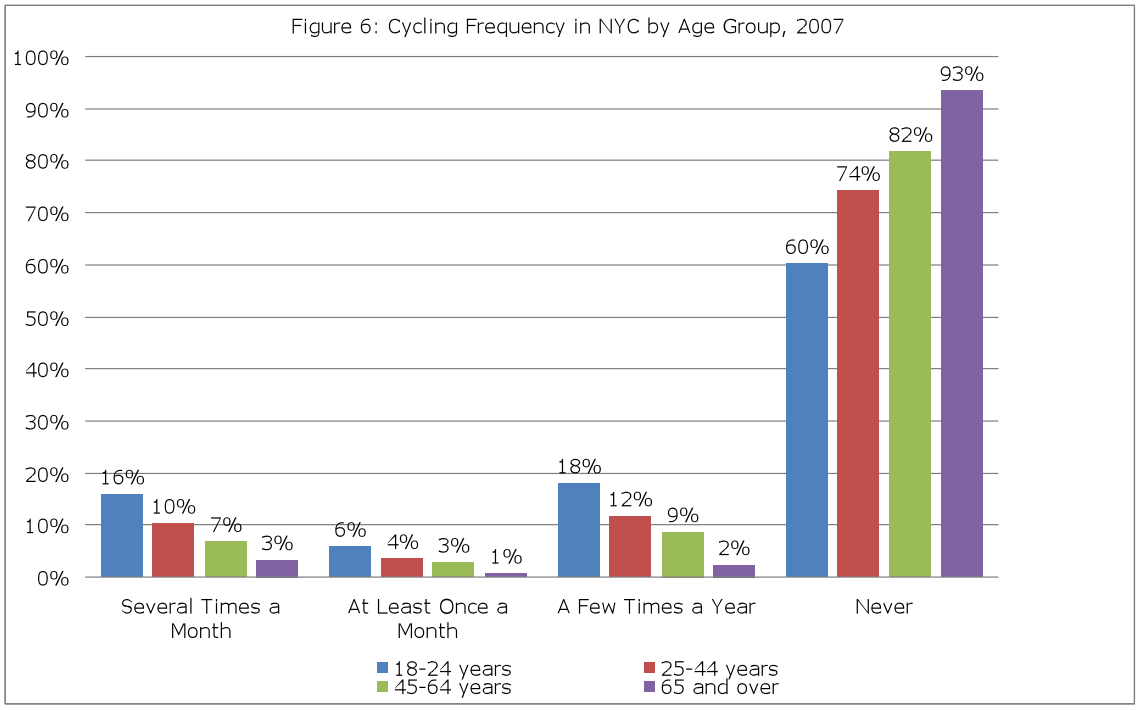
There is considerable variation in women's cycling rates according to the type of cycling facilities that are available. Since 2002, the New York Metropolitan Transportation Council (NYMTC) has conducted an on-going survey of cyclist characteristics at hundreds of sites throughout the five boroughs (NYMTC, 2010). Each surveyed site is designated by NYMTC as either an off-street, multi-use path or an on-street facility. Women in all five boroughs clearly prefer off-street paths. As shown in Figure 5, the average percentage of women cyclists on paths is about three times greater than the percentage of women using on-street facilities such as bike lanes or simply bike routes on shared traffic lanes. The difference is greatest in Staten Island and the Bronx, where the female share of cyclists is roughly four times higher for off-street paths as on streets. Even in Manhattan, Brooklyn, and Queens, the ratio is well over two-to-one.



Source: Calculated by the authors from data in NYMTC (2010)

Although the NYMTC survey does not officially distinguish between different kinds of on-street facilities, the NYMTC website provides several photos of each surveyed site, enabling researchers to determine the specific sort of facility. Upon examination of those photos, we found that most on-street facilities with more than 15% women cyclists were bike lanes and that on-street facilities with the highest share of women cyclists (20% to 25%) were wide bike lanes with diagonally striped buffer zones between the bike lane and the traffic lanes.

In short, the greater the physical separation from motor vehicle traffic, the higher the women's share of cyclists. Several other studies have also found a strong preference of women for physically separated cycling facilities (Garrard et al, 2008; Baker, 2009). That preference might explain the increasing percentage of women bike commuters between 2000 and 2008, when NYC DOT tripled the extent of the bikeway network, as noted later in this article.



Source: Adapted by the authors from data in NYCDOH (2010)

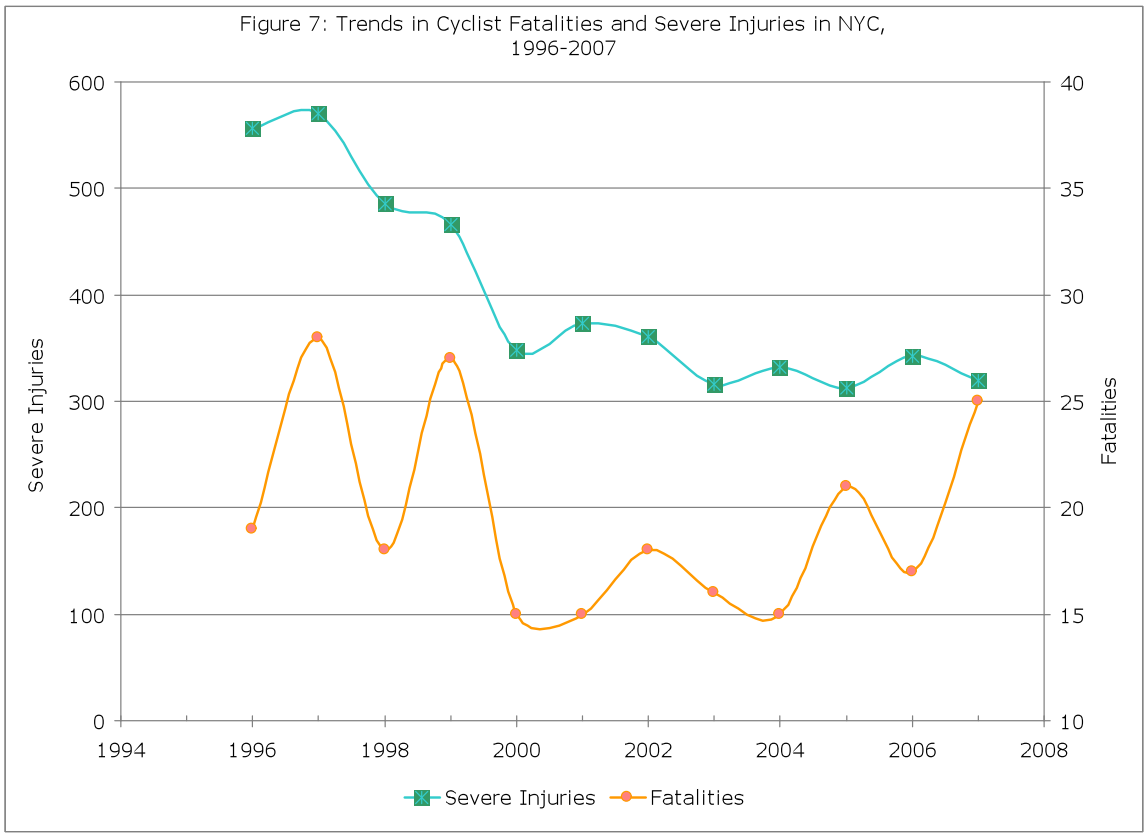
Cycling levels also vary considerably by age. The 2007 DOH survey showed that only 3% of New Yorkers aged 65 or older cycled several times a month, compared to 17% of those aged 18-24 and 10% of those aged 25-44. So clearly, cycling levels fall dramatically with age. Indeed, over 93% of New Yorkers who are 65 or older never cycle at all.

According to the 2007 DOH survey, there was almost no difference in cycling rates by income class: 9.4% frequent cyclists in the lowest income category vs. 9.8% in the highest income category. Immigrants were slightly less likely to be frequent cyclists than US-born residents: 8.4% vs. 9.3%. White, non-Hispanics had the highest percentage of frequent cyclists: 10.7% vs. 9.5% for Hispanics, 6.2% for Black non-Hispanics, and 6.7% for Asians. College graduates were only slightly less likely to be frequent cyclists as those without a high school diploma (9.7% vs. 10.6%). Thus, there are no significant differences in cycling rates by income, ethnicity and race, education, and immigrant status.

Trends in cycling safety

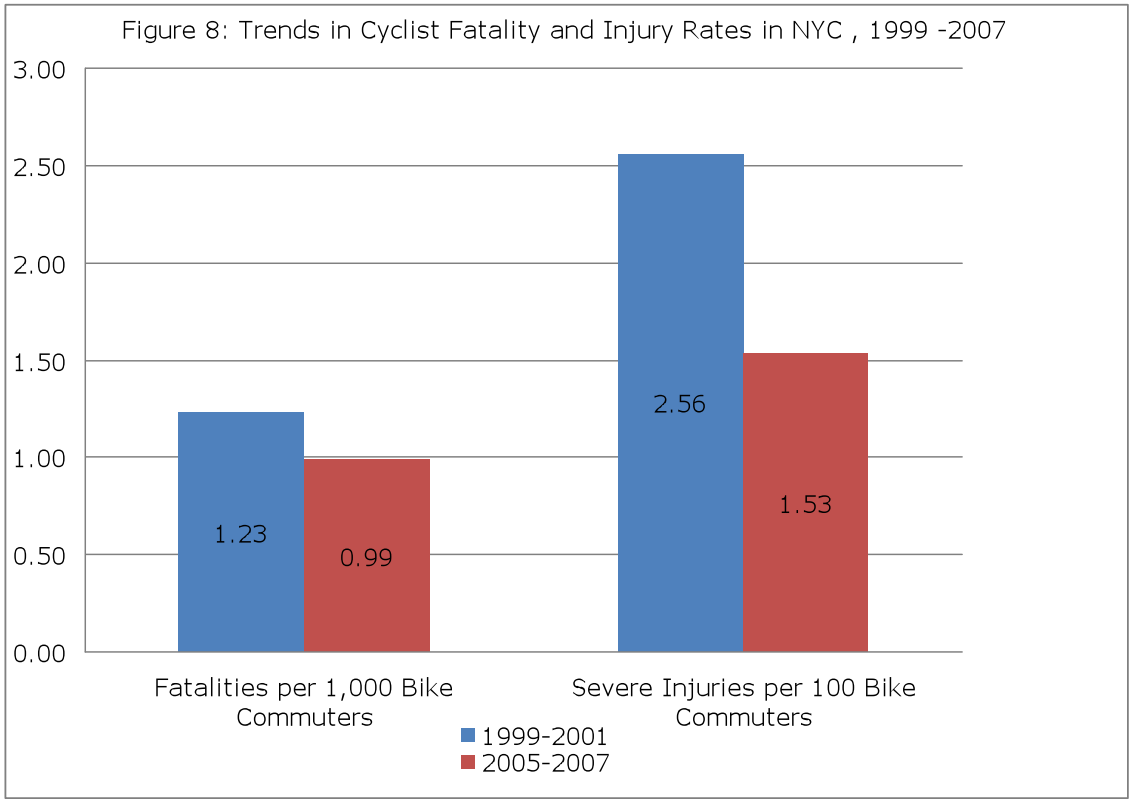
The available statistics from the New York State Division of Motor Vehicles indicate significant improvement in cycling safety in New York since 1996 (NYSDMV, 2010). NYSDMV defines fatalities as deaths that occur within 30 days following injury from a crash. It defines severe injuries as "skull fractures, internal injuries, broken or distorted limbs, unconsciousness, severe lacerations, and unable to leave the scene without assistance." As shown in Figure 7, cyclist fatalities have fluctuated between 15 and 28 from 1996 and 2007, generally declining until 2004 and then rising. Severe cyclist injuries fell by almost half from 1996 to 2003, but have levelled off since then at about 320 per

year. With rising cycling levels since 2000, the number of cyclist fatalities and injuries relative to the number of bike trips has fallen, indicating considerable improvement in cycling safety.



Source: Calculated by the authors from data in NYSDMV (2001-2010)

Figure 8 shows our rough approximations of fatality and injury rates over time, calculated as a percentage of NYC bike commuters reported by the U.S. Census and American Community Survey. Three-year averages are used both for injuries and bike commuters to increase sample size, reduce annual fluctuations, and enhance reliability of the estimated rates. As shown in Figure 8, the fatality rate per 1,000 bike commuters fell by 20% over the six-year period between 1999-2001 and 2005-2007. The severe injury rate per bike commuter fell by 44% over the same period. Ideally, one would calculate these rates relative to total bike trips, including all trip purposes, but data on cycling volumes are only available for work commutation. Whatever their limitations, these rough calculations confirm the impression that cycling has become safer over the past decade. They are also consistent with the findings of an earlier report on bicycling safety produced jointly by four NYC departments.



Sources: Calculated by authors from data in U.S. Census Bureau (2010b, 2010c; NYSDMV, 2001-2010)

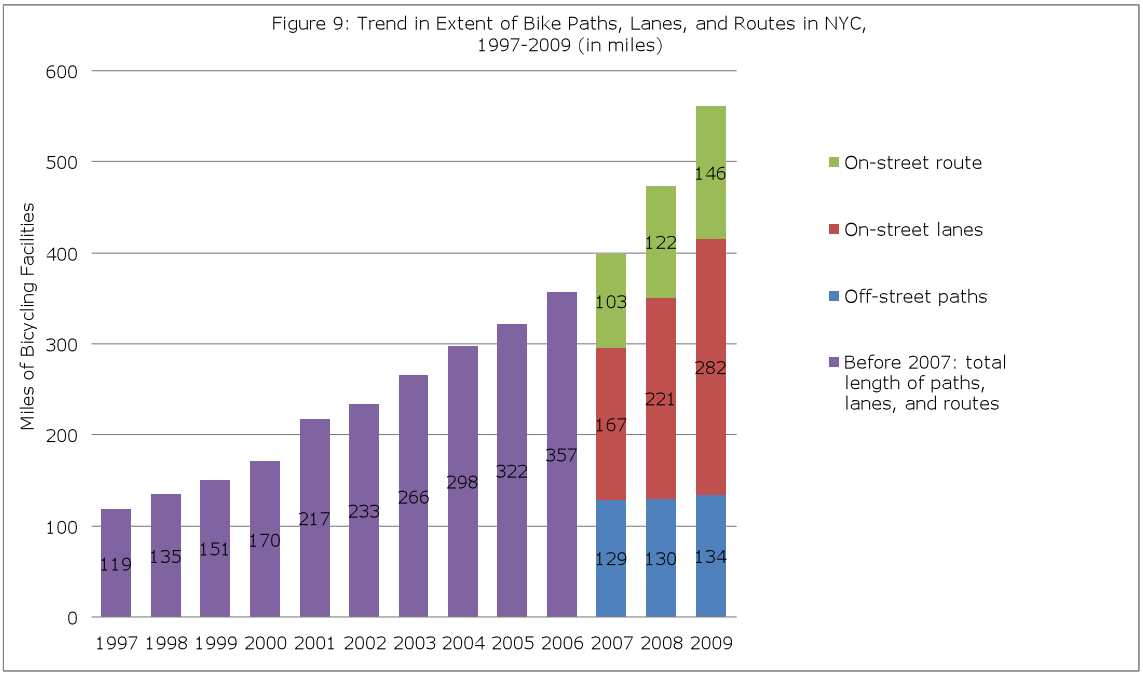
That joint report analysed 225 cyclist fatalities and 3,462 serious cyclist injuries (requiring transport to a hospital) during the period 1996 to 2005 (NYCDOT et al., 2006). It documented roughly constant levels of annual fatalities but a 46% decline in serious injuries. Over 95% of cyclist fatalities and three-fourths of serious injuries involved motor vehicles. Most fatalities (53%) occurred on arterials, although they account for only 10% of streets in NYC. Only one cyclist fatality occurred within a marked bike lane, while the rest were in mixed traffic on roadways, confirming the benefits of separating bikes from motor vehicle traffic, especially on arterials. In addition, 89% of fatalities and 70% of serious injuries were at or near intersections, indicating the need for special treatments there.

As described in more detail later in this paper, New York City has responded to these safety problems by greatly expanding and improving the network of bike lanes and paths and by installing special traffic signals and bike boxes (advance stop lines) for cyclists at some intersections. Most studies show that bike lanes and paths are safer for cyclists, especially on heavily traveled arterials (Fietsberaad, 2010; Netherlands Ministry of Transport, 2007; Pucher and Buehler, 2008, 2010; Pucher et al., 2010). Thus, it seems likely that separate cycling facilities have contributed to improved cyclist safety in New York.

To some extent, however, the improvement in cycling safety might have resulted from increased cycling

itself. Several studies have demonstrated the principle of "safety in numbers" (Elvik, 2009; Jacobsen, 2003; Jacobsen et al., 2009; Robinson, 2005). Using both time-series and cross-sectional data, they find that cycling safety is greater in countries and cities with higher levels of cycling, and that cyclist injury rates fall as levels of cycling increase. As the number of cyclists grows, they become more visible and more normal to motorists, both of which are crucial factors in moderating driver behaviour in ways that reduce dangers to cyclists. Similarly, a higher percentage of motorists are likely to be cyclists themselves, and thus more sensitive to the needs and rights of cyclists. The presence of large numbers of cyclists may also help underpin their legal use of roadways and intersection crossings and generate public and political support for more investment in cycling infrastructure. Obviously, greater cycling safety also encourages more cycling, so causation runs in both directions. All studies agree on the importance of improving traffic safety to encourage more walking and cycling.

Figure 9: Trend in Extent of Bike Paths, Lanes, and Routes in NYC, 1997-2009 (in miles)



Source: Calculated by the authors from data in NYCDOT (2010e)

Expansion of cycling facilities

New York City's efforts to increase cycling and make it safer have focused on expanding and improving cycling facilities such as bike lanes, bike paths, bike boxes, roadway markings, and traffic signals (NYCDCP and NYCDOT, 1997; City of New York, 2007). In 1997, there were 119 miles of bicycling routes in New York, consisting mostly of on-street bike lanes or suggested on-street bike routes without any physical separation from motor vehicles. The bicycling network increased almost 5-fold between 1997 and 2009 (see Figure 9). Of the 561 mile total on July 1, 2009, 134 miles were physically separate facilities such as off-street paths and

traffic-protected, on-street bike paths (cycle tracks); 282 miles were on-street bike lanes; and 146 miles were suggested bike routes without any special provisions. The three categories of facilities offer very different levels of riding comfort and safety.

Figure 10: Separate bike paths such as the Hudson River Greenway facilitate cycling by entire families and are especially important for children

(Source: Transportation Alternatives)

Figure 11: The Hudson River Greenway carries about 4,200 bike trips per weekday and even more on weekends. (Source: Nicholas Klein)

Some of the physically separate facilities are truly first-rate, state-of-the-art bicycling infrastructure. The best and most heavily used facility is the Hudson River Greenway, the initial segments of which opened in 2001. The Greenway is a fully separate, bi-directional bike path along the entire length of Manhattan's western shore, offering not only safety and speed but also scenic views of the Hudson River and the Manhattan skyline. Recreational cyclists as well as daily commuters go out of their way to take advantage of this facility, which averaged 4,200 cyclists per weekday in 2009 (NYCDOT, 2010). Physically separated bike paths are now available on the Brooklyn, Manhattan, Williamsburg, and Queensboro Bridges over the East River. They provide crucial connections between Manhattan and western Brooklyn and Queens, especially for work commuters. The number of bike trips crossing the four bridges more than quadrupled between 2001 and 2009, increasing from 2,473 to 10,995 (NYCDOT, 2010b).

Figure 12: This cycle track along Allen Street leads to the Williamsburg and Manhattan Bridges, as indicated by the green directional signs on the post to the left. (Source: Lewis Thorwaldson)

Figure 13: This bike and pedestrian path on the Williamsburg Bridge is one of four crucial cycling facilities over the East River bridges connecting Brooklyn and Queens to Manhattan. (Source: Transportation Alternatives)

New York has been experimenting with new designs for physically separate facilities, pioneering their introduction in North America. NYC DOT has installed traffic-separated cycle tracks on a few arterial streets. They are similar to on-

street bike lanes but have a physical barrier that protects cyclists from motor vehicle traffic. As of 2010, there was a total of 4.9 miles of cycle tracks along short stretches of seven different streets. The most innovative bicycling infrastructure is in Manhattan: the pair of cycle tracks along nearly mile-long segments of 8th Avenue (northbound) and 9th Avenue (southbound) and on Broadway (southbound) between Central Park (59th St.) and Madison Square (23rd St.). The cycle tracks provide not only physical separation from moving traffic and parked cars but also traffic-signal protection from turning cars. There are also cycle tracks along short portions of Grand and Allen Streets in Manhattan and Tillary and Sands Streets in downtown Brooklyn. The current 4.9 miles of European-style cycle tracks represent less than one percent of the total bicycling network, but NYC DOT has plans to build more in the coming years. For example, DOT has committed funding to install almost 9 miles of cycle tracks on First and Second Avenues in Manhattan in 2010. Most of the other 129 miles of physically separated cycling facilities currently in NYC are bike paths in parks, along waterways, and on bridges.

Figure 14: This cycle track along Allen Street in Manhattan provides safe, convenient, and pleasant cycling, completely separated from motor vehicle traffic. (Source: Nicholas Klein)

Figure 15: The 9th Avenue cycle track in Manhattan is designed to minimize conflicts with left-turning cars, both through lane design and traffic signals. (Source: Lewis Thorwaldson)

Figure 16: Special traffic signals along the 9th Avenue cycle track protect cyclists from left-turning motor vehicles, while pedestrian crossings are facilitated by median islands. (Source: Ralph Buehler)

Figure 17: The Sands Street cycle track in Brooklyn, near the Manhattan Bridge, is bi-directional and offers complete separation from motor vehicle traffic. (Source: Nicholas Klein)

On-street bike lanes make up the bulk of cycling facilities in New York, with more than twice the mileage of separate paths and traffic-protected cycle tracks (282 vs. 134 miles). NYC DOT has not only expanded the total mileage of on-street bike lanes in recent years but also improved their quality. About a tenth of the lane network is now painted bright green to increase visibility to motorists and increase cyclist safety. On some streets, there are buffered bike lanes. Although they do not provide physical barriers from motor vehicles, they offer some additional separation via a diagonally striped lane between the bike and car lanes. The buffer zone varies in design from one location to another and ranges from 2ft to 8ft wide.

Figure 18: The buffered bi-directional bike lane on Kent Avenue in Williamsburg provides some separation from heavy car and truck traffic on this arterial. (Source: Devin Reitsma)

State-of-the-art cycle tracks, bike paths, and better bike lane design have all contributed to the overall improvement in the cycling infrastructure in New York. Nevertheless, serious problems remain. Many on-street bike lanes are only four feet wide and are located immediately adjacent to parked cars, thus subjecting cyclists to the dooring hazard, a major cause of cyclist injuries (NYCDOT et al., 2006). NYC DOT has been gradually redesigning substandard bike lanes to meet the AASHTO five-foot standard for bike lanes next to parked cars, such as on lower Fifth Avenue. Moreover, all new bike lanes now being constructed are five feet wide, and some come with an extra buffer zone between the bike lane and parked cars.

Figure 19: The buffered cycle path on Grand Street in lower Manhattan makes cycling safe enough to take kids along on a ride. (Source: Nicholas Klein)

Figure 20: The diagonally striped buffer zone on the Grand Street bike path enhances cyclist safety by increasing the distance of motor vehicles from cyclists, but it provides no physical barriers. (Source: Nicholas Klein)

Figure 21: This green bike lane on Bleeker Street in Greenwich Village provides much less protection than a buffered bike lane or cycle track, but at least it is clearly marked. (Source: Lewis Thorwaldson)

Figure 22: Many infrastructure modifications have been made at Madison Square to improve the safety and convenience of both cycling and walking. (Source: Nicholas Klein)

Figure 23: Many intersections in New York have markings to guide cyclists through to facilities on the other side, such as here in Manhattan, where Bleeker Street crosses The Bowery. (Source: Lewis Thorwaldson)

Figure 24: Many bike lanes in New York are too narrow and subject cyclists to the dooring hazard because of the proximity to parked cars, as here on 6th Avenue in Manhattan. (Source: Ralph Buehler)

By far the most serious problem with bike lanes is double parking. Blockage of lanes by illegally parked or waiting cars and trucks is common throughout New York City. Rarely can a cyclist ride uninterrupted on a bike lane for long before having to veer off into the car lanes to avoid blockages. A recent Hunter College study of 492 randomly selected street blocks in Manhattan found a 60% probability that a cyclist will encounter a motor vehicle blocking the bike lane over an average stretch of 5 to 6 city blocks (Tuckel and Milczarski, 2009). Swerving in and out of moving traffic is extremely dangerous for cyclists. A report by the NYC Department of City Planning confirmed the severity of the problem (NYCDCP, 2006). There is a bike advocacy website for posting photos, license numbers, and other details of motor vehicles blocking lanes (My Bike Lane, 2010). The NYC Department of Transportation also acknowledges the problem of blocked bike lanes as a justification for building separate cycling facilities such as cycle tracks and bike paths (NYCDOT, 2009c). From our research on bike facilities in other cities in the USA, the problem of bike lane blockages by motor vehicles is worse in NYC than anywhere else in the country.

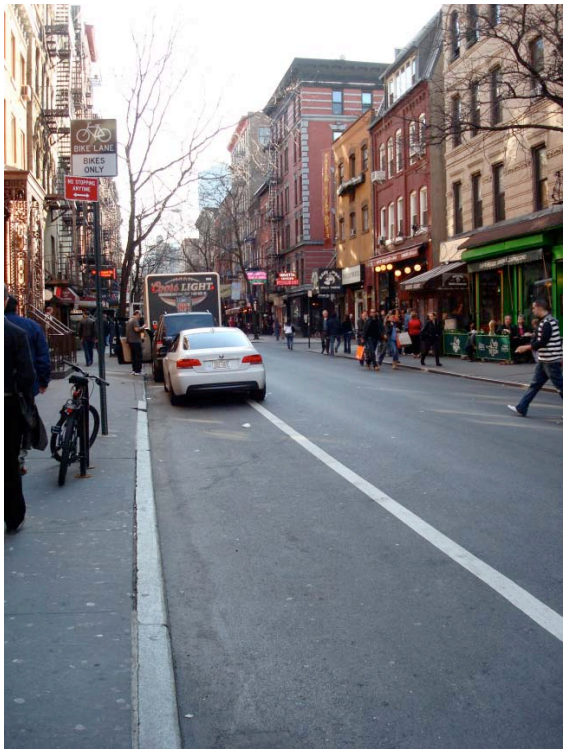


Figure 25: Blockage of bike lanes by motor vehicles is endemic in New York. Here on McDougal Street in Greenwich Village an entire row of motor vehicles is parked on the bike lane, making it totally useless for cyclists. (Source: Lewis Thorwaldson)

Figure 26: Delivery trucks in New York often block bike lanes while unloading, as here on Manhattan Avenue in Greenpoint, Brooklyn. (Source: Devin Reitsman)

Figure 27: Roadway construction, potholes, utility covers, drain grates and otherwise uneven pavement make cycling on some lanes dangerous. (Source: Lewis Thorwaldson)

Figure 28: The frequent blockage of bike lanes by motor vehicles in New York forces cyclists to swerve into traffic lanes, as here on Leonard Street in Greenpoint, Brooklyn. (Source: Lewis Thorwaldson)

Figure 29: Some bike lanes end abruptly, such as this one in Greenpoint, Brooklyn, forcing cyclists into dangerous conflicts with on-coming motor vehicles. (Source: Lewis Thorwaldson)

The third category of cycling facility offered by the city is on-street bike routes. They are usually designated by 'sharrows,' special chevron markings on the street pavement indicating that motorists must share the road with cyclists. Aside from those pavement markings, "share the road" street signs, and bike route directional signs, such on-street bike routes offer no special provisions for cyclists. In many cases, shared lanes with sharrows are NYC DOT's approach to improving cycling conditions on streets without enough room for full bike lanes. Most of these bike routes are on lightly travelled streets, but some are on roads with heavy car and truck traffic, such as First, Second, and Seventh Avenues in Manhattan and Fifth Avenue in Brooklyn. Most of the "sharrowed" lanes are 12 feet wide, but some (as on Seventh Avenue) are only 10 feet wide, generally considered too narrow for safe sharing of lanes by cars and bikes. The sharrow markings offer some route guidance for cyclists and alert motorists to the presence of cyclists, but they provide no physical protection at all from motor vehicles.

Figure 30: Where there is not enough room or cycling volume for a full bike lane, sharrows are used to indicate shared-use lanes, such as here on Greenpoint Avenue in Greenpoint, Brooklyn. (Source: Lewis Thorwaldson)

One important category of cycling facility that is almost completely absent in New York as well as most other U.S. cities is traffic-calmed residential neighbourhoods. The speed limit on all NYC streets is 30mph unless otherwise posted. By comparison, many northern European cities have reduced speed limits to 19mph (30km/hr) on most residential streets. The slower speed is mainly enforced through a wide range of infrastructure measures such as speed humps, raised intersections and crosswalks, bulbouts, median islands, widening of sidewalks and narrowing of streets, artificial dead-ends, chicanes, and special pavement. The strategic placement of bike and car parking as well as planters and street furniture often forces a winding, circuitous, and thus slow route for motor vehicles through such residential neighbourhoods. Not only does such traffic calming slow down traffic, but it discourages through traffic altogether. Many studies have shown that traffic calming dramatically improves pedestrian and cyclist safety and encourages more walking and cycling (Fietsberaad, 2010; Netherlands Ministry of Transport, 2009; Pucher and Dijkstra, 2003; Pucher and Buehler, 2008; Pucher et al., 2010). Apart from largely car-free Roosevelt Island, no residential neighbourhood in New York City is comprehensively traffic-calmed, i.e. in their entirety, as opposed to a few, isolated streets with reduced speed limits or speed humps. Even without any special cycling facilities, traffic-calmed residential streets provide ideal cycling routes, since traffic is light and slow. There is much potential to encourage more cycling as well as walking in New York by traffic calming its residential neighbourhoods.

Figure 31: Most residential neighbourhoods in Germany are traffic calmed, with motor vehicle speed limited to 20mph. Some residential streets are super traffic-calmed to 5mph, such as the street above. Traffic calming turns such streets into ideal cycling routes, with no need for special cycling facilities. By comparison, NYC has no comprehensively traffic calmed residential neighbourhoods. (Sources: City of Freiburg)

Improving intersection design is crucial for reducing bike conflicts with motor vehicles. As noted above, most cyclist fatalities and injuries occur at or near intersections. The main approach to this problem in NYC has been the installation of bike boxes, which are advance stop lines for cyclists, about 10-15 feet ahead of the stop line for cars. Some of the bike boxes are painted the same bright green as the specially marked bike lanes in order to raise visibility and alert motorists to the presence of cyclists. As of 2010, there were 204 bike boxes installed at key intersections, virtually always connected to on-street bike lanes. In addition, there are special pavement markings ('chevrons') at many intersections to alert both motorists and cyclists to the presence of a bike route or lane crossing the intersection.

To complement the expanded network of bicycling facilities, NYC DOT has installed almost a thousand directional signs for cyclists. Every year the NYC Department of City Planning updates its map of the bike route network, clearly indicating the various types of cycling facilities on different routes as well as the location of public bike parking. The printed maps are distributed free of charge and are also available for downloading on both the DOT and DCP websites (NYCDCP, 2010; NYCDOT, 2010c). An interactive, online version of the map was developed by Ride the City for individualized bike route planning and is accessible via the DOT website. Users enter the origin and

destination of the trip, and the bike trip planner indicates the suggested route on the map. Google Maps also shows bike routes in all five NYC boroughs and provides interactive bike route planning (maps.google.com). Improved signage, mapping, and interactive route planning enhance the overall usefulness of the expanded and improved bike network in the city.

Bike parking

New York City has expanded public bike parking over the past 15 years: from only 600 bike racks in 1996 to 6,100 in 2009. Since 2006, NYC DOT's CityRacks program has been installing about a thousand additional racks each year. Nevertheless, the current supply does not match the rapidly growing demand for bike parking. NYC lags far behind cities such as Chicago, Toronto, and Minneapolis, which are far smaller but have much more bike parking than NYC (Alliance for Biking and Walking, 2010; Pucher, 2008; Pucher and Buehler, 2009). Of the fifty largest American cities, NYC has one of the lowest rates of bike parking per capita (Alliance for Biking and Walking, 2010). Moreover, there is almost no secure public bike parking in NYC, let alone full-service bike stations such as those in Chicago, Minneapolis, Toronto, Washington, and San Francisco.

Figure 32: In July 2007, NYC DOT converted 3 car parking spaces into about 30 bicycle parking spaces next to the Bedford Avenue subway station in Williamsburg, Brooklyn. These spaces are usually overflowing with bikes, so that many cyclists have to lock their bikes to posts, parking meters, signs, railings, and fences in the vicinity. (Source: Lewis Thorwaldson)

Figure 33: The CityRacks program has expanded the supply of sidewalk bike parking, but many places suffer from excess demand, such as this rack in Greenpoint, Brooklyn. Theft and vandalism are rampant in many locations. (Source: Devin Reitsma)

New York is moving in the right direction by expanding overall parking supply, mainly through its CityRacks programme (NYCDOT, 2010a). As part of that programme, NYC DOT has installed 20 covered bike rack shelters, holding 8 bikes each. In July 2007, it converted three car parking spaces to bike parking, yielding about ten bike parking spaces for each car parking space, or 30 spaces in total. Those pilot projects are welcome improvements, but their small scale hardly makes a dent in the bike parking needs of a city with over eight million residents who are cycling more each year.

Moreover, the specific placement of the limited supply of bike racks is questionable. For example, scores of racks were installed adjacent to the relatively short 8th and 9th Avenue cycle tracks, but there are virtually no racks located in or near Central Park, a destination for many hundreds of New York City cyclists each day. Similarly, there is almost no bicycle parking at key public transport hubs, such as Grand Central Station, Pennsylvania Station, and the Port Authority Bus Terminal. New York needs much more bike parking, especially sheltered and secure bike parking, located at destinations cyclists most often bike to.

Perhaps the city's most important bike-parking initiative is the revision of zoning and building ordinances to require provision of bike parking or access in private buildings, following the lead of Chicago, San Francisco, Vancouver, and Toronto. In November, 2007, the City Council amended zoning codes to require one bike parking space for every ten car parking spaces up to 200 spaces in new commercial and community facilities

(NYCDCP, 2007). In April, 2009, the City Council adopted an amendment to the zoning code that requires secure bike parking in new and expanded multi-family residential and commercial buildings as well as community facilities (NYCDCP, 2009a). For example, one bike parking space is required for every two residential units in buildings with ten or more tenants. For commercial buildings, one bike parking space is required per 7,500 sq. ft. of floor area for commercial offices and one bike parking space per 10,000 sq.ft. of floor area for retail and most other commercial uses. Moreover, one bike parking space is required per 10 motor vehicle parking spaces in new and most existing public parking garages. Finally, in August 2009, the City Council passed a law requiring commercial building owners to create a bike access plan that allows tenants to bring bikes into buildings, unless there is no cargo elevator available (NYCDCP, 2009b; NYCDOT, 2010d). It also requires commercial garages and lots holding 100 or more vehicles to establish minimum levels of bicycle parking but permits parking fees to be charged. Most private garages have been charging at least $5 per day and up to $15 day, resulting in almost no cyclists parking their bikes there (Goodman, 2010).

Bike-transit integration

With 55% of all work trips by public transport, New York City has, by far, the highest transit mode share of any city in North America. Thus, one might expect substantial coordination of bicycling with public transport. In fact, New York's transit systems have done little to promote bike-transit integration (Pucher and Buehler, 2009). The Metropolitan Transportation Authority (MTA) does not provide bike parking of any kind at the city's 467 subway stations, so the only option for cyclists is to park on nearby sidewalks, such as the CityRacks that NYC DOT has installed near some subway stations. By comparison, the Chicago and San Francisco transit systems each provide over 6,000 bike parking spaces at their rail stations, including sheltered, indoor parking.

Compounding the problem of insufficient bike parking at subway stations, there is no secure bike parking at any public transport terminals in NYC. Train, bus, and ferry terminals do not offer bike lockers, bike stations, or guarded bike parking. There are a few bike racks on sidewalks near some public transport terminals, but there is no parking available within the terminals themselves. The supply of nearby sidewalk racks is so limited that many cyclists resort to locking their bikes to traffic signposts, lampposts, or other stationary objects within a few blocks of the stations. The lack of secure bike parking is a serious problem. Bike theft and vandalism in New York City are rampant, discouraging cyclists from leaving their bikes parked for a long time anywhere.

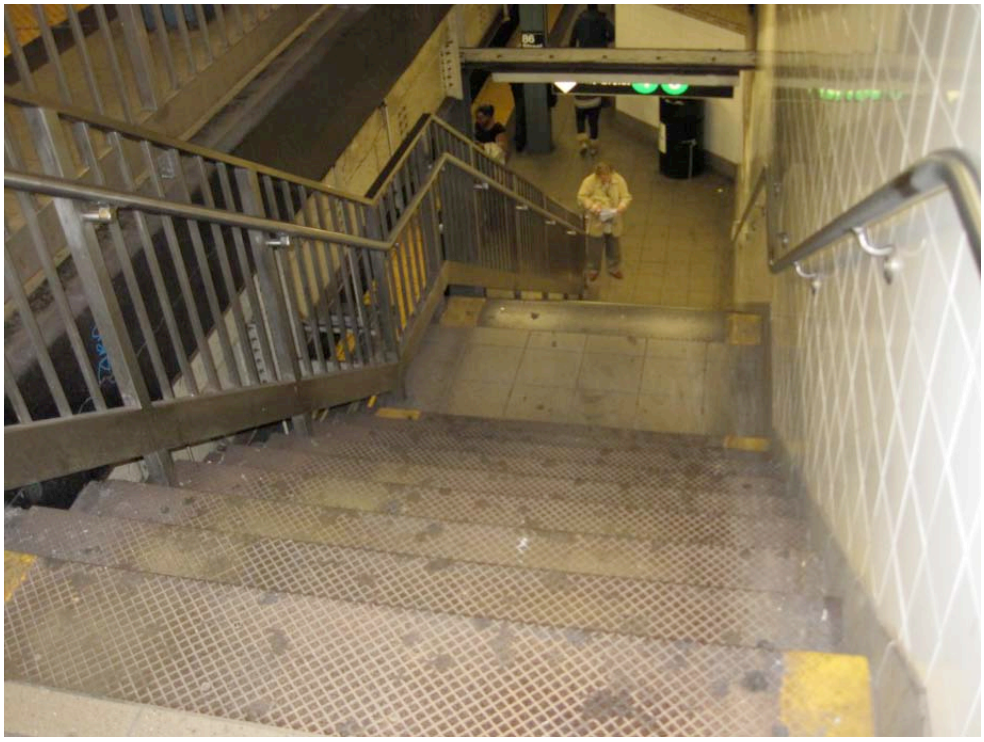


Figure 34: Only 16% of New York City subway stations have elevators, and cyclists are prohibited from using escalators. Thus, cyclists must carry their bikes up and down long flights of stairs such as at this subway station in Manhattan. That discourages the integration of cycling with public transport in New York. (Source: Alan Rotenberg)

NYC subways are unique among American public transit systems in permitting bikes on board trains at all times, but it is difficult to get bikes to the train platforms. Only 16 percent of New York's subway stations are ADA accessible via elevators or ramps. At the remaining 84 percent of stations, cyclists must carry their bikes up and down long flights of stairs, as they are prohibited from using escalators in stations where they are available. Bikes are allowed on the MTA's two suburban railroads (MNR and LIRR) except during peak hours in the peak direction, but cyclists must register in advance and purchase $5 lifetime permits. Folding bikes are allowed at all times.

Figure 35: None of NYC MTA's 5,929 buses has a bike rack, and non-folding bicycles are not allowed on board. Bus-bike integration is virtually non-existent in New York. (Source: Lewis Thorwaldson)

Figure 36: These bike racks outside of Pennsylvania Station hardly come close to meeting the bike parking needs at New York's main train terminal, which has no secure bike parking at all. (Source: Lewis Thorwaldson)

Figure 37: The lack of good bike parking at New York's public transport terminals and subway stations forces cyclists to improvise by locking their bikes to any stationary object. (Source: Lewis Thorwaldson)

Bike-bus integration is almost non-existent in New York City. Not a single bus in the MTA's fleet of 5,929 buses has a bike rack. That contrasts sharply with other American cities, which average three-fourths of their buses equipped with bike racks. In nearby New Jersey, by comparison, over half of all buses were equipped with bike racks in 2010, and by 2014, 95% of buses will have racks. Only since spring 2008 have folding bikes been allowed on most MTA buses, while most other cities allowed this years earlier.

As shown in two recent surveys, bike-transit integration in New York City is worse than in any other large city in the country (Pucher and Buehler, 2009; Alliance for Biking and Walking, 2010). It is one of the key shortcomings in New York's overall programme to encourage cycling.

Traffic law enforcement and role of police

The impressive accomplishments of NYC DOT in expanding and improving cycling facilities in New York have been seriously undermined by the failure of the NYC Police Department to enforce the many traffic laws intended to protect cyclists. The problem of motor vehicles regularly blocking bike lanes is just one example of the police ignoring the needs of cyclists (Tuckel and Milczarski, 2009a). Many cyclists interviewed in the NYC Department of City Planning's "State of Cycling" report criticised the police for not keeping bike lanes clear (NYC DCP, 2006). A more general concern was that the NYPD "aggressively ignores helping cyclists" (NYCDCP, 2006, pg. 12). Similarly, the police were criticised for being "extremely hostile and antagonistic toward bicyclists" (NYCDCP, 2006, pg. 12) and for "police mistreatment, harassment, no response to bike theft,

and no support of injured and attacked cyclists" (NYCDCP, 2006, pg. 13).

Both the NYPD and the courts have consistently neglected their responsibility to protect cyclists (NYCDCP, 2006). Most important, they have refused to issue summonses and impose serious penalties on motorists who endanger, injure or kill cyclists, even when the motorists are unquestionably at fault. One study analysed 1,020 pedestrian and cyclist fatalities in New York City from 1994 to 1997 (Komanoff, 1999). 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 strictly, largely, or partly culpable in 90% of the cases." Yet 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 the fatal crashes did the police issue summonses to motorists specifically for violations of pedestrian or cyclist rights of way, such as failing to yield in crosswalks or driving in bike lanes (Komanoff, 1999). In a related study of 71 cyclist fatalities in NYC over the four-year period 1995-1998, Komanoff and Smith (2000) determined that driver misconduct was the principal cause in 66% of fatal crashes and a contributing factor in 85% of crashes. That contrasts sharply with the NYPD's claim that three-fourths of cyclist fatalities are solely the fault of cyclists (Komanoff and Smith, 2000).

Clearly, the NY Police Department is not enforcing the many laws specifically protecting the rights of cyclists to ride on the roadway and requiring motorists to avoid endangering cyclists. The New York State Vehicle and Traffic Law, Title VII, Article 34, Section 1231, states that "Every person riding a bicycle upon a roadway shall be granted all of the rights and shall be subject to all of the duties applicable to the driver of a vehicle." In addition, Sections 1122, 1129, and 1146 of the same law protect cyclists from unsafe passing, tailgating and lack of due care by drivers. Sections 1146 and 1180(a) require motorists to exercise due care to avoid striking cyclists and to drive at speeds that are reasonable and prudent under the conditions in light of actual and potential hazards.

Compounding their failure to punish motorist endangerment of cyclists, the NYPD and courts do little to ensure that cyclists obey traffic laws, resulting in dangerously illegal cycling. A Hunter College study analysanaed the riding behaviour of 5,275 cyclists at 45 intersections in Midtown Manhattan, between 1st and 10th Avenues east-west and between 14th Street and 59th Street north-south (Tuckel and Milczarski, 2009b). Conducted from April 2-29, 2009, the study found that over a third of cyclists (37%) did not stop for red lights at all, while 29% of cyclists paused briefly and continued through the intersection while the light was still red. Only a third of cyclists (34%) actually came to a full stop and proceeded only when the light turned green. Running red lights without even stopping is even more frequent during the evening (50%) than during daylight hours (35%).

In summary, the police and courts in New York have contributed to an environment of lawlessness and rampant violations of traffic regulations by both motorists and cyclists. Individual motorists and cyclists should be held responsible for their actions, but police inaction has unquestionably encouraged and enabled their dangerous behaviour.

Education and training

One important reason for the dangerous driving and cycling habits of New Yorkers is the lack of comprehensive, rigorous education and training in safe driving and cycling. As discussed in detail elsewhere, driver training and testing for a motor vehicle driver's license in the USA is far less rigorous than in northern Europe and pays much less attention to the need for motorists to avoid endangering non-motorists such as cyclists (Netherlands Ministry of Transport, 2009; Pucher and Dijkstra, 2000). Only a tiny percentage of schoolchildren in the USA receive training in safe cycling, and that is true in New York City as well. Few NYC schools offer bicycling education, and it is not compulsory in any school. By comparison, virtually all German, Dutch, and Danish schoolchildren receive comprehensive education and training in their schools by the 3rd or 4th grades, usually including on-the-road training and testing by police officers (Pucher and Dijkstra, 2000; Pucher and Buehler, 2008).

In response to the government failure to provide cycling education, various non-governmental organisations have developed voluntary programmes. The non-profit group Bike New York has been offering an increasing number of cycling training courses for both children and adults. The courses cover a wide range of skill levels, from beginner to advanced rider training. They include commuter cycling skills, bike maintenance, and bike rodeos that teach bike handling skills, road skills, helmet fitting, and bike safety inspections (Bike New York, 2009). The organisation also offers train-the-trainer programmes which teach how to conduct basic riding courses and bike rodeos and provide training for League of American Bicyclists Cycling Instructor certification. Bike New York's training efforts are still modest in scope but have been increasing in recent years, quadrupling from 2,129 students and 247 trainees in 2008 to 8,979 students and 438 trainees in 2009. The New York Cycle Club offers a 10-week training programme in effective cycling called the Special Interest Group (SIG), which reaches hundreds of riders at various skill levels.

Transportation Alternatives, a walking and cycling advocacy organisation, has also promoted cycling safety since the 1980s by publishing safety tips in their regular newsletters and on their website. In 2003, it launched a "Give Respect, Get Respect" campaign to convince cyclists to refrain from the most common forms of illegal cycling. Notably, the campaign was multi-lingual, seeking to educate the Spanish- and Chinese-speaking bicycle delivery workforce. In 2008, Transportation Alternatives launched a broad education and encouragement campaign called "Biking Rules!" This programme includes an interactive website (bikingrules.org) and a cycling safety brochure, "Biking Rules: A New Streetcode for NYC Cyclists," which is

freely available on the TA website (Transportation Alternatives, 2010).

Finally, the NYC Bicycle Safety Coalition recently began the LOOK campaign, which aims to educate the public about bike safety and encourages sharing the road (NYCDOT, 2010f). Their ads appear on buses, taxis, bus stop shelters, phone kiosks, posters, and postcards. In June 2009, the Coalition aired ads on television showing injured cyclists being taken to the hospital as a reminder to drivers to watch out for cyclists and avoid endangering them.

These nongovernmental, non-profit programmes to improve cyclist and motorist behaviour in NYC are laudable, but they are no substitute for mandatory, comprehensive training of both motorists and cyclists, as in northern Europe, which reaches everyone and not just a handful who volunteer for special courses. Another programme New York might consider is Cycling Ambassadors, which sends cycling trainers out into the neighbourhoods throughout the city to teach safe cycling skills, give talks promoting cycling, and distribute free helmets and information such as maps and safety guidelines. Chicago, Toronto, and Minneapolis have extensive cycling ambassador programmes, which have been very successful at promoting interest in cycling, especially among children.

Promotional events and media coverage

New York City offers a range of bike events. The largest ride is the Five Borough Bike Tour in early May, which is organized by Bike New York and attracts over 30,000 riders. About 6,000 cyclists participate in the New York Century Ride, organized by Transportation Alternatives (TA) and held every September. Other TA rides include the Tour de Brooklyn (2,000 riders), Tour de Bronx (4,000 riders), and Tour de Queens (1,000 riders). The Five Borough Bicycling Club sponsors the Montauk Century Ride (1,000 riders) and numerous smaller rides. The New York Cycle Club and Times Up offer many group rides. There are also various fund-raising rides, such as the annual Multiple-Sclerosis ride in early October, which draws about 2,000 riders.

Figure 38: Summer Streets in 2008 and 2009 attracted over 100,000 people to the 5 miles of Park Avenue that were closed down for three consecutive Saturdays in August. (Source: John Pucher)

The City of New York itself has been sponsoring an increasing number of car-free events, such as Summer Streets, when Park Avenue is closed to motor vehicle traffic on three Saturdays in August (NYCDOT, 2009d). In both 2008 and 2009, over 100,000 pedestrians and cyclists turned out to take advantage of the chance to ride and walk up and down Park Avenue. In addition, there are dozens of street festivals throughout the city where roads are closed to motor vehicle traffic, but most of them are intended for pedestrian use and are so crowded that cycling would be virtually impossible.

NYC DOT has vigorously advertised its accomplishments to garner support for its pro-bike policies. Thanks to its commissioner, who has a background in public relations and communications, DOT employs a full range of electronic outreach media, including its own comprehensive, multi-faceted website. It also promotes its policies and accomplishments via television clips, press releases, newspaper articles, website links, blogs and social media platforms (NYCDOT, 2010e). DOT has sent its staff to make presentations at hundreds of community meetings, professional conferences, and transport forums around the world to publicize its efforts to promote cycling and to tout NYC as the "nation's bicycling capital." The public relations effort has been extraordinarily successful, resulting in newspaper articles in Australia, Canada, and Europe portraying New York as a veritable bicycling paradise and even suggesting that NYC is worth a visit to enjoy the unique experience of cycling in America's most urban environment.

NYC DOT has orchestrated a masterful public relations campaign to generate political and public support for its pro-bike policies and programmes. The massive expansion of cycling facilities in NYC is an impressive political feat considering that less than one percent of trips in New York are by bike. Effective communications through the media has been a key strategy of NYC DOT to promote its policies to increase bicycling. These sorts of public relations efforts are crucial for the implementation of the many policies and programmes required to make cycling safer, more convenient, and more pleasant.

Conclusions and Policy Recommendations

Upon completion of over 200 miles of new bicycling facilities between 2006 and 2009, the City of New York officially declared itself to be the "bicycling capital of the nation" (NYCDOT, 2009a). Yet according to the American Community Survey of the U.S. Census, the bike share of work commuters in 2008 was only a tenth as high in New York City as in Portland, Oregon (0.6% vs. 6.0%) and a fourth as high as Washington, DC (2.3%) (U.S. Census Bureau, 2010). Growth in New York's cycling has been spatially concentrated in the Manhattan CBD and north-western Brooklyn. Even those most bike-oriented parts of NYC have only 1.8%-2.3% of their workers commuting by bike, only a third as high as the 6.0% bike share for the entire City of Portland.

If one bases New York's ranking on overall cycling policies and conditions, in addition to actual cycling levels, it is obvious that New York City is not #1. The League of American Bicyclists designates New York with the lowest of four levels of cycling status—bronze—compared to 36 cities with silver, gold, and platinum status (LAB, 2010). Bicycling Magazine designated Minneapolis, Portland, Seattle, and Boulder as the best cities for bicycling in 2010, and rated New York City as one of the most improved cities for cycling, together with Albuquerque, Long Beach, Cleveland, and Miami (Bicycling Magazine, 2010). The bold claim by NYC DOT that New York is already the "nation's bicycling capital" probably reflects New York boosterism in general as well as DOT's ambitious goals for rapidly improving cycling conditions and raising cycling levels. New York may someday become the best cycling city in America, but is does not yet deserve that status.

As noted previously, the NYCDOT screenline counts overstate cycling levels by focusing only on the Manhattan CBD, which has the highest bike rates in the city. The decennial U.S. Census and annual American Community Survey understate cycling levels since they only report journeys to work and thus exclude bike trips for all other purposes. The lack of consistent, comprehensive information on cycling trends highlights the need for New York to implement a regular travel survey that comprises the entire city. Portland, Oregon, for example, conducts an annual survey which provides a representative indicator of cycling levels over time and across each of the different parts of the city (City of Portland, 2009). Such a survey would provide useful information for planning new cycling facilities in all parts of NYC, responding to the different needs of

different neighbourhoods. It would also help gauge the changing demand for cycling facilities over time due to evolving demographic and economic trends.

In spite of data limitations, it is clear that New York has made impressive progress at improving cycling conditions and raising cycling levels in recent years. The number of bike trips has almost doubled since 2000, thanks to vastly expanded cycling infrastructure, including innovative treatments such as cycle tracks, buffered bike lanes, special bike signals, bike boxes at intersections, and bright green lane markings. Similarly, the supply of bike parking has risen 10-fold over the past decade. Current NYC DOT plans call for continued expansion and improvement of cycling infrastructure in the coming years.

So far, the best cycling facilities have been limited to Manhattan and north-western Brooklyn. That is understandable, since it is crucial to establish a successful core bicycling network that is well used and generates public and political support for further expansion. As a matter of social justice and geographic equity, however, attention should be paid to other parts of the city as well. That will provide an increasingly integrated and comprehensive system of bikeways as the mileage of routes grows toward the official NYC DOT goal of 1,800 miles of bike paths, lanes, and routes by 2030 (City of New York, 2007; NYC DOT, 2010a).

Of course, there is still much to be done. The biggest obstacle to raising cycling levels in New York City is heavy car and truck traffic, which makes cycling stressful, unpleasant, and unsafe. There are several ways that European cities have dealt with this problem: reducing overall motor vehicle speeds, removing car parking, traffic calming residential neighbourhood streets, and providing physically separated bike lanes and paths along arterials.

NYC DOT's increasing focus on pedestrian and cyclist needs is a welcome turnaround from the priority given to motor vehicle traffic in previous decades. For example, DOT has also been implementing "road diets" in a few locations to reduce traffic volumes and speeds (NYCDOT, 2010e). That has generally involved the narrowing of roads by transferring some street space from cars to bikes and pedestrians: by creating bike lanes and diagonally striped buffer lanes; by widening pedestrian malls, refuge islands, and sidewalks; and by installing planters, mini-parks, and plazas. Unfortunately, DOT has implemented those sorts of innovative road diets on only a tiny percentage of the city's vast roadway network. For the city as a whole, much more needs to be done to lower the overall speed limit, reduce car parking, and traffic calm neighbourhoods. Most bike trips in New York still require cycling on traffic lanes with motor vehicles or on unprotected bike lanes, which are often blocked by motor vehicles.

The NYC Police Department has been one of the biggest obstacles to increased cycling. If the NYPD wanted to, it could immediately enforce rules against motor vehicles in bike lanes and vastly improve

cycling conditions in New York overnight. It could also introduce a policy of zero tolerance of motorists who endanger, injure, or kill cyclists, which would greatly enhance cycling safety and encourage more cycling. NYC DOT already plans to further expand its system of cycling infrastructure, but that will take time and might be slowed down by the current fiscal crisis of both the City and State of New York. By comparison, strict enforcement of laws to protect cyclists could start immediately and produce quick and dramatic results.

Another important strategy to facilitate more and safer cycling in New York would be to reduce the supply of on-street car parking by converting it to bike lanes. That would mitigate the dooring problem as well as the conflict between cyclists and motor vehicles waiting for parking spaces or manoeuvring into or out of them. All studies show that the availability and low cost of on-street parking encourage more driving, more air pollution, more congestion, and more energy use (Shoup, 2005).

There are many ways to improve the integration of bicycling with NYC's vast public transit system. Secure, sheltered parking is needed at the city's hundreds of rail stations and especially at major bus, rail, and ferry terminals, where full-service, high-capacity bike stations are the obvious solution. Bike racks should be installed at least on express buses and routes serving outlying portions of the city, where transit stops are farther away from residences and more likely to be beyond walking distance than in the city centre.

In short, there are many ways to improve cycling conditions in New York and thus encourage yet further growth in cycling. New York has come a long way over the past decade, but it still has a long way to go before it can legitimately claim to be the nation's bicycling capital.

Acknowledgements

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Youth transport, mobility and security in sub-Saharan Africa: the gendered journey to school

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Introduction

This paper examines the gendered journey to school in sub-Saharan Africa. Gender differences in school enrolment and attendance in Africa are well established: education statistics in many countries indicate that girls' participation in formal education is often substantially lower than boys', especially at secondary school level. Transport and mobility issues commonly form an important component of this story, though the precise patterning of the transportation and mobility constraints experienced by girl schoolchildren, and the ways in which transport factors interact with other constraints, varies from region to region. On the basis of a large set of empirical data we have gathered in a research project on children's mobility in Ghana, Malawi and South Africa, our aim in the paper is to explore the diversity of gendered travel experiences across geographical locations, paying attention to associated patterns of transport provision. Our research covers 24 urban and rural sites across Africa. Issues of security form a key theme in some of the locations where we collected data, especially where girls are concerned: they may face a very real threat of rape. In other cases girls' journeys to school and school attendance are hampered by Africa's transport gap and cultural conventions which require females to take on this burden (by pedestrian head loading) and other work before leaving for (or instead of attending) school. There is insufficient room in this paper to examine in depth the role that girls' household duties associated with Africa's transport gap plays in shaping gendered patterns of travel to school, but it is important to note its presence and contextual significance for the daily travel patterns described below.

Following a short review of background literature and methods we present and comment on the comparative survey data for the locations in which we worked. We examine the implications of our findings for gendered patterns of access to education, and suggest areas where policy intervention could be beneficial.

Background

Primary education enrolment figures have been boosted substantially across sub-Saharan Africa by the emphasis on 'free' universal primary education in the Millennium Development Goals [MDGs] but attendance figures often remain substantially below enrolment. Children's time spent at school has to be balanced against the opportunity costs of its

alternative use in contribution to household production and reproduction. Additionally, although fees have been abolished, parents are still expected to fund other items such as uniform, books, furniture, Parent Teacher Association etc. Other potential constraints include poor school quality and lack of access to credit, though these vary in importance between urban and rural areas (Ersado 2005). The significance of the time, effort and/or costs of transport incurred in getting to school has been little considered in the literature.

Once children have completed primary school or junior secondary school [where this latter middle stage occurs], a move to [senior] secondary education may be contemplated but is often not achieved. The barriers to enrolment are more substantial at this level since fees are imposed. Additionally, secondary schools are fewer in number than primaries and tend to be located in major service centres (Porter 2007). Consequently, in addition to fees and related school-based costs (uniform, books, PTA etc), there are likely to be substantial travel costs, a very long daily walk or costs of accommodation at or close to the school. In remoter rural areas even primary school enrolment and attendance may be affected by travel distance, since schools cannot normally be provided in every settlement, but at secondary level the barriers imposed by distance are usually much increased.

Studies directly concerned with travel to school in Africa are rare, especially outside of South Africa. Early work in Uganda (Gould 1973) showed how poor transport services forced most children to walk to primary school; secondary school children usually had to live away from home due to the distances involved. This situation is still common across Africa. In Ghana, Avotri et al. (1999) found that the closer the secondary school, the more likely it is that children will be sent to primary school, because continuity of the child's education is feasible. Their work also shows (pp. 94-5, 165) how long walks to school due to lack of or high cost of transport and associated lateness problems encourage late 'over-age' enrolment (especially of girls), truancy and early drop out. In South Africa, a number of studies indicate the scale of the travel to school problem. A 1998 survey of rural KwaZulu Natal schools found that 75% of secondary school walkers walked over 3 kms to school, while 43% of primary school walkers walked over 3kms: at least 280,000 children in this region walked for over 1 hour, one way to school. An associated survey of school principals found 60% of pupils were often late, 58% sometimes absent and 70% of pupils were often tired at school, due to long walking distances to reach school each day (Mahapa 2003). The 2003 South Africa National Household Travel Survey adds further support to this picture: seventy-six percent of 'learners' were reported to walk to their educational destination and almost 3 million out of the 16 million total (especially those located in more rural provinces) spent more than an hour a day walking to and from educational institutions (RSA Department of Transport 2005). Long journeys to school, when coupled with required contributions to household labour demands, are likely to impact strongly on

attendance. However, Filmer (2007) suggests from his analysis of data for rural areas of 21 poor countries (including some of the poorest in Africa) that simply building schools will not bring large increases in school participation rates: a combination of interventions may often be essential to improved participation.

Children's school attendance and performance is further impeded by the widespread household transport gap, notably lack of piped water and electricity for cooking. Girls, in particular, are often required to carry water, wood fuel and other loads, as well as performing their other household duties, both before and after school. This delays the time when they leave home in the morning and not only increasing the likelihood of late arrival at school (with consequent punishment from their teachers), but also leaving them exhausted during lesson time. Poor roads, unreliable, costly or non-existent transport services may add further to their problems on the journey to school.

In some countries the school transport situation is further complicated by the substantial expansion of private education. Perceived deficiencies in the quality of education provided in state schools may persuade even relatively poor families to send their children to a more distant private school rather than the local state school. As Lewin and Sayed (2005) observe, the limited availability of places at state secondary schools for the growing numbers of children graduating from the free primary education promoted by the MDG priorities may also be encouraging this trend.

Since girls' school enrolment rates are considerably lower than boys' across much of sub-Saharan Africa, transport impacts on girls' education are of particular interest. Low enrolment and attendance among girls are in part related to their particularly heavy household duties, but also associated with cultural perceptions regarding the (limited) value of girls' education, and perceived dangers for girls who have to travel a long distance to school or board away from home. A study in Niger using DHS surveys indicates that there are only 41 girls per 100 boys at school in rural areas, compared to 80:100 in town and that distance of home from school is a key factor (UK Department for International Development 2001:7). Improvements to road access and transport availability can probably make a significant impact on girls' attendance in some contexts, as research in Morocco indicates (Khandker et al. 1994, Levy and Voyadzis 1996, cited by African Union et al. 2005).

Methodology

This paper draws on a survey of approximately 1,000 children aged 7-18 in each of our research countries [n=2967]. In the discussion, we compare statistics from the quantitative survey for four locational types in each country:

1. Remote rural with no school and few, if any, basic services. Poor access along unpaved road with very limited or no transport services (RR in the tables which follow).

2. Rural with services i.e. with at least a primary school and some kind of health service, if only as an occasional visiting facility. Poor access along unpaved road with some (fairly limited) transport services (RS)
3. Peri-urban or small town within daily reach of an urban centre, with some residents travelling daily into the urban centre (PU)
4. Poor, high density urban neighbourhoods (U).

Each category includes two sites per country from different agro-ecological zones.

A random sample of approximately 125 children per settlement was obtained [see www.dur.ac.uk/child.mobility for details]. The parent/carer was asked to give some basic information about the selected child. The subsequent interview with the child was conducted wherever possible out of hearing (though within sight) of the parent and other family members. The survey was preceded and accompanied by substantial qualitative research not only by academic researchers but also by 70 child researchers who interviewed their peers, made photo diaries, etc. The child and adult qualitative research has played a crucial role in shaping the survey design, specific questions and our interpretation of findings.

Findings

1. Gender and schooling

The vast majority of the children and young people we interviewed in our survey were enrolled in school, which suggests an encouraging trend, probably at least in part a reflection of efforts associated with the MDGs. Gender patterns of enrolment were as one might expect for Ghana [82.4% of girls enrolled, compared to 92.6% of boys across the full country sample of children] and South Africa [90.3% of girls compared to 95.4% of boys], but in Malawi, where overall enrolment figures in rural areas are lower than in Ghana and South Africa, we found a smaller proportion of boys enrolled than girls among our total Malawi sample [82.2 % girls compared to 74.2% of boys]. However, it is probably more useful to focus on enrolment of children between the ages of 9 and 15 years, rather than our total sample when looking at enrolment statistics, since it is common for younger children to be enrolled fairly late, especially in remoter areas, while children over 15 are beyond the age of compulsory education. A breakdown of this data for 9-15 year olds, by settlement type, provides useful detail:

Percentage of children aged between 9 and 15 years (inclusive) enrolled in school [n=2180]

	South Africa	Ghana	Malawi
RR	F=96.3% M=98.7	F=88.9% M=90.7	F=75.8%* M=58.5
RS	F=98.9 M=98.7	F=90.4 M=95.8	F=76.9 M=87.6
PU	F=98.8 M=100.0	F=89.5* M=97.1	F=90.8 M=89.2
U	F=95.0 M=98.2	F=94.9 M=93.3	F=96.6 M=93.3

* P (Chi-square)= <0.05 F=female M=male

Overall, it would appear that enrolment is directly linked to settlement accessibility only in Malawi, where both for girls and for boys there is a clear pattern of increased enrolment from remote rural to urban settlement types. The significantly higher figures for girls than for boys in Malawi Remote Rural settlements can be related to the fact that some boys are involved in herding, charcoal burning and other livelihood activities in remoter rural areas. In rural Ghana and South Africa, enrolment figures are substantially higher than in Malawi. Overall, in both these countries there is less distinction in accessibility terms than in Malawi. In Ghana girls' enrolment is significantly lower than boys in the peri-urban locations surveyed, perhaps because this is the settlement type where girls contribution to retail and other work for households engaged in a nearby urban economy is highest.

School attendance figures are actually much more important than enrolment figures in terms of children's access to education: we encountered very many children who are enrolled but spend many days out of school. Unfortunately, we are not able to satisfactorily compare attendance data for the last week across all 3 countries because in some locations, particularly in South Africa and Malawi, the survey had to be conducted during the school holidays.

2. Travel to and from school

Travel patterns to and from school by gender: attending the nearest school

In all the following discussion we focus on all children in the survey who travel to school (i.e. not only those between 9 and 15 years). The vast majority (95% or over) of both boy and girls children interviewed in our survey travel daily to school in all three countries. The majority interviewed also attend the school (relevant to their educational level) closest to home, but there are important distinctions according to location in Ghana and Malawi where both boys and girls were particularly likely to attend the closest school in rural settlements with services [RS]. This is because such settlements all have at least primary and

usually also JSS provision, and are sufficiently far from other centres to disincline parents from choosing to send their children to a school elsewhere, since this is likely to involve substantial travel costs. The picture is less clear in South Africa. In all three countries, but especially Ghana, urban children are less likely than others to attend the nearest school: there are opportunities to select other schools which, although not the nearest for their particular level, are clearly within reasonable travel distance, and can usually be reached on foot. They are selected for a variety of reasons including factors such as family members having attended the school, religion, proximity to the family business, or government allocation (in the case of secondary school). Urban figures regarding attendance at the nearest school are highest in Malawi, presumably because this is the poorest, least developed of the three countries, and thus pressures to educate as close to home as possible and at minimum cost are highest, even in urban areas.

Gender distinctions in each country regarding attendance at school closest to home are relatively small in urban areas [U] and rural areas with services [RS] (where schools will be close), but in remote rural areas [RR] in Ghana and particularly in Malawi, a considerably higher proportion of girls than boys attend the closest school. This presumably reflects poverty levels in remote areas, girls' workloads and concerns about girls' safety during the journey to school, an issue to which we will return later. In South Africa, although there are serious safety concerns regarding girls' travel to school, there is relatively more availability of scholar transport in remote rural areas (see below).

Percentage of children attending the school closest to home (all children 9-18 currently attending school, n= 2528)

	South Africa n=879	Ghana n=865	Malawi N=784
RR n=569	F=88.7% M=90.9	F= 90.7% M=86.7	F=92.0%* M=80.9
RS n=650	F=91.1 M=89.8	F=97.3 M=97.4	F=98.9 M=98.1
PU n=629	F=92.8 M=87.8	F=95.2 M=90.6	F=95.9 M=86.9
U n=680	F=66.2 M=67.9	F=56.6 M=59.1	F=72.3 M=70.7

F=female M=male

* P (Chi-square)= <0.05

Daily travel times

Children were asked to estimate the time it took to travel to school on the most recent school day. In Ghana as a whole, just over half all girl children who responded to this question [n=1998] estimated they reached school in 15 minutes or less [50.6%]. Figures for girls in Malawi and South Africa were lower [34.3% and 28.3% respectively]. Corresponding percentages for boys were somewhat lower than for girls in Ghana [44.6%] but very similar in Malawi and South Africa [35.3%, 28.5% respectively]. Turning to longer journeys, in all three countries roughly 20% of boys and girls estimated their journey at between 46 and 90 minutes. Journeys over 90 minutes were few in Ghana and Malawi [under 3% of girls and boys in Ghana, under 5% in Malawi], but reported by 7.8% girls and 8.4% boys in South Africa.

A review of differences across different settlement types in each country adds significantly to the broad picture. As one would expect, our survey data for estimated daily travel time to school in Malawi shows the longest journeys in remote rural areas, where a majority of children, both boys and girls, estimate that their journey takes over three-quarters of an hour. By contrast, journeys in rural centres with services tend to be the shortest; not surprising given that this is the settlement type in which the most children are likely to attend the nearest school. Journey time is more varied in both urban and peri-urban locations, reflecting proximity to schools in urban areas, but also the tendency to attend a school other than the closest, especially in urban locations. Differences in gendered patterns are relatively small, though more boys (especially in remote rural Malawi) travel distances requiring long journeys (over one and a half hours) compared to girls.

Estimated daily travel time to school on most recent school day: Malawi

	Under 15mins	16-45 mins	46mins -1hr 30mins	1 hr 31 mins - 2 hours 30 mins	Over 2 hours 30 mins
RR	F=8.8% M=5.4	F=17.6% M=19.6	F=63.2% M=57.1	F=10.3% M=17.9	F=0% M=0
RS	F=67.7 M=59.8	F=29.0 M=36.6	F=1.6 M=1.2	F=1.6 M=1.2	F=0 M=1.2
PU	F=42.2 M=46.8	F=37.3 M=39.2	F=20.6 M=11.4	F=0 M=2.5	F=0 M=0
U	F=25.2 M=18.1	F=57.5 M=66.7	F=16.5 M=13.9	F=0.8 M=1.4	F=0 M=0

Daily travel times for South Africa are similar to Malawi in terms of distribution across geographical locational categories, with the majority of the longer journeys in remote rural [RR] locations and the majority of short journeys in rural

settlements with services [RS]. Gender distinctions appear relatively small. The data accords with the 2003 South Africa National Household Travel Survey conclusion that 3 million out of the 16 million total learners (especially those located in more rural provinces) spent more than an hour a day walking to and from educational institutions (RSA Department of Transport 2003).

Estimated daily travel time to school on most recent school day: South Africa

	Under 15mins	16-45 mins	46 mins-1hr 30mins	1 hr 31 mins - 2 hours 30 mins	Over 2 hours 30 mins
RR	F=7.7% M=4.6	F=21.2% M=29.6	F=57.7% M=50.0	F=13.5% M=15.8	F=0% M=0
RS	F=60.4 M=53.3	F=28.8 M=33.7	F=8.8 M=9.0	F=2.1 M=3.1	F=3.1 M=1.7
PU	F=49.0 M=47.8	F=34.6 M=37.3	F=15.2 M=13.8	F=1.1 M=1.1	F=0 M=0
U	F=37.2 M=38.1	F=48.8 M=51.4	F=12.8 M=10.0	F=0.5 M=0	F=0.3 M=0

As we noted above, daily travel times for Ghana as a whole are relatively short, particularly when compared to South Africa. The strongest preponderance of short journey times in Ghana is in peri-urban sites, even more than in rural settlements with services. This probably reflects the high density of schools in the peri-urban areas concerned, including private schools. No particular gender pattern is discernable.

Estimated daily travel time to school on most recent school day: Ghana

	Under 15mins	16-45 mins	46 mins-1hr 30mins	1 hr 31mins-2 hours 30 mins	Over 2 hours 30 mins
RR	F=9.5% M=4.8	F=26.2% M=45.2	F=58.3% M=45.2	F=6.0% M=4.8	F=0% M=0
RS	F=62.8 M=49.1	F=17.7 M=27.2	F=16.8 M=18.4	F=2.7 M=5.3	F=0 M=0
PU	F=72.5 M=58.8	F=22.5 M=32.4	F=3.9 M=8.1	F=1.0 M=0.7	F=0 M=0
U	F=49.2 M=54.3	F= 40.6 M=35.9	F=9.4 M=9.8	F=0.8 M=0	F=0 M=0

Travel mode: travel to school

Walking is totally dominant as the mode of transport to school in all three countries, in all types of settlement and across both genders. In Ghana and Malawi it is almost the exclusive mode of transport on journeys to school, in all settlement types. In Ghana 98.6% of

girls and 97.4% of boys had walked to 99.3% of girls and 99.1% of boys in Malawi. Bicycle use to school (either as cyclist or riding pillion) was reported by only one boy and not even one girl in the Malawi sample, and by three boys and just one girl in Ghana. This may seem surprisingly low, especially in view of the fact that when we asked about whether children's knew how to ride a bicycle, so many said they could (Ghana: 58% girls, 87% boys; Malawi: 44% girls, 72% boys; South Africa 48% girls, 82% boys). However, many children learn to ride a cycle through borrowing a family member's bicycle or by hiring a cycle for a few minutes at a time (called kobo-kobo in southern Ghana). If the family has a bicycle, it is unlikely to be available to be parked at school all day while the school the previous school day, and child is in lessons. Fears regarding the vulnerability of bicycles to theft at school or on the journey to/from school were also expressed.

Motorised transport use was similarly remarkably low: in Ghana three girls and three boys had travelled to school by motor taxi, while in Malawi only one boy and two girls had taken a bus/minibus to school the previous school day. The Ghana data accords closely with earlier findings in Ghana's coastal region (Porter and Blaufuss 2003). In South Africa the travel to school picture is a little more varied, however, and worth examining in detail since we can compare our survey data with data from the national travel survey briefly reported above.

South Africa: Major modes of transport to school on most recent school day

	Walked only	Bus/minibus/combi/bakki	Bicycle
RR	F=84.7% M=82.8	F=15.3% M=15.5	F=0% M=0
RS	F=80.3 M=88.5	F=16.6 M=11.5	F=0 M=0
PU	F=93.2 M=88.5	F=1.7 M=3.8	F=1.7 M=0
U	F=87.4 M=85.7	F=7.4 M=10.2	F=0 M=0

Although walking dominates among both genders in South Africa (as in Ghana and Malawi), in remoter rural areas of South Africa, the availability of motorised transport services for part of the school journey has clearly proved advantageous for some children, both boys and girls. Cycle use is remarkably low, however. There have been sporadic efforts to expand the use of bicycles among school pupils in poorer areas of South Africa under the Shova Kalula programme ((Mashiri et al, 2001; Mahapa 2003), but this has clearly had no influence in our study settlements. According to the 2003 South Africa National Household Travel Survey (as noted earlier), 76 % of 'learners' were reported to walk to their educational destination. This figure is still far exceeded in the (overwhelmingly poor) study areas where our project is focused.

3. Dangers faced on the journey to and from school

In our survey children were asked about problems faced on the journey to and from school. They were first asked to identify the principal danger (if any) they faced as they travelled to school. In South Africa the three principal dangers identified were as follows (in rank order) risk of attack from thieves/thugs (8.4%), rivers and streams to cross (8.2%), rough terrain travelling to school (5.1%). In Ghana snakes were ranked first by children as the biggest danger (14.3%), followed by rough terrain (5.1%) and dangerous taxis (4.9 %). In Malawi, rough terrain ranked first (5.2%) followed by crossing rivers and streams (4.4%) and harassment or verbal abuse by drunkards (4.3%). In each country, a significant proportion of children said they did not experience any major dangers on the journey to and from school: 56.3% in Ghana, 57.9% in Malawi and 46.1% in South Africa. These figures accord with our qualitative data in that it also suggests that children in South Africa report facing greater dangers on their journey to school, by comparison with children in Malawi and Ghana, though as we show below, the degree to which children perceive themselves to face overall danger varies between rural and urban environments in all three countries, and to a smaller extent by gender.

Percentage of children who experience NO dangers on the journey to and from school

	South Africa	Ghana	Malawi
RR	F=20.6% M=24.4	F=31.2% M=43.8	F=41.9% M=44.9
RS	F=72.6 M=75.4	F=59.5 M=49.5	F=57.0 M=66.0
PU	F=39.5 M=38.1	F=62.0 M=58.0	F=52.6 M=56.1
U	F=44.3 M=47.8	F=70.3 M=64.2	F=67.9 M=69.7

The figures above indicate that the boy and girl children who feel safest as they travel to and from school in South Africa are those resident in rural locations with services, where girls feel almost as safe as boys. As we have shown above, these are the settlements in South Africa where children's travel time to school is shortest. In urban areas slightly more boys than girls feel safe, perhaps related to girls' perceived (and actual) risk of rape in urban locations (see below). In Ghana the children who appear to feel safest as they travel to and from school are those resident in urban and peri-urban locations. A greater proportion of Ghanaian girls than boys feel safe in urban locations but a greater proportion of boys feel safe than girls in rural locations. In Malawi the urban children

reported the least dangers on the way to school, while those in remote rural communities experienced the most hazards; in all Malawi locations, a greater proportion of boys than girls feel safe.

The types of danger experienced also vary considerably between locational types and in some cases by gender. Our respondents were asked whether they were exposed to particular specific risks: rough terrain, streams which are difficult to cross, risk of attack from people, risk of harassment (verbal abuse), risk of rape, fear of animals, dangerous vehicles and supernatural risks. As might be anticipated, there is substantially less difference in gender perceptions of danger for some of these risks than for others.

Dangers associated with physical factors (topography and rivers)

Rough terrain, unsurprisingly is considered a more frequent hazard in remote rural than other locations across all three countries, with the highest perception of danger reported in remote rural South Africa. In one of the two remote rural South African settlements, in particular (in Eastern Cape), children must cross a mountain even to reach primary school. Gender patterns for the high risk areas relating to rough terrain – remote rural sites- suggest a slightly greater proportion of boys perceive topography as an issue than girls in all three countries. This may be because for girls other dangers seem much more important and by contrast rough terrain is considered a less significant impediment to travel, or possibly because girls are used to rough terrain as they are exposed to it when undertaking tasks such as firewood collection. It is also likely to be related to the statistics [see above] indicating that in remote rural areas [RR]of Malawi and Ghana, a higher proportion of girls than boys attend the closest school. Boys from remote rural areas who are sent to more distant schools rather than the school closest to home are very likely to encounter additional hazards of rough terrain along their longer route. The significant difference between girls' and boys' perception of the terrain hazard in Malawi rural with services settlements [RS] will need further investigation, but may be related to boys' play or work diversions on the journey to school.

Percentage of children reporting rough terrain as a danger in journeys to/ from school

	South Africa	Ghana	Malawi
RR	F=22.7% M=26.4	F=13.1% M=16.7	F=20.9% M=21.7
RS	F=6.6 M=13.0	F=10.6 M=15.5	F=5.1* M=18.2
PU	F=11.7 M=13.0	F=13.7 M=13.2	F=7.9 M=11.0
U	F=3.6 M=4.2	F=5.4 M=3.3	F=1.4 M=5.3

* P (Chi-square)= <0.05

Stream or river crossing dangers present a similar pattern to rough terrain. In South African remote rural sites they present a major danger to many children. In Malawi remote rural sites they are also a considerable problem for some children, but in the Ghana sites, stream crossings mostly present a relatively insignificant issue for children on their way to and from school. However, the difference between girls and boys in Ghanaian rural with service settlements is significant and may reflect some deviation from the most direct route to school by boys associated with play (as we suggested also in the case above re terrain and Malawi RS boys). The otherwise relatively low reportage of dangers associated with rough terrain and rivers in Ghana is not surprising given that the two Ghana project study regions, Cape Coast and Sunyani areas (and, indeed the country as a whole) have much less rugged topography than Malawi's Shire Highlands or South Africa's Eastern Cape study regions.

Percentage of children reporting crossing rivers or streams as a danger in journeys to/from school

	South Africa	Ghana	Malawi
RR	F=24.8% M=22.1	F=0.0% M=1.2	F=18.6% M=15.9
RS	F=3.5 M=6.5	F=3.5* M=10.3	F=2.6 M=3.0
PU	F=1.5 M=1.9	F=1.0 M=0	F=1.8 M=6.1
U	F=0.5 M=1.9	F=0.8 M=2.2	F=0.7 M=1.3

* P (Chi-square)= <0.05

Traffic hazards

Traffic on the journey to and from school mentioned by children as a danger included tipper trucks, taxis, minibuses/combis, even bicycles (the latter especially in Malawi). Children refer to traffic dangers more frequently in urban and peri-urban areas than in rural areas across all three countries, as might be expected, given associated traffic density patterns. In South Africa and Ghana, even children living in remote rural areas are likely to encounter traffic dangers on the journey to school because their schools are located in centres where some vehicular traffic exists. Malawian rural children do not record motorised traffic as a danger, even in the two rural centres with services, because these centres are located off-road in a country where poverty is such that rural vehicular traffic is limited. Malawian figures for urban areas are also relatively low compared to Ghana and South Africa. So far as gender patterns are concerned, girls are significantly more aware of traffic dangers than boys in rural areas in Ghana, which accords with the fact that boys tend to have more traffic-related

accidents than girls [see Porter and Blaufuss 2003 re Ghana]. In urban areas, however, across all three countries, the data suggests that boys are slightly (South Africa) or considerably more (Ghana and Malawi) aware of the traffic danger than girls. However, this does not appear to have translated into reduced traffic accident statistics for boys.

Percentage of children reporting dangerous vehicles as a hazard on journeys to/from school

	South Africa	Ghana	Malawi
RR	F=6.2% M=2.4	F=13.1%* M=2.4	F=0% M=0
RS	F=5.4 M=4.7	F=3.5 M=1.7	F=0 M=0
PU	F=20.9 M=21.6	F=16.7 M=22.8	F=20.2 M=13.4
U	F=20.9 M=23.6	F=22.5 M=32.6	F=11.3 M=18.4

* P (Chi-square)= <0.05

Animal hazards

Our child researchers first alerted us to the significance of animals and reptiles (biting dogs, snakes etc.) as a serious potential hazard for some children and we consequently incorporated questions about animals in the survey questionnaire. In the survey children included dogs, snakes, cattle, wild pigs, worms, lions, rats and donkeys among the 'animal' dangers they might encounter on the journey to and from school. While no child is likely in reality to meet a lion, the imagined prospect of such a meeting can be a very significant issue (Porter et al. in press). The data below shows that animal-related dangers were reported particularly in remote rural areas in Ghana and South Africa: in Ghana, in particular, snakes were a major concern. Snakes were reported to be a particular problem for children passing through less habited areas, notably fields or uncleared bush areas on the way to school. The lower percentages for remote rural Malawi are more difficult to explain. There is no clear gender pattern in the data.

Percentage of children reporting dangerous animals as a hazard on journeys to and from school

	South Africa	Ghana	Malawi
RR	F=36.8% M=40.9	F=53.6% M=56.0	F=15.1% M=17.4
RS	F=22.7 M=26.3	F=27.7 M=37.9	F=22.8 M=22.0
PU	F=15.4 M=13.8	F=5.9 M=11.8	F=13.3 M=8.5
U	F=3.3 M=4.7	F=6.2 M=7.6	F=0.7 M=1.3

Attack from people, including rape, other forms of attack and verbal harassment

Hazards presented by people were recorded by many children on their journey to school. Among these 'people', children sometimes specified bandits, older boys, murderers, kidnappers, thieves, fighting with friends, men who chase, thugs, unruly pupils and children who throw stones.

The highest proportion of children observing general danger of attack from people was in rural areas. In urban areas perceived risk of attack is highest in South Africa and lowest in Ghana. In Ghana and Malawi relatively few children, particularly in urban and peri-urban areas, perceived danger from people. However, gender patterns show a significant difference in perception of dangers in Ghana peri-urban areas where boys are more concerned than girls and in Malawi rural with service settlements where girls are more concerned than boys, but the data is perhaps more usefully examined below in terms of specific dangers from rape. Figures for Ghana in the generalised category of risk from attack by people were substantially higher than for rape or for verbal harassment (below): children in Ghana often appear to have included risks like fights with friends and bullying from older boys in this general category.

Percentage of children reporting risk of attack from people on journeys to/from school

	South Africa	Ghana	Malawi
RR	F=22.3% M=21.2	F=25.0% M=17.9	F=17.4% M=21.7
RS	F=13.2 M=11.9	F=13.3 M=20.7	F=19.0* M=7.0
PU	F=10.3 M=14.1	F=2.0* M=8.8	F=7.0 M=6.1
U	F=11.6 M=13.0	F=2.3 M=5.4	F=6.4 M=6.6

* P (Chi-square)= <0.05

The specific danger of rape on the journey to school was indicated by a much higher proportion of South African children [12.9% of the total sample] than either Ghanaians [0.4%] or Malawians [0.2%]. However, the sentiments expressed by a fathers' group in Kanyola, Malawi were common in qualitative interviews across our southern Africa sites: 'We fear girls will be cheated on or get raped on way to school'. The figures for Ghana are particularly low and are supported by qualitative evidence which suggests parental perceptions of children's travel dangers are associated more with getting lost than with 'stranger danger' (also see Porter and Blaufuss 2003). In southern Africa, rape presents a particularly great danger given the high incidence of HIV/AIDs in the region. In South Africa, boys are possibly more exposed to dangers of rape than elsewhere in Africa, due to long-standing cultural patterns of male co-residence in male mine-labour communities. Nonetheless, significant gender differences regarding perceived danger of rape are found in South African remote rural, peri-urban and urban sites (and in Malawi urban sites).

Percentage of children reporting rape as a danger experienced on journeys to and from school

	South Africa	Ghana	Malawi
RR	F=10.3%* M=1.4	F=0% M=0	F=2.3% M=0
RS	F=1.2 M=0	F=0.9 M=0	F=1.3 M=0
PU	F=8.1* M=1.1	F=0 M=0	F=2.6 M=0
U	F=7.2* M=0.5	F=0.8 M=1.1	F=6.4* M=0

* P (Chi-square)= <0.05

Risk of harassment and verbal abuse on the journey to school was reported to come from diverse people in various contexts: drunkards, strangers, cannabis users and minibus conductors were all singled out as potential sources of verbal abuse. Such harassment is reported particularly widely as a hazard by boys and girls in Malawi. Like fear of rape, it is rarely reported in Ghana, and particularly rarely by Ghanaian boys. In both Malawi and South Africa, a higher proportion of girls in urban and peri-urban areas report harassment/verbal abuse than boys: in Malawi's peri-urban areas this gender pattern is statistically significant.

Percentage of children reporting harassment/verbal abuse as a danger or difficulty on journeys to and from school

	South Africa	Ghana	Malawi
RR	F=7.0% M=6.8	F=2.4% M=1.2	F=12.8% M=15.9
RS	F=6.2 M=6.8	F=1.8 M=0.9	F=13.9 M=18.0
PU	F=13.6 M=4.5	F=2.0 M=0	F=22.8* M=11.0
U	F=11.6 M=4.2	F=3.1 M=0	F=17.1 M=9.2

* P (Chi-square)= <0.05

Despite all the dangers and difficulties that children reported above, remarkably few children, girls or boys, are accompanied by adults on the journey to school, whatever their age. Most children travel to and from school in groups with their siblings and friends - their parents are at work, on the farm or otherwise occupied.

Children accompanied by a parent or other adult

	South Africa	Ghana	Malawi
RR	F=0% M=0	F=0% M=0	F=0% M=0
RS	F=1.6 M=0.4	F=3.5 M=0.9	F=0 M=0
PU	F=1.1 M=0.7	F=0 M=0.7	F=1.8 M=1.2
U	F=1.4 M=1.4	F=0.8 M=1.1	F=0.7 M=1.3

Conclusion: Significance of findings for theory and public policy

Analysis of the empirical data presented in this paper provides a comparative cross-country and locational perspective on boys' and girls' travel to school hitherto unavailable. The three countries present rather different contexts, which are reflected in our findings. Some of the selected study areas of Malawi [Blantyre region's Shire Highlands] and South Africa [Eastern Cape region] exhibit considerably more rugged topography than the sites in Ghana, for instance, which are all relatively flat: consequently the journey to school for children in remote rural areas in South Africa and Malawi tends to be more hazardous than for children in Ghana in terms of terrain and flooded rivers. This confirms a rather predictable conclusion that topography presents variable challenges for children on their school journeys, but it is important to take account of the varied terrain of African landscapes in making public policy. With reference to diverse levels of economic development, only in South Africa are there the resources to provide some degree of motorised transport provision in rural areas, including dedicated school buses. Malawi and South Africa are both experiencing high prevalence of HIV/AIDs, which not surprisingly translates into concern about exposure to attack from people and, in particular, fear of rape.

Some basic characteristics of the journey to and from school are remarkably similar across the three countries. Walking is the dominant mode of travel to school throughout all regions and in the remote rural areas of all three countries children walk particularly long distances to and from school each day. We have undertaken accompanied walks with children on their journeys from school and can not only attest to the very real physical difficulties and dangers they face but also to the less concrete fears they express on these journeys (Porter et al. in press). Passing by a lonely graveyard or sacred grove where witches, lions and robbers are reputed to lie in waiting is a fearsome task if the child is delayed and has to walk home alone. As a young girl pupil in her early teens observed to us, as we accompanied her on her long walk home from school in a remote area of the Shire Highlands region in Malawi during one of our pilot studies, "there are so many problems [here]. You meet a very long person and I suspect it's a witch, and there are dogs that chase us and fierce animals – lions and hyenas- and they bit us. Three children were once bitten – one by a lion and she died, and two boys were bitten by hyenas, but they are still alive"

Children in rural centres with services appear to be best served in terms of short length of school journey, but this may also reflect lack of available alternative schools in the vicinity. In urban and peri-urban areas, although the density of schools is much higher, and journeys to school might be expected to be extremely short, more parents choose to send their children further than the closest school appropriate to their level, or are required by school allocation systems. Such urban journeys may impose additional stresses, especially on girl children in South Africa and Malawi, who report high levels of harassment and, to a lesser extent, fear of rape.

Again, the findings are supported by qualitative research with children and their parents and teachers, including our child research collaborators' own findings in this area. Cecilia observes: "We have to walk in groups because there are boys who are not schooling who take our money and mobile phones" (Cecilia, 18 years, Umtata, South Africa). For Susan, a 17 year old secondary school pupil in Winterveld in NorthWest province, South Africa, the dangers are even greater. She walks daily about 5 km across an uninhabited bushland area to school: "I fear people who hide in the bush [waiting] for us. They wait for us in the bush and as we walk, especially when you are alone, they grab your school bag and all the belongings that you have with you…. The bush is bad, you cannot see people hiding or seeking you…. It is even worse to cross the bush at night. There are so many rapists there at night and a lot of drunk people." We accompanied Susan on one of her journeys; the next day a girl from the same school was raped along this route. Some boys also fear attack, as our data has illustrated, but for girls the perceived risk appears considerably higher, with likely impacts on broader patterns of mobility.

There may be a number of potential routes to improving safe school access, especially for girls. These include:

1. Expansion of girls' boarding house provision and general boarding provision, especially at primary schools. Boarding is more often available at secondary school but provision is inadequate (especially in Malawi) and boarding is also needed at primary level especially for girls who live in remote rural areas. The threat of rape is such that parents delay sending their daughters to school and curtail their attendance. Boarding may reduce children's domestic work burdens during the school week and more likely availability of electricity [commonly absent in remote rural settlements] would enable them to complete homework. The loss of child contributions to domestic production and reproduction would inevitably impact on families, particularly in rural areas. A holistic approach will be needed, incorporating not only expansion of girls' school boarding provision, but also attention to labour-saving interventions which will reduce domestic work demands in home villages, especially improved water provision.

2. The walking bus is used in Western contexts to help children to walk safely to school in regions where traffic levels are high and child obesity a growing problem (e.g. Kingham and Ussher 2007). However, the walking bus may also offer a route to reducing dangers of rape and harassment. This suggestion was received with interest in our peri-urban site at Winterveld, after an accompanied school to home walk with Susan (cited above) and other children emphasised the very real fear of rape among children schooling in that community. We now have funding in place to support a walking bus pilot, in collaboration with a local NGO.

3. Cycle hire centres based at schools might help to overcome the shortage

of cycles available to girl children, in particular, for travelling between home and school. This could be particularly effective if accompanied with security measures for guarding cycles at schools and girls' training in cycle riding, maintenance and repairs. As noted above, many girls say they know how to cycle, but being able to cycle over a long distance requires associated knowledge in maintenance and repair.

4. Various non-transport intervention aimed at reducing girls' time poverty, including improved availability of water supplies, community woodlots, grinding mills etc. to reduce girls' time poverty.

5. Sensitisation of teachers and education authorities to transport/distance related lateness. Many teachers impose extremely harsh punishment on children who arrive late for school (corporal punishment, cleaning the lavatories, sweeping the yard, grass-cutting, carrying sand for school building etc.). In some cases children reported being sent directly home by teachers because they had arrived at school late, requiring them to retrace their long walk to school, possibly alone: this is the type of punishment which encourages truancy. Teachers whose pupils collaborated in our research admitted that they had not adequately appreciated the problems that children face in getting to school on time and there was a common response that they would be more sympathetic to lateness among pupils living at a distance from school in future.

Above all, however, a stronger focus on gendered transport, mobility and access issues in the development policy and practitioner community is essential. The failure to recognise the specific importance of mobility and transport and the ramifications of immobility in the Millennium Development Goals is clear testament to this omission. In the context of the MDGs regarding universal primary education (MDG 2) and the promotion of gender equality and women's empowerment through the elimination of gender disparity in all levels of education (MDG 3), a firmer and more specific recognition of the roles which distance, perceived and real travel hazards, transport availability and other mobility factors play in allowing or barring access to school is urgently required.

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