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Title

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Permalink

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Journal

Berkeley Planning Journal, 19(1)

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Publication Date

2006

DOI

10.5070/BP319111491

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Sustainable Transport in Canadian Cities: Cycling Trends and Policies

John Pucher and Ralph Buehler

Abstract

This article examines cycling trends over time, as well as differences in cycling levels, policies, and programs among different Canadian provinces and metropolitan areas. Some policies and measures have been quite successful and innovative, providing valuable lessons for other countries about how best to increase cycling while improving its safety. While Canadian cities have been more successful than American cities at promoting cycling as a mode of transport, they fall far short of European cities. As noted in the conclusion of this article, there are two key differences that help explain the much higher levels of cycling in Europe: more compact land-use patterns leading to shorter trip distances and a wide range of policies discouraging car use by making it more expensive or more difficult.

Introduction

In 2002, the Canadian Government ratified the Kyoto Protocol, thus officially committing the country to reduce its greenhouse gas (GHG) emissions. By the year 2012, Canada must achieve at least a 6 percent reduction in total GHG emissions below the 1990 emissions level (Environment Canada 2004). Encouraging Canadians to use their bikes for a higher percentage of trips — and their cars for a lower percentage — would be an ideal way to reduce Canadian GHG emissions from transportation sources (Transportation Association of Canada 1993, 1998, 2004).¹ Bicycling is one of the most sustainable transport modes. Riding a bicycle emits virtually no GHG at all.

¹ In 2002 when Canada ratified the Kyoto Protocol, GHG emissions from petroleum combustion (in millions of metric tons of carbon equivalent) contributed 47 percent of Canada's total emissions. To meet the Kyoto target of 6 percent below 1990 levels (based on 2002 data), the country as a whole must reduce its emissions by 20 percent. Since 2002, the level of emissions has actually increased, making the necessary reductions even greater and more challenging (Energy Information Administration 2006).

Moreover, bikes require far less roadway and parking space, thus helping to relieve the growing congestion problems in most cities. Bicycling is also an equitable mode of transport, since it is affordable for virtually everyone, and with proper training, most people can learn to cycle. Finally, cycling is an extraordinarily valuable form of cardiovascular exercise that improves both physical and mental health (Pucher and Dijkstra 2003).

This article examines cycling trends over time, as well as differences in cycling levels, policies, and programs among different Canadian provinces and metropolitan areas. Some policies and measures have been quite successful and innovative, providing valuable lessons for other countries about how best to increase cycling while improving its safety. While Canadian cities have been more successful than American cities at promoting cycling as a mode of transport, they fall far short of European cities. As noted in the conclusion of this article, there are two key differences that help explain the much higher levels of cycling in Europe: more compact land-use patterns leading to shorter trip distances and a wide range of policies discouraging car use by making it more expensive or more difficult.

The article begins with an overview of aggregate time trends and geographic differences in Canadian cycling levels and injury rates. Most of the policy analysis, however, is focused on eight case study cities in Canada's four most populous provinces: Montreal and Quebec City in Quebec, Toronto and Ottawa in Ontario, Vancouver and Victoria in British Columbia, and Calgary and Edmonton in Alberta. Since urban transport policy in Canada is determined at the provincial and local level, disaggregate case study analysis is the only way to examine the nature, extent, and impacts of cycling policies in Canada.

Overall Trends and Spatial Variation in Canadian Cycling

As shown in Table 1, bicycling accounted for only 1.2 percent of Canadian work trips in 2001. That was a 10 percent increase over the 1996 bike share of 1.1 percent, but it remains a tiny percentage of trips. With over a fourth of all trips in Canadian cities less than two miles long — a distance that can easily be covered by bike — there is obviously much potential for increasing cycling and thus reducing car use that contributes so much to GHG emissions.

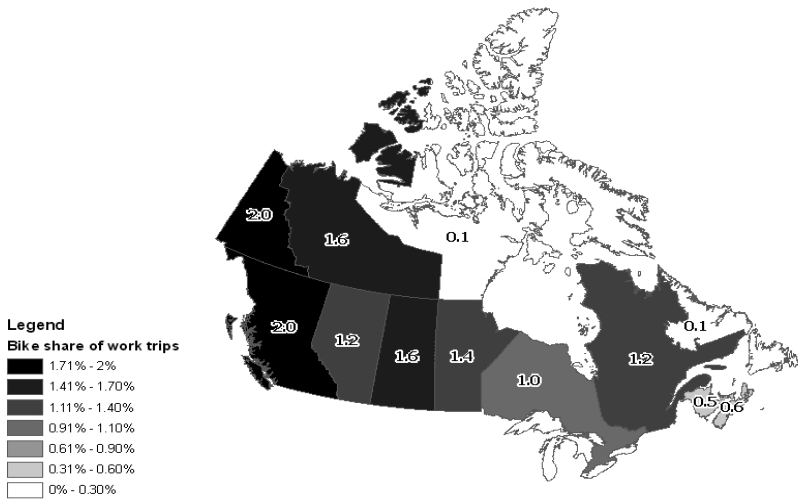
As shown in Figure 1, levels of cycling vary widely among Canada's provinces: from a high of 2.0 percent in both British Columbia and Yukon Territories to a low of 0.1 percent in Newfoundland and Labrador. It is notable that British Columbia has about twice as high a cycling share of work trips as Ontario, Canada's most populous province. Moreover, while the cycling share rose from 1996 to 2001 in British Columbia (from 1.9 to

Table 1. Choice of Transport Mode for the Journey to Work in Canada, 1996 and 2001

	Total Number of Work Trips per Day			Modal Share	
	1996	2001	% increase	1996	2001
All Modes	12,183,410	13,450,855	10.4	100	100
Car, Truck, Van as Driver	8,934,025	9,929,470	11.1	73.3	73.8
Car, Truck, Van as Passenger	899,340	923,975	2.7	7.4	6.9
Public Transport	1,233,870	1,406,585	14.0	10.1	10.5
Walk	850,855	881,085	3.6	7	6.6
Bicycle	137,435	162,910	18.5	1.1	1.2
Other	127,885	146,835	14.8	1	1.1

Source: Statistics Canada (1998 and 2003).

Figure 1. Modal Split of Workers Bicycling to Work in Canadian Provinces and Territories



Source: Statistics Canada (2003).

2.0 percent) and from 1.1 to 1.2 percent in Quebec and Alberta, it remained constant in Ontario (at 1.0 percent).

Table 2 contains the cycling share of work trips for each of Canada’s metropolitan areas with at least 100,000 inhabitants. Of Canada’s two largest cities, Montreal has a considerably higher bike share of work trips than Toronto (1.3 vs. 0.8 percent). In the next largest category, however, Vancouver and Ottawa-Hull are tied at 1.9 percent. In the middle category, the bike share ranges from 1.5 percent in Calgary to 0.9 percent in Hamilton, Ontario. The next category displays much more variation, with a 10 to 1 ratio of bike shares: from 4.8 percent in Victoria, British Columbia, to only

0.5 percent in Oshawa, Ontario. The smallest-size category has the most variation, with a 25 to 1 ratio of bike shares: from 2.5 percent in Saskatoon, Saskatchewan, to only 0.1 percent in St. John's, Newfoundland.

Table 2. Bicycling Share of Work Trips in Canadian Metropolitan Areas, by Population Size Categories, 2001

Number of Inhabitants	Modal Split	Metropolitan Area	Population
3 million or more	1.3	Montreal	3,426,350
	0.8	Toronto	4,682,897
	Group Mean	<u>1.1</u>	
1 million to 2,999,999	1.9	Vancouver	1,986,965
	1.9	Ottawa Hull	1,063,664
	Group Mean	<u>1.9</u>	
500,000 to 999,999	1.5	Calgary	951,395
	1.4	Winnipeg	671,274
	1.3	Quebec	682,757
	1.2	Edmonton	937,845
	0.9	Hamilton	662,401
	Group Mean	<u>1.3</u>	
250,000 to 499,999	4.8	Victoria	311,902
	1.5	London	432,451
	1.1	Windsor	307,877
	1.1	Kitchener	414,284
	0.9	St. Catherines-Ni.	377,009
	0.9	Halifax	359,183
	0.5	Oshawa	296,298
	Group Mean	<u>1.5</u>	
100,000 to 249,999	2.5	Saskatoon	225,927
	2.2	Kingston	146,838
	1.5	Trois Rivieres	137,507
	1.4	Regina	192,800
	1.0	Thunder Bay	121,986
	0.9	Abbotsford	147,370
	0.8	Chicoutimi-Jonquiere	154,438
	0.8	Sherbrooke	153,811
	0.4	Greater Sudbury	155,601
	0.4	Saint John	122,678
	0.1	St John's	172,918
	Group Mean	<u>1.1</u>	

Source: Statistics Canada (2003).

Comparability of Data and Methods

The information presented in this paper comes from several sources. We used consistent data sources as much as possible, relying most heavily on the Canadian Census. The census collects travel data for Canadian cities and provinces and is the only fully comparable source of information on cycling levels in different Canadian provinces and cities. Unfortunately, as with the U.S. Census, the Canadian Census only reports on the journey to work, thus excluding all bike trips for other purposes. Another problem is that the census only reports the primary mode used for the work trip, thus excluding bike trips made to access public transport, for example. That probably understates the total number of bike trips.

As with the U.S. Census, the Canadian Census only collects work trip data during one month of the year: May in Canada vs. April in the U.S. That limitation to one month of the year hides important variations in cycling levels throughout the year in both countries, but especially in Canada. Cycling levels are obviously much lower in the colder and rainier winter months than in May, when the survey is taken. The Canadian Census is taken every five years, but bicycling information has only been collected for the past two censuses, 1996 and 2001.

To supplement the Canadian Census data and to obtain information on non-work trips by bicycle, we also gathered information from a variety of travel surveys that were conducted at the local level, generally for a few large metropolitan areas. Unlike the multipurpose Nationwide Personal Transportation Survey (NPTS) and National Household Travel Survey (NHTS) travel surveys in the United States, Canada has no nationwide travel survey that captures trips for non-work purposes. Only the individual metropolitan area surveys in Canada provide information on total travel, including both work trips and non-work trips, and they are limited to only a few large cities. Those metropolitan surveys, however, suggest considerably higher bike mode shares for total travel, including all trip purposes, than for work trips alone (Pucher and Buehler 2005). Unfortunately, such metropolitan area travel surveys in Canada vary in design, methodology, and timing, and are not fully comparable across Canadian cities.

Unlike the U.S., no study has attempted to collect, standardize, and compare the extent of bicycling facilities for Canada. From our own examination of the metropolitan level information, there appears to be great variability in the classification and measurement of cycling infrastructure in different cities and in the degree of availability of such information at all. Consequently, the corresponding statistics and information we collected for individual metropolitan areas are not necessarily representative.

In general, they were provided by the cycling coordinators either at the provincial level or at the individual metropolitan level.

Trends in Cycling Fatalities and Injuries

Both the aggregate Canadian data cited above — and the case studies discussed later in this article — suggest considerable growth in cycling over the past two decades. In spite of increased exposure through more cycling, both fatalities and injuries have fallen considerably in most provinces over that same period. For Canada as a whole, total cycling fatalities fell by 50 percent from 1984 to 2002 (from 126 to 63), and total cycling injuries fell by 33 percent (from 11,391 to 7,596) (Transport Canada 2004).

Figures 2 and 3 portray cycling safety trends for Canada's four most populous provinces. Fatalities fell by 61 percent in Ontario, by 60 percent in British Columbia, and 46 percent in Quebec. In Alberta, cycling fatalities remained roughly constant. Injuries fell by 41 percent in British Columbia, by 37 percent in Ontario, and by 31 percent in Quebec. In Alberta, cyclist injuries increased by 9 percent. It is notable that all four provinces reported an increase in cycling injuries from 1984 to 1987 and then a decline from 1987 until 2002.² Overall, it seems likely that cycling has, in fact, become safer in all four provinces, especially considering the growth in cycling levels over the same time period, which suggests an even sharper fall in fatalities and injuries per kilometer cycled.

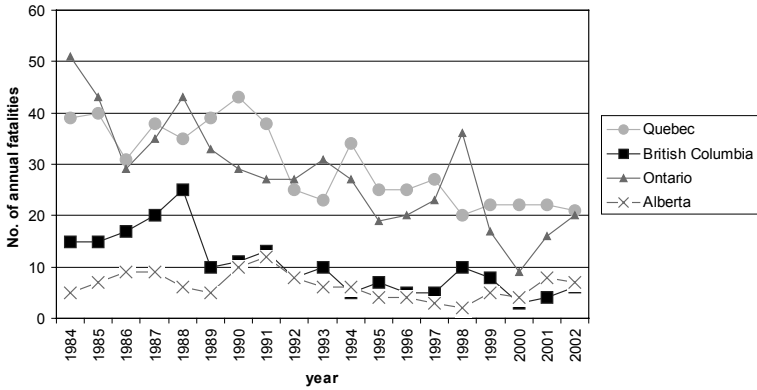
Increases in cycling levels and reductions in cycling fatality rates may be functionally related. For example, Jacobsen (2003) analyzed a wide variety of both time-series and cross-sectional data from different countries and showed that higher levels of cycling are very strongly correlated with lower levels of cycling deaths and injuries. The causation probably goes in both directions. Safer cycling encourages more people to cycle, and as more people cycle, there are more cycling facilities, more cycling training, and more consideration by motorists of cyclists, all of which make cycling safer.

Overall, these trends suggest that Canadian cycling is indeed thriving — increasing in both quantity and quality. Clearly, however, there are important differences between provinces and among cities. Moreover, the

² There is no simple explanation for the increase between 1984 and 1987. There was no change in definition of cycling fatalities and injuries, so that is not the cause. For the province of Quebec, data show that the total number of persons injured or killed using other modes of transport than cycling also increased during this time period. That suggests that the increase was not due to a factor affecting only cycling safety but other modes as well. Experts we interviewed from the Ministry of Transport in Quebec hypothesized that the increase in bike fatalities and injuries might be connected to economic factors that induced an increase in all forms of travel demand, and thus greater exposure to the risk of accidents.

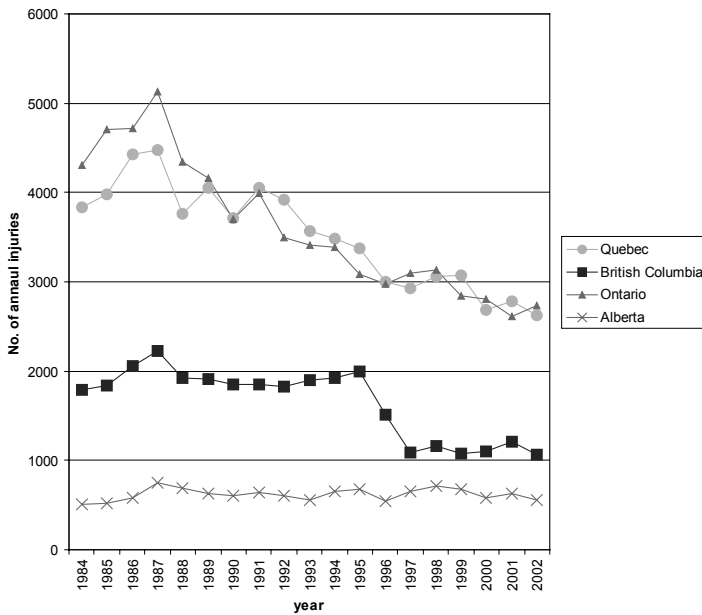
specific measures taken to promote cycling can only be examined at the provincial and local level.

Figure 2. Trends in Bicycling Fatalities in the Provinces of Quebec, Ontario, Alberta and British Columbia, 1984–2002



Source: Transport Canada (2004).

Figure 3. Trends in Bicycling Injuries in the Provinces of Quebec, Ontario, Alberta and British Columbia, 1984–2002



Source: Transport Canada (2004).

Federal Bicycling Policies

Traditionally the federal government in Ottawa had no involvement in cycling policies or funding. Only in 2003 did Transport Canada — the federal ministry of transport — announce the new Urban Transportation Showcase Program. In a nationwide competition, eight Canadian municipalities were awarded a total of \$40 million³ over five years for innovative projects that would help reduce GHGs from transportation sources (Transport Canada 2003). Four of the eight funded proposals included cycling elements in their overall projects. While this new funding is welcome, it is a one-time program and amounts to only about \$2 million a year in federal cycling funds for the entire country.

Bicycling Policies and Funding at the Provincial Level

The extent of provincial involvement in cycling policies and funding varies considerably by province. Generally, the involvement in most provinces relates to safety programming and regulations. Quebec is a notable exception in its strong support of cycling. The provincial ministry of transport, Transports Quebec, and the province-wide bicycle advocacy organization, Velo Quebec, have taken the lead in planning, coordinating, and funding the province-wide network of cycling paths. The province adopted an official bicycle policy in 1995 with the goal of increasing cycling levels while enhancing safety. As part of that official policy, all provincial transport infrastructure projects must incorporate the needs of cyclists in their design. \$89 million dollars in funding from Transports Quebec and about \$180 million from other government agencies and municipalities has helped Quebec's bikeway network grow almost ten-fold from 1992 to 2004 (from 778 to almost 7,000 km), with even more expansion planned (Transports Quebec 2004a and 2004b; Velo Quebec 2003). Contrary to most other Canadian provinces, helmet use is not mandatory in Quebec (Velo Quebec 2001).

The provincial government of Ontario provides virtually no funding, planning or program coordination for cycling. Ontario's involvement is limited to the regulations that most provinces have about whether helmet use is mandatory and on which highways cycling is permitted.

The provincial government of British Columbia provides only very limited funding for improvements in cycling infrastructure. Requiring at least an equal match by local governments, the province provided about \$2 million per year from 1995 to 2001, then suspended the program for three

³ All monetary figures are in Canadian dollars. One Canadian dollar is roughly equal to 0.8 U.S. dollars.

years, and re-instated the program in 2004 at only half the former level of support. Moreover, all municipalities applying for provincial funding are required to establish bicycling facility plans as part of their overall community development plans. That in itself has been a positive development. Helmet use has been mandatory throughout British Columbia since 1995, as well as front and rear lights on bikes used after sunset (Capital Regional District 1999 and 2003a).

Until recently, the direct involvement of Alberta's provincial government in bicycling was mostly limited to traffic regulations and occasional bicycle infrastructure projects, mainly for recreational cycling in parks. Alberta Transportation, the provincial transport ministry, maintains websites on bike safety education and publishes a series of bicycle safety brochures for children and adults, which are distributed free of charge (Alberta Infrastructure and Transportation 2006). Since 2001, a share of Alberta's provincial gasoline sales tax is returned to municipalities for transportation infrastructure improvements, including potential bicycling infrastructure programs. In 2005, the provincial government allowed municipalities to share its annual budget surplus. Local governments have to apply for this money on a project-by-project basis.

Bicycling Policies at the Local Level: General Findings

As difficult as it is to obtain comprehensive, nationwide information on federal and provincial policies and funding, it is even more difficult to obtain comparable data of individual cities. We present in this section, a brief summary of typical measures undertaken by Canadian cities, providing specific examples in a few cities. The cities included may not be fully representative, but they give some indication of what different cities are doing. Most of the information is based on detailed city case studies published elsewhere (Pucher and Buehler 2006 and 2005; Pucher et al. 1999) but with updates and the inclusion of a few additional cities, we investigated especially for this paper. Tables 3 and 4 summarize and compare some selected measures and policies implemented in the eight case study cities. While the information presented in the tables represents the best we could obtain, it is not necessarily exhaustive and not fully comparable, as we noted above. Fully comparable, complete statistics quite simply do not exist.

Bike Network

Table 3 presents our summary of the best available estimates of the length of separate cycling facilities per 100,000 persons in seven Canadian cities. Somewhat similar to the modal split statistics, the bicycling facilities sta-

tistics show large variation among cities within the same population size category. Cycling facilities appear to be considerably more extensive, at least on a per-capita basis, for medium-size cities than for large cities.

Table 3. Extent of Cycling Facilities in Selected Canadian Cities (km per 100,000 Population)

Population Size	Metropolitan Area	Kilometers of Bike Paths and Lanes per 100,000 Persons
3,000,000–5,000,000	Toronto	8.7
	Montreal	29.3
	Average	19.0
1,000,000–2,999,999	Vancouver	29.0
	Ottawa	65.9
	Average	47.5
500,000–999,999	Calgary	68.3
	Edmonton	64.6
	Quebec	54.0
	Average	62.3
	National Average	42.9

Source: Author's calculations, based on information from municipalities.

Statistics on the extent of bike lanes and paths understate the full extent of the cycling network, since they do not include signed bike routes on roadways or traffic-calmed residential streets. For example, Vancouver, Toronto, and Calgary rely heavily on traffic-calmed neighborhood streets as essential components in their overall cycling network. We attempted to collect statistics on the exact extent of traffic calming, but very few cities have this information. Bike lanes and paths can also vary in type. For example, almost all of Montreal's bike lanes are bi-directional and separated from motor vehicles by special barriers. Toronto and a few other cities have mixed-use bike/taxi/bus lanes on downtown streets. Many cities also have so-called "sidepaths," bike paths that closely parallel roads, with some sort of buffer between cyclists and motor vehicle traffic. Cycling on sidewalks is usually illegal, but common in all cities. In Edmonton, however, over 100 km of sidewalks have been officially designated as mixed-use facilities, with signs and pavement markings indicating that cycling is permitted.

Parking and Integration with Transit

Convenient, safe, and ample bike parking is an inducement to cycle, just as convenient, ample free car parking is an inducement to drive. Most of the large Canadian cities we studied in detail require the private provision

of bike parking in their zoning and building codes and make the public provision of bike parking on sidewalks and at transit stops a top priority (Pucher and Buehler 2005). The city of Toronto, for example, has almost 15,000 of its post-and-ring bike racks on sidewalks, and continues to install about 1,000 new racks per year. The city also provides bike parking at most rail transit stations. Indeed, Toronto is reputed to have the most bike parking of any city in either Canada or the U.S. Ottawa has the second-most bike parking in Canada, with over 10,000 bike racks in public spaces and government offices. Many cities in Canada also have specific policies to encourage integration of transit and cycling by putting bike racks on buses, allowing bikes to be taken on trains, and providing bike parking at transit stops.

Intersection Modifications, Safety Programs, and Other Policies

Several Canadian cities provide special intersection modifications that give cyclists an advance stop line as well as priority signaling, triggered either manually by push buttons or automatically by sensors in the pavement. Most Canadian cities have been improving their overall bike route network, with better linkages, better signage, and clearer route designations.

Almost all large and medium-size cities in Canada offer a wide range of cycling courses for all age groups through the national cycling education program CAN-BIKE as well as promotional events such as bike races, bike rodeos, and cycling festivals. Toronto has a Cycling Ambassador outreach program that sends a team of ten professionally trained cyclists into neighborhoods throughout the city to teach cycling safety and skills courses and to promote cycling in general. Several Canadian cities have detailed cycling maps available as well as extensive websites with a wide range of up-to-date information for cyclists. Montreal offers a special cycling café'-restaurant (Maison des Cyclistes) that also serves as a multi-faceted center to coordinate cycling events, provide information, promote cycling tourism, and repair bikes. Finally, many cities have introduced police squads on bikes.

Cycling Trends and Policies in Quebec

Cycling Trends in Montreal and Quebec City

The Province of Quebec overall has the same percentage of bike work-trips as Canada as a whole (1.2 percent). Montreal, however, has a much higher bike share of work trips than Canada's other major metropolis, Toronto

Table 4. Selected Policies Implemented in Canadian Cities to Promote Cycling				
City	Bike Network	Convenience & Parking	Safety Training	Promotion/ Other
Montreal	Some intersections with push-button activated bike traffic lights, 210 km of separate bike paths, 95 km of bike lanes, and 66 km of bike routes	1,600 bike parking spaces at metro stations and 550 spaces at suburban rail stations, bikes allowed on buses and trains during off-peak, lots of bike parking at universities	SAAQ (Societe d'Assurance Automobile du Quebec) promotes bike safety in many schools	Bike tours and races, bike magazine, maps, website, cycling cafe in Montreal
Quebec City	Some intersections with push-button activated bike traffic lights, 220 km of separate bike paths, 121 km of bike lanes, and 66 km of bike routes	Bike parking on sidewalks, at bus stops, and at the university, bike racks on buses		
Toronto	252 km of bikeways, including 154 km of off-road paths, 63 km of bike lanes, and 35 km of shared roadways, traffic calming in many residential neighborhoods	Intersections with special bike traffic signals, zoning code requires all large new developments to provide both bike parking and shower facilities for cyclists, 14,500 bike parking spaces on city sidewalks, bike and ride, bikes on subway and suburban rail at off-peak hours	CAN-BIKE	Cycling Ambassador Program, signage, bike map, bike events
Ottawa	511 km of bike routes on arterial and secondary roads (83km separate bike lanes, 81 km paved shoulders, and 35 km extra-wide shared lanes), 311 km of off-road bike routes	Intersections with special bike traffic signals, zoning and building codes require bike parking for certain kinds of land uses, 6,000 bike parking spaces, plus parking at federal offices	CAN-BIKE	Bike map, bike events
Vancouver	1,347 km of bike routes , mostly on lightly traveled roads	Cyclist-activated traffic signals, buses and ferries with bike racks	CAN-BIKE	Bike Month, bike map
Victoria	377 km of bike routes, some traffic calmed neighborhoods	Cyclist-activated traffic signals, buses and ferries with bike racks	Bike Smarts Program (schools), CAN-BIKE	Bike to Work Week, bike map
Edmonton	603 kilometers of bike trails and paths in parks, 250 kilometers bike routes along road rights-of-way (including 100 kilometers of shared-use sidewalks)	Bikes allowed on light rail and buses, 230 bike racks with over 1,000 bike parking spaces along bike routes	CAN-BIKE	Multi-Use Trail Corridor (MUTC) network project, Ribbon of Steel (ROS)
Calgary	550 kilometers of pathways and 260 kilometers of on-street bicycle routes, traffic calming	Bikes allowed on light rail and buses, 200 U-shaped bike racks in downtown	CAN-BIKE	"Park 'n Bike" sites

Note: The information presented in this table is not exhaustive and not necessarily comparable; details are discussed in the case studies in this paper.

(1.3 vs. 0.8 percent), in spite of colder weather throughout the year. Quebec City also has a 1.3 percent bike share of work trips, about the average for Canadian cities of that size, but impressive given the cold climate there. Although the bike share of work trips reported in the 2001 Canadian Census is the same in both Montreal and Quebec City (1.3 percent), other surveys suggest slightly higher cycling shares of travel in Montreal. Surely the most impressive accomplishment in Quebec has been increasing cycling levels while sharply reducing cycling injuries (Velo Quebec 2000).

Bicycling Infrastructure and Safety

Clearly, one reason for both the growth in cycling levels and its increasing safety is the enormous expansion of both off-road and on-road cycling facilities throughout the province of Quebec. In Montreal, there are 210 km of separate bike paths, 95 km of bike lanes, and 66 km of bike routes on lightly traveled roads. Although it is much smaller, Quebec City has even more cycling facilities: 220 km of separate bike paths, 121 km of bike lanes, and 66 km of bike routes on lightly traveled roads (Velo Quebec 2004a). For Quebec province as a whole, 41 percent of bike trips are on separate bike paths as opposed to shared roads (Velo Quebec 2001). In general, the Government of Quebec bears the cost of bikeway projects on provincial roadways, while municipalities finance bikeway projects on city streets. There are only a few intersections with push-button activated bike traffic lights, but no automatic sensors for cyclists, as in Toronto, Ottawa, and Victoria.

Cycling safety is promoted in many schools thanks to the Quebec car insurance company Societe d'Assurance Automobile du Quebec (SAAQ). It distributes free bicycling safety instruction materials and offers prizes of free bikes and bike helmets for winners of various cycling safety competitions (SAAQ 2004).

Cycling Convenience and Promotion

While bikes can be taken on some buses, metros, and suburban trains, especially at off-peak times, there are no special provisions for bikes on most transit vehicles (Agence Metropolitaine de Transport (AMT) 2004 and Velo Quebec 2003). Bike parking has also been expanded at metro and suburban rail stations. In 2000, Montreal had 1,600 bike parking spaces at metro stations and 550 spaces at suburban rail stations. Both Montreal and Quebec City have been increasing the number of bike racks on sidewalks, and their universities have thousands of bike parking spaces on their campuses (Velo Quebec 2003).

Quebec has been at the forefront of cycling promotion in Canada thanks to Velo Quebec, a private non-profit organization funded mainly by member fees, events, and sponsors (Velo Quebec 2004b). Velo Quebec sponsors numerous special events such as tours, conferences, races, and cycling courses. The organization also publishes a cycling magazine (Velo Mag), maintains an informative, multifaceted website, and operates a cycling café in Montreal that offers food as well as cycling publications and supplies (Maison des Cyclistes) (Velo Quebec 2004c).

Cycling Trends and Policies in Ontario

Cycling Trends in Ottawa and Toronto

The Ottawa metropolitan area has a considerably higher level of cycling than the Toronto metropolitan area: 1.9 vs. 0.8 percent of work trips (Statistics Canada 2003). Even though cycling's share of travel in metropolitan Ottawa has been falling slightly over the last years, Ottawa still has the highest bike share of travel of any major city in Canada and the United States.

Cycling trends vary greatly in Toronto between the inner and outer portions of the metropolitan area. For the greater metro area, the Canadian Census reports the same 0.8 percent bike share of work trips in both 1996 and 2001 (Statistics Canada 2003). For the much smaller core area called Metro Toronto, however, the Canadian Census bike share of work trips rose from 1.1 percent in 1996 to 1.3 percent in 2001. City counts also suggest considerable cycling growth in the inner portions of the metro area from 1999 to 2003 (Decima Research 2000; City of Toronto 2001).

Both Ottawa and Toronto have succeeded in improving cycling safety. In the past ten years, for example, cycling injuries have fallen by 33 percent in Ottawa, and cycling fatalities have been cut in half (City of Ottawa 1999-2003 and 2003b). Over the same period, cycling injuries in Toronto fell by 9 percent, and fatalities fell by about two-thirds (City of Toronto, 2005a).

Bicycle Infrastructure and Safety Promotion

Ottawa and Toronto have undertaken a broad range of measures to improve cycling safety (City of Ottawa 1994 and 2001; City of Toronto 2001 and 2003). Both cities have greatly expanded their systems of bike paths and lanes to provide more separate rights of way for cyclists. As of 2003, Ottawa had 511 km of bike routes on arterial and secondary roads, of which 83 km had separate bike lanes, 81 km had paved shoulders specifically for

cycling, and 35 km had extra-wide shared lanes. Ottawa also has 311 km of off-road bike routes. Included in Ottawa's total of 822 km of cycling facilities is the extensive system of bike paths known as the National Capital Pathway, mainly along waterways or in parks and greenways.

Although Toronto has been steadily expanding its network of bike routes, it remains much smaller than Ottawa's. In 2003, it offered 252 km of bike-ways (compared to Ottawa's 822 km), including 154 km of off-road paths, 63 km of bike lanes, and 35 km of shared roadways (City of Toronto 2001 and 2004). While Ottawa offers more cycling facilities, Toronto has more extensive traffic calming of its residential neighborhoods, making cycling on shared streets both safer and more pleasant. Toronto and Ottawa have many intersections with special bike traffic signals, including some with innovative roadway sensors that detect waiting bikes and automatically trigger a green light for cyclists.

CAN-BIKE in both Toronto and Ottawa offers a variety of education and training courses for all age groups and skill levels. In addition, Ottawa schools offer instructional programs for cycling skills and traffic safety. The City of Toronto recently took over the CAN-BIKE program and now runs it directly through its parks and recreation department, with instructors hired as city employees.

Toronto offers the most extensive bike parking facilities in all of North America, with a total of 14,500 bike parking spaces on city sidewalks as of 2004. The post-and-ring bike stand was developed in Toronto and has become a symbol of Toronto cycling (City of Toronto 2001). Toronto and Ottawa's zoning codes require new developments to provide both bike parking and shower facilities for cyclists for certain kinds of land uses. The City of Ottawa provides well over 6,000 bike parking spaces, not including the many thousands of bike parking spaces at federal offices and large employers, for which bike parking statistics are not available (City of Ottawa 2004).

Convenience and Bike Promotion

Intermodal coordination of cycling with public transport appears to be much better in Ottawa than in most Canadian cities. In addition to bike parking at all light rail (O-Train) and express bus (Transitway) stops, an increasing number of Ottawa buses come equipped with bike racks. Additionally, bikes are permitted on the O-Train at all times of day, while Toronto's subway and suburban rail trains only allow bikes during off-peak hours. Fortunately, there is bike parking at many subway and commuter rail stations in Toronto, thus facilitating bike and ride.

Both Toronto and Ottawa offer an impressive array of programs to promote cycling (City of Toronto 2001 and 2004; City of Ottawa 2001). Both cities have a detailed map of cycling routes, designating various kinds of bike routes, bike share pickup/drop-off sites, transit connections, and other items of interest to cyclists. Toronto's improved bike route signage system in itself is an attempt to encourage more cycling by making it easier to find the best routes to popular destinations.

Toronto has a unique Cycling Ambassador Program that employs about ten proficient cyclists who reach out to communities throughout the city, disseminating information about cycling; promoting safety; assisting with cycling courses; and gathering feedback from communities to improve the city's cycling policies and programs. In addition to all of these efforts by the Cities of Toronto and Ottawa, citizen groups have been key to promoting cycling.

Cycling Trends and Policies in British Columbia

Cycling Trends in Vancouver and Victoria

The Canadian Census reports that the bike share of work trips in the Vancouver metropolitan area rose from 1.7 percent in 1996 to 1.9 percent in 2001, but that increase may have been caused by a public transport strike during the survey period, which probably forced some riders to cycle instead of taking transit. Since another regional travel survey in 1999 reported the same 1.7 percent bike share of work trips as indicated by the 1996 Census, it is likely that the bike share of trips has been stable in recent years (Translink, 2001). As in Toronto, levels of cycling vary greatly between different portions of Vancouver's metropolitan area. While only 0.6 percent of suburban households made their work trips by bike in 1996, 3.3 percent of city residents commuted by bike, and in the university district, the share was 12.2 percent (Translink 2001).

Greater Victoria has an even higher bike share of work trips than Greater Vancouver — indeed the highest of any Canadian metropolitan area: 4.9 percent in 1996 and 4.8 percent in 2001, according to the Canadian Census.

Bicycling Infrastructure and Safety Promotion

Increased cycling safety in British Columbia is probably due to expanded cycling facilities, traffic calming of neighborhoods, improved education and training of both motorists and cyclists, and increased helmet use. In

addition to the CAN-BIKE program, the Bike Smarts Program in Victoria is aimed at cycling education for school children aged 7 to 13 years old (Capital Region District 2003a). Almost half of all Victoria area elementary schools participate in this program, which entails five hour-long sessions of cycling courses (taught by regular school teachers) on rules of the road, bike handling, and correct helmet use.

Both the Vancouver and Victoria regions have been steadily expanding their network of separate bike paths and lanes, while also extending their systems of bike routes on lightly traveled roads. Vancouver, for example, constructed sixteen bikeways from 1986 to 1999, with a total length of 133 km (City of Vancouver 1999). Nevertheless, most of the 1,347 km of bike routes in the Greater Vancouver area in 2004 were on lightly traveled roads, sometimes with modest accommodations for bikes. Indeed, it is the specific policy of Vancouver to focus on facilitating cycling on local side streets with low traffic volumes, including streets in traffic calmed residential neighborhoods (City of Vancouver 1999).

The Victoria Capital Region has a total of 377 km of bike routes (Capital Regional District 2003b). Moreover, some Victoria neighborhoods have been traffic calmed, thus reducing vehicle speeds and facilitating safe and pleasant cycling. There are ambitious plans for expanding the Capital Region's bike route network to 550 km and improving connections among routes, but funding is a key problem (Capital Regional District 2003a).

Both Victoria and Vancouver have made special efforts to accommodate cyclists at intersections (Capital Regional District 2003a; Translink 2004 and 2005). Cyclist-activated traffic signals are available at many locations. Victoria is expanding the number of intersections with special bike access lanes and bike boxes for cyclists waiting for a green light.

Local Funding, Bike Convenience and Promotion

From 1990 to 1999, Greater Vancouver spent almost \$6 million on bikeway facilities. Translink, the regional transport authority for Greater Vancouver was established in 1999 (Translink 2005). Since then, it has increased funding for cycling infrastructure to several million dollars a year, financed by a portion of the gasoline tax dedicated to transport improvements. Both Victoria and Vancouver have made considerable efforts at intermodal coordination with transit (Capital Regional District 2003a; Translink 2004 and 2005). Thus, most buses in both cities are equipped with bike racks, and bikes can be taken on the ferries at any time (Translink 2004).

Efforts to promote cycling in British Columbia include the Bike-to-Work Week in Greater Victoria and the Bike Month with over 50 events through-

out the Vancouver region (Capital Regional District 2003a; Translink 2004 and 2005). Bike route maps are available for both the Vancouver and Victoria regions.

Cycling Trends and Policies in Alberta

Cycling Trends in Edmonton and Calgary

With a bike share of 1.2 percent, the Edmonton census metropolitan area has the same share as Canada as a whole but trails its provincial neighbor Calgary, which has a bike share of 1.5 percent (Statistics Canada 2003). Cyclist fatalities in Edmonton have averaged a fairly stable one or two a year since 1989, while cyclist injuries have declined by 22 percent, roughly the same as the overall provincial average since 1989 (City of Edmonton 2006b).

Edmonton's mainly flat road and street network is ideal for cycling. In the north, Edmonton is intersected by the North Saskatchewan River Valley and Ravine system, which contains 603 km of bike trails and paths. About 130 km of these are granular or paved multi-use trails, 11 km are shared sidewalks, while 450 km are 0.5 meter or wider unpaved trails where cycling is permitted. Multi-use trails and shared sidewalks are open to all kinds of active transport modes, such as cycling, walking or inline skating. Besides the cycling facilities in parks, Edmonton boasts 250 km of cycling network along road rights-of-way. Of these, 105 km are on-road recommended bike routes, mainly on wide shoulders with special signage. An additional 30 km are multi-use trails along rail or utility rights-of-way, and 100 km are shared-use sidewalks. Shared use sidewalks are a minimum of 2.5 meters wide and are either marked with a "share the sidewalk" sign or a yellow line in the center separating cyclists and pedestrians. Furthermore, there are 6 km of shared bus, taxi and bike lanes and 6 km of contra flow bike lanes on one way streets where cyclists travel with cars in the permitted direction and in the bike lane in the opposite direction.

In 2002, the Edmonton City Council approved the \$22 million, 62 km Multi-Use Trail Corridor (MUTC) network, which will connect all quadrants of Edmonton to the downtown and the River Valley. Together with a planned secondary network of 140 km of connector routes (of which 50 km already exist), the corridor will greatly improve the connectivity of the bike network.

Another noteworthy project is the 600 meter long Ribbon of Steel (ROS). It is situated in a former rail right-of way and includes a 3.0 meter wide, asphalt multi-use trail for pedestrians, cyclists and other active modes, a

historic streetcar, as well as underground access to the light rail running beneath the corridor. The ROS is a good example for the development of bicycle planning in Edmonton since the 1990s. The City adopted its bicycle transportation plan in 1992, where it identified the potential to convert former rail corridors to bike paths. The Transportation Master Plan (1999) outlined the goal to develop non-motorized transportation facilities along abandoned rail lines. The Multi-Use Trail Corridor Study in 2002 resulted in the final approval by City Council.

With a bike share of 1.5 percent, the Calgary metropolitan area has the highest modal split for cycling to work of any Canadian city in its size category. City counts reinforce the impressive bike share of work trips, indicating that about 8 percent of commuters to downtown Calgary either walk or ride their bikes to work (City of Calgary 2006).

Timing of recent bicycle planning in Calgary has been similar to that in Edmonton. The Calgary Cycle Plan was adopted in 1996 and the Pathway and Bikeway Plan, was completed in 2000 (City of Calgary 2006). Within Calgary there are approximately 550 km of pathways and 260 km of on-street bicycle routes, mainly on low-traffic-volume residential roads. Calgary pursues the policy of making every street a bicycle friendly street by ensuring wide curb lanes, road maintenance and repair, bicycle friendly sewer grates and cyclist accommodations in traffic calmed areas.

Convenience and Safety Education

Many buses in Edmonton and Calgary have bike racks. Bikes are also permitted on light rail trains in Edmonton and Calgary, except for weekday morning and evening travel peak times (City of Edmonton 2006b; City of Calgary 2006). Bike parking exists at many light rail stations and major bus stops in both cities. Edmonton also has 230 bike racks with over 1,000 bike parking spaces along bike routes. This number underestimates the amount of bike parking in the city, as it neither includes the previously mentioned bike parking at transit stops nor the bike racks on private property and city facilities, such as recreation centers and libraries (City of Edmonton 2006b). Nearly all major office buildings in downtown Calgary offer secured indoor employee bike parking. The City of Calgary also installed 200 U-shaped bike racks in downtown in 2004 through its bicycle parking sponsorship program (City of Calgary 2006). Finally, the City of Calgary offers seven "Park 'n Bike" sites. They are located about 5 to 8 km from the city center, easily accessible from major highways. They enable direct access to the city core by bike. Commuters can park their cars and avoid downtown traffic congestion by cycling the segment leading to the city center (City of Calgary 2006).

As in most Canadian cities, volunteers run CAN-BIKE courses for children and adults in both Calgary and Edmonton. Both cities also publish and distribute cycling maps. Furthermore, Edmonton and Calgary carry out or support signage and cycle safety campaigns, organize annual bike events and conduct bicycle user surveys.

Conclusions, Policy Recommendations, and Future Research

All eight of the Canadian case study cities examined in this article have made impressive efforts to encourage more and safer cycling. The result is bicycling shares of urban travel roughly three times as high as in U.S. cities of comparable size. For all metropolitan areas in aggregate, the bike share of work trips in Canada was 1.2 percent in 2001, compared to only 0.4 percent in the United States (Statistics Canada 2003; Pucher and Renne 2003). That is particularly impressive given the long, harsh winters in most Canadian cities.

Nevertheless, Canadian cities are now struggling with many obstacles to further increasing cycling levels. Perhaps the most important challenge is the proliferation of low-density, sprawling suburbs spreading out around virtually every Canadian city, usually outside the local governmental jurisdiction of the central city (Nivola 1999). Thus, as noted for several case studies, bicycling is concentrated in the denser urban core, with the bike share of travel steadily declining with increased distance from the center. The strong trend toward suburbanization of both population and jobs in Canada works against efforts to promote cycling. Unless Canadian metropolitan areas can implement more mixed-use, compact, less car-dependent land use policies on a truly regional level that includes the suburbs, an increasing proportion of Canada's population will live in areas where cycling is impractical as a mode of daily transport, and will only be occasionally used for recreation.

There are other reasons as well for the stagnation of cycling levels in many Canadian cities in recent years after considerable growth during the 1970s and 1980s. Until now, only the politically "easy" measures have been adopted. Unlike the wide range of car-restrictive measures found in most European cities, Canadian cities, much like their U.S. neighbors to the south, have been quite hesitant to impose restrictions on car use or to increase its price (Pucher and Lefevre 1996; Pucher 2004; Transportation Research Board 2001). Traffic calming of residential neighborhoods, car-free zones, parking restrictions, and parking supply limitations are not nearly as extensive as in most European cities. Moreover, gasoline prices, motor vehicle registration fees, sales taxes on cars, roadway tolls, and parking prices are generally only a fraction of European levels (Pucher 1998).

The wide range of “carrot and stick” measures in European cities have helped achieve bike modal shares of travel that average about 10 percent for Western European countries, but range widely from lows of 4 to 6 percent in the United Kingdom, Italy, and France to highs of 20 to 30 percent in Denmark and the Netherlands (Pucher and Dijkstra 2003). Unless Canadian cities can implement more of the European-style “stick” measures against excessive car use — while enhancing the safety and feasibility of alternative modes — it may be difficult to convince increasingly suburbanizing Canadians to drive less and bike, walk, and take transit more often.

Even the “carrot” measures used to encourage cycling in Canadian cities have been far more limited than those used in European cities (Pucher 1997). No Canadian city has a truly comprehensive, integrated, regional network of cycling facilities such as those found in so many Dutch, German, and Danish cities. The lack of integrated facilities forces cyclists to share the road with motor vehicles for most of their trips, often diminishing the safety, feasibility, and attractiveness of cycling for many potential cyclists, especially children, the elderly, the inexperienced, and anyone who finds cycling in mixed traffic unpleasant and stressful.

Coordinating public transport with bicycling is crucial to encouraging increased use of both of these modes. Especially in lower-density residential areas, cycling is ideal as a feeder and distribution system to access public transport stops. Such integration can be achieved by provision of convenient and secure bike parking at both rail and bus stops, bike racks on all buses, and accommodation of bikes on all rail transit vehicles.

Virtually all of the many case study respondents contacted for this research indicated that a lack of government funding was a crucial hindrance to that needed infrastructure expansion. With the exception of Quebec, no other Canadian province has provided significant funding, coordination, planning, or policy guidance to assist local communities. The Province of Ontario, in particular, is noteworthy for directing so few resources towards cycling, but British Columbia and Alberta have not been much better.

Similarly, Canada’s federal government has neglected cycling as a serious transport mode. National legislation similar to the U.S. Intermodal Surface Transportation Efficiency Act (ISTEA) and Transportation Equity Act for the 21st century (TEA-21) could greatly increase funding for investments in cycling infrastructure (U.S. Department of Transportation, 2004a, 2004b, and 2004c). The Canadian federal government should also provide more research funding and more guidance in bicycling planning. That would foster the necessary collaboration and exchange of ideas and experiences of local bicycling planners throughout the nation, which is particularly important as provinces and cities in Canada have primary responsibility for meeting the Kyoto Accord targets on curbing GHG emissions.

Cycling is surely the most sustainable of all mechanized transport modes, producing virtually no pollution of any kind and requiring no non-renewable energy resources at all. It is time for the Canadian federal and provincial governments to provide the sort of support for cycling that would enable cities to make the needed investments in cycling infrastructure, as well as fund to complementary educational, training, and law enforcement programs. Without such increased federal and provincial government involvement, it may be that cycling in Canadian cities has now reached a plateau. Even at this current level, Canada far outperforms the United States in cycle use; nonetheless, given concerns for transport sustainability, it would be prudent to provide the funding that would enable Canadian cities to realize the enormous unmet potential for more cycling. That, in turn, would help achieve a range of environmental, safety, energy, congestion reduction, and public health benefits.

Future research on cycling in Canada would benefit from much greater involvement of the federal government in collecting data on bike use and bicycling facilities. As mentioned earlier, Canada does not have a nationwide travel survey collecting comparable data on bicycling for all trip purpose throughout the year. A national travel survey, with a special focus on bike trips, would be an excellent source of information on cycling levels and bicyclist characteristics, including variability across cities and provinces as well as differences by season of the year and trends over a period of years. The federal government might also establish a periodic inventory of bicycling facilities in Canada's cities and provinces. Such data should be collected using standardized definitions of bike facilities and programs. Together, such a nationwide travel survey and inventory of cycling infrastructure would enable researchers and practitioners to evaluate the success of specific measures geared towards promoting bicycling and to identify and implement best practices.

Acknowledgments

The authors would especially like to thank Claire Stock, Nicole Jensen, Jeff Grutz, and Fred Wilton for the information they provided for our case studies of cycling in Alberta Province.

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