How far out of the way will we travel?

Built environment influences on route selection for bicycle and car travel

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Background

Current travel demand models are calibrated for motorized transportation, and perform less well for non-motorized modes. Little evidence exists on **how much**, and **for what reasons**, the routes people actually travel deviate from shortest-path or least-cost routes generated by transportation models.

The purpose of this study was to identify factors to be considered in travel models when modeling travel by bicycle, making comparisons to motorist travel. We investigated differences in total distance, road type used, and built environment features along the shortest distance routes and the actual routes for car and bicycle trips in an urban area with extensive bicycle facilities, the Metro Vancouver region.

The study captures travel behaviors in a population-based sample of cyclists, including potential, infrequent, and regular cyclists, a population purposefully selected based on Stages of Change Theory from health promotion.

Metro Vancouver

Setting

The Metro Vancouver region in southwestern British Columbia, Canada comprises 21 municipalities and a population of 2.6 million. The median work commute distance is 7.4 km, suggesting that that cycling is a viable mode for daily travel in the region. The region has a mild climate, facilitating cycling year round. Despite this, cycling mode share for work trips is only 3.7% within the city itself, and 1.7% for the entire census metropolitan area.

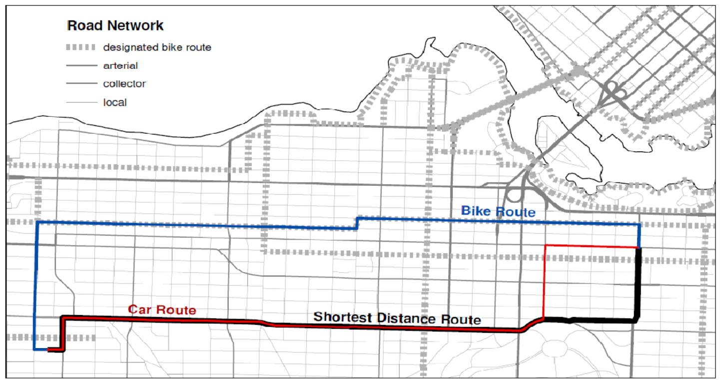
Bicycle facilities

The region has over 1300 km of "designated" bike routes, about 170 km of which are off-road.

Methods

- Interviews with a random sample of participants from the Cycling in Cities survey
- Collected trip data on 117 trips from 74 individuals:
  - 8% cycled ≥ 1 week, 43% ≥ 1/month, 35% ≥ 1/year, and 14% had not cycled in the past year
- Compared shortest distance and actual travel route, using GIS tools to calculate:
  - Total trip distance
  - Distance traveled along road type classifications
  - Built environment measures in a 250 m buffer around route.

Shortest vs. actual travel routes by car & bike



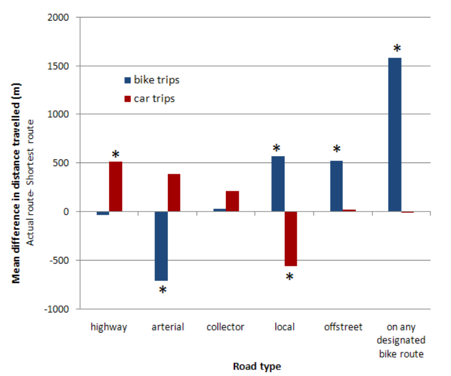
Actual route: reported travel path. Shortest distance route: modeled using Dijkstra's algorithm, weighted on distance

Differences in Built Environment

	Bike Trips (n=50)			Car Trips(n=67)		
	Actual route	Shortest route	Difference (actual-shortest)	Actual route	Shortest route	Difference (actual-shortest)
Built environment variable[a]	Mean	Mean	Mean	Mean	Mean	Mean
gross population density (per ha)	0.35	0.36	-0.01	0.23	0.23	0.00
% of land area with green cover	31.6	32.5	-0.92	30.4	30.5	-0.04
average air pollution (ppb NO_2)	27.7	28.2	-0.56	29.4	29.1	0.35
variation in elevation	13.0	13.4	-0.34	18.4	17.5	0.92
% of road segments >10% slope	1.1%	1.0%	0.00	1.6%	1.4%	0.00
# traffic calming features	6.0	4.0	**1.96** [b]	2.8	2.4	0.42
# stencils	37.2	27.6	**9.66** [b]	21.6	24.4	-2.78
# bike route signs	25.9	18.6	**7.30** [b]	18.1	17.8	0.28
# traffic crossings with bike activated signals	4.5	3.8	0.76	3.2	2.9	0.33
ratio of 4 way intersections: all intersections	0.42	0.41	0.01	0.35	0.35	0.00
% of land area with use:						
agriculture	4.1	4.6	-0.53	3.1	3.1	0.01
commercial	3.4	3.3	0.05	3.8	3.6	0.16
education	3.1	2.9	0.17	2.1	2.1	0.07
entertainment	0.15	0.16	-0.02	0.14	0.11	**0.03** [b]
industrial	3.6	3.3	0.32	4.0	3.9	0.09
office	1.5	1.3	0.17	1.4	1.4	-0.03
park	8.6	8.6	0.01	8.4	7.7	0.63
single family residence	37.0	36.8	0.12	37.1	38.4	-1.31
multifamily residence	2.2	2.3	-0.11	2.4	2.3	0.07
land use mix	0.27	0.26	0.01	0.29	0.28	0.01

[a] within a 250 m buffer of the route
[b] $p<0.05$ in paired t-tests of whether the mean difference between actual route and shortest route is different than 0

Differences in Road Type Used



**p* < 0.05 in paired t-tests of whether mean difference in distance travelled on road class X between a given actual and shortest route pair is different than 0, for each road class.*

How far out of the way do people go?

	Shortest route	Actual route	Mean detour	95% CI
Car trips (n=67)	6.9 km	7.4 km	**0.5 km**	0.29-0.79
Bike trips (n=50)	4.9 km	5.3 km	**0.4 km**	0.14-0.58

Regardless of mode, people do not detour far off the shortest distance route.

Detour ratios (actual distance/shortest distance) were similar between modes:

- ¾ of trips within 10% of the shortest path route distance
- at least 90% within 25% of the shortest path route distance.

Policy Implications

Road infrastructure and bicycle-specific aspects of the built environment do influence travel patterns in mode-specific ways:

- Cyclists deviate from shortest routes to routes with better bicycle facilities (traffic calming features, bike stencils, and signage) and to local roads, off-street paths, and designated bike routes.
- Car drivers detour from shortest routes to highways and arterials.

Cyclists are a heterogeneous population and not all will make the same route choices. However, this study included regular and infrequent cyclists, work and non-work trips, and its findings clearly indicate the importance of bike facilities.

These factors should be considered in transportation models to more accurately reflect bicycle travel.

Furthermore, this research provides guidance about how dense a bike network needs to be to attract more people to cycling for daily travel: cyclists are unlikely to detour more than ~ 0.4 km to find good facilities.

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