ANNOTATED BIBLIOGRAPHY ACTIVE TRANSPORTATION (ONGOING UPDATES)

Curated by SAFE Summerside Last Update: December 7, 2023

(Project is in infancy so be kind and gentle 😊)

Document Vision: Serve as a one-stop-shop for all things AT.
Each section will begin with a summary of research and then we provide an annotated bibliography.

Topic not listed? Or have relevant research?

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BI-DIRECTIONAL VS UNIDIRECTIONAL

Summary

There is a well-supported negative safety outcome of bi-directional pathways at intersections and driveways based on literature in Canada (Wexler, 2017; Harris et al., 2013; Nosal and Miranda-Moreno, 2012a, Nosal and Miranda-Moreno, 2012b, Teschke et al., 2012) and internationally (Cicchino, 2020; IIHS, 2019; Wachtel and Lewiston, 1994). The overarching concern is contraflow traffic: Drivers turning right hit cyclists because they looked left for cars and did not expect/look right during the critical turning phase (Reynolds, 2009; Rasanen and Summala, 1998; Wachtel and Lewiston, 1994). Other studies recommend that cycle tracks end before intersections as intersections are the leading location of injuries (Marques et al., 2015) and even to include tunnels or overpasses (Gårder, 1994). In Montreal, bicyclists viewed intersections with bidirectional cycle tracks twice as negatively at the mid-point (Transportation Research at McGill, 2013). We include various Active Transportation Plans and Street Engineering documents in this literature review since they are based on best practice:

- the PEI Active Transportation Network Plan (draft, 2022) states “bi-directional facilities can present design challenges, such as increased conflict at driveways and intersections”,
- the Transportation Association of Canada (TAC) states “two-way protected or buffered bicycle lanes without parking separation tend to increase bicyclist collision risk at intersections,” (2020)
- the TAC’s the Geometric Design Guide for Canadian Roads states bidirectional works for “long block lengths [no intersections]”.
- The BC Design Guide (2019): “Uni-directional bicycle pathways are more appropriate within this context [adjacent to a road]. Uni-directional pathways travel in the same direction as motor vehicle traffic and also provide greater access to destinations than a bi-directional multi-use or bicycle pathway on one side of the road. In some contexts, such as areas with fewer motor vehicle interactions, bi-directional bicycle pathways may be considered.”
- The Protected Intersection Design Guide (Ottawa, 2021) recommended special guidelines for contraflow movement on bidirectional pathways: all intersections with a traffic volume of over

100 vehicles in peak hour are required to have a Fully Protected Right Turn Phase on bidirectional Pathways to offset the travel concerns.

- Marianne Giguere, City Councillor, Special Advisor Montreal City Hall, states: "We have had enough bidirectional cycle paths in Montreal. We know it is not comfortable enough, safe enough, wide enough because at every intersection it is just too complicated for everyone. That is how we worked before, but that is not how we are going to work right now." (Eckerson, 2021)

Annotated Bibliography Bidirectional vs Unidirectional

British Columbia Active Transportation Design Guide (2019). Ministry of Transportation and Infrastructure https://tinyurl.com/BCATGuide

The BC Design Guide is often used as the "Canadian National Standard." The Design Guide is a comprehensive set of planning and engineering guidelines offering recommendations for the planning, selection, design, implementation, and maintenance of active transportation infrastructure across the province. The Design Guide was developed based on national and international best practices and is one of the most comprehensive and innovative active transportation planning and design documents that has been developed to date anywhere in North America.

Some key points bidirectional findings in the BC Design Guide:

- "Conflict points along corridors with unidirectional protected bicycle lanes can be more predictable when compared to bidirectional facilities. This is because when people are cycling in the same direction as motor vehicles, it is easier for motorists to anticipate their movements. Bi-directional facilities have sometimes been found to have higher collision rates than uni-directional facilities when comparing collisions between motorists and people cycling travelling in a contraflow direction." (p.166)
- "Bi-directional protected bicycle lanes may be considered on constrained corridors where there is insufficient space for a pair of uni-directional protected bicycle lanes, or on one-way roads" (p.167)
- "Limited access to destinations on the other side of the road may result in sidewalk cycling and potential conflicts with people walking." (p.167)
- "People walking and motor vehicle drivers who are turning may not expect to see people cycling in the contraflow direction. This can increase collision risk, particularly at intersections, laneways, and driveways where drivers and pedestrians fail to look for people cycling approaching from the contraflow direction." (p.167)
- "Contraflow movements require special attention at intersections, driveways, and other conflict points, as pedestrians and motorists may not anticipate contraflow bicycle movements. Providing a bi-directional protected bicycle lane on a two-way road introduces contraflow movement which can be challenging to accommodate. The same challenge can occur when providing a bidirectional protected bicycle lane on a one-way road." (p.167)
- Connectivity: "Uni-directional bicycle pathways are more appropriate within this context, as people cycling will be travelling adjacent to a road. Uni-directional separated bicycle pathways . . . allow people cycling to travel in the same direction as motor vehicle traffic

and also provide greater access to destinations than a bidirectional multi-use or bicycle only pathway on one side of the road." (p. 213)

- "When considering a bi-directional facility, particularly if it is adjacent to a roadway, it is important to review all constraints and challenges with contraflow travel by all users of the pathway. Contraflow bicycle movements in particular requires special attention at intersections, alleyways driveways, and other conflict points as people walking and driving may not anticipate contraflow movements. Appropriate sight distances between motorists and bicycle users are important to allow both parties to react accordingly." (225)
- "Uni-directional bicycle pathways are more appropriate within this context [adjacent to a road]. Uni-directional pathways travel in the same direction as motor vehicle traffic and also provide greater access to destinations than a bi-directional multi-use or bicycle pathway on one side of the road. In some contexts, such as areas with fewer motor vehicle interactions, bi-directional bicycle pathways may be considered" (p. 235)

Cicchino, Jessica B., McCarthy, Melissa L., Newgard, Craig D., Wall, Stephen P., DiMaggio, Charles J., Kulie, Paige E., Arnold, Brittany N., Zuby, David S. (2020) Not all protected bike lanes are the same: Infrastructure and risk of cyclist collisions and falls leading to emergency department visits in three U.S. cities. Accident Analysis & Prevention, Volume 141,105490, https://doi.org/10.1016/j.aap.2020.105490 . Request free access to full article.

Cicchino (2020) examined the risk of collisions or falls leading to emergency department visits associated with bicycle facilities (e.g., protected bike lanes, conventional bike lanes demarcated by painted lines, sharrows) and other roadway characteristics in three U.S. cities. They surveyed 604 patients from emergency departments in Washington, DC; New York City; and Portland, Oregon during 2015–2017 who fell or crashed while cycling. They found that protected bike lanes with heavy separation (tall, continuous barriers or grade and horizontal separation) were associated with lower risk (adjusted OR = 0.10; 95 % CI = 0.01, 0.95), but those with lighter separation (e.g., parked cars, posts, low curb) had similar risk to major roads when one way (adjusted OR = 1.19; 95 % CI = 0.46, 3.10). Of importance, **bidirectional (two-way) bike lanes were found to be at a higher risk** (adjusted OR = 11.38; 95 % CI = 1.40, 92.57). They stated that "heavier separation," less frequent intersections with roads and driveways, and less complexity appear to contribute to reduced risk in protected bike lanes, stating that planners should minimize conflict points when choosing where to place protected bike lanes and should implement countermeasures to increase visibility at these locations when they are unavoidable.

Some direct quotes:

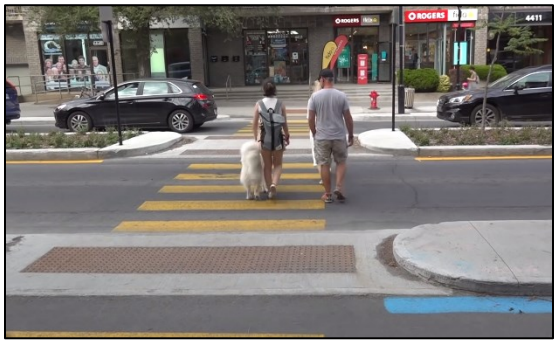
- Interactions between intersection presence and route type indicated that cyclists were significantly more likely to crash or fall at intersections on bike lanes (p=0.0018) and on local roads with bike lanes, sharrows, or traffic calming (p=0.0098) than at nonintersections on these facilities relative to major roads. Similarly, an interaction between intersection presence and grade indicated. (p. 6)
- In protected bike lanes, 60.0 % of incidents involving moving vehicles occurred at intersections, 26.7 % at junctions with driveways or alleys, 6.7 % at junctions with exit ramps, and 6.7 % at midblock (not at junctions). Most incidents involving pedestrians in protected bike lanes occurred midblock (66.7 %) (p. 6)

- Intersections and other junctions can be particularly challenging for vehicles turning across contraflow or two-way protected bike lanes, because drivers look most frequently in the direction of traffic and thus may be less likely to detect cyclists approaching from the opposing direction (Räsänen and Summala, 1998; Schepers et al., 2011; Summala et al., 1996). Two-way protected bike lanes alongside two-way vehicle traffic add additional complexity as turning drivers need to monitor both oncoming vehicle traffic and two-way bicycle traffic in the bike lane. The riskiest protected bike lane segment in this study was a two-way lane with light separation along a two-way street. (p.10)

Eckerson, Clarence Jr (2021) Streetfilms: Biking Montreal: Montreal's Newest Bicycling Infrastructure Dazzels! 1,000 film feature: https://www.youtube.com/watch?v=GSl0doR9lD4

Eckerson features Montreal's REV (the express bicycle route). The route had previously two lanes of cars and cyclists bicycling with traffic. Now, the street has midway pedestrian crossings which slow down cars and large protected widths (some are 3.5-4 m wide) to provide side by side riding and for families to ride together.

In the "Moving Away from 2-Way" section of the film, Marianne Giguere, City Councillor, Special Advisor Montreal City Hall, states: "We have had enough bidirectional cycle paths in Montreal. We know it is not comfortable enough, safe enough, wide enough because at every intersection it is just too complicated for everyone. That is how we worked before, but that is not how we are going to work right now." (7:41)



Gårder, Per (1994). Bicycle Accidents in Maine: An Analysis. Transportation Research Record, 1438, 34-41.

Gårder analyzed over 2,000 police-responded bicycle accidents. Gårder also included hospital-reported accidents and found only 14 percent were reported to the police, and that roughly three out of four accidents involving a bicyclist happen at intersections. The risk of intersections on off-street bike paths is because turning motorists do not observe the cyclist as easily as when they share the same right-of-way and partly because the angle of collision typically increases from almost parallel to about 90 degrees when the bike path is installed. These differences result in more serious accidents. Gårder found that in 86 percent of the accidents the bicyclist was going straight through an intersection and hit by a vehicle. Gårder recommended a separation by tunnels or overpasses at intersections – with more study (and education) required to keep the most vulnerable road users safe.

TO LOCATE THIS STUDY - A DIFFERENT Gårder et al study concluded that cycle tracks may enhance safety between intersections, but not at intersections, and recommended the cycle lanes stop at intersections.

Harris, A., Reynolds, C. C. O., Winters, M., Cripton, P. A., Shen, H., Chipman, M. L., … Teschke, K. (2013). Comparing the effects of infrastructure on bicycling injury at intersections and non-intersections using a case-crossover design. Injury Prevention, 19(5), 303–310. http://doi.org/10.1136/injuryprev-2012-040561

Harris et al. (2013) studied 683 adult bicyclists who were injured in Toronto and Vancouver in a injury risk. The authors found that motor vehicle speeds less than 30 km/h reduced the risk. Downhill grades increased the risk at intersections, as did high cycling traffic, but traffic circles (roundabouts) were more hazardous than all other intersection types (traffic lights, two-way stops, four-way stops, and uncontrolled intersections). They also found a suggestion of increased risk with shared lanes or sharrows. They also found bicyclist injury risk was significantly lower on protected bicycle lanes compared to roadways without bicycle facilities (adjusted OR 0.05, 95% CI 0.01 to 0.59). Also, cyclists coming from riding on a sidewalk **(common practice in Summerside)** enter the street traveling opposite the flow of traffic (because the sidewalk is only on one side of street) was associated with increased risk of injury. In fact, they state that infrastructure that pairs cyclists with either motor vehicles (shared lanes and sharrows) or pedestrians (multi-use paths, sidewalks) offered no such protection and that shared lanes and sidewalks were associated with increased odds of injury. Lastly, they included a variable indicating whether the cyclist was travelling in the opposite direction to motor vehicles and found it to significantly increase risk at intersections. "While not an infrastructural variable, it can be related to infrastructure (eg, sidewalk riding) or **forced by infrastructure (two-way cycle lanes at one side of the street)**" (p.306)

Harris, M. A., Reynolds, C. C., Winters, M., Chipman, M., Cripton, P. A., Cusimano, M. D., & Teschke, K. (2011). The Bicyclists' Injuries and the Cycling Environment study: a protocol to tackle methodological issues facing studies of bicycling safety. Injury prevention : journal of the International Society for Child and Adolescent Injury Prevention, 17(5), e6. https://doi.org/10.1136/injuryprev-2011-040071

Harris et al (2011) interviewed 690 injured cyclists from emergency visits of five hospitals in Vancouver and Toronto during 18 months with the goal to "[s]ystematically investigat[e] the influences of the built environment on injury risk [to] allow urban planners and transportation engineers to make informed design choices to make cycling safer and more appealing." (p 4) The mean length of the injury trip was 5.4km, and 72% reporting cycling four or more times per week. Found the Study Protocols but did not discuss the RESULTS and CONCLUSION sections.

Insurance Institute for Highway Safety (2019). IIHS Study: Some Protected Bike Lanes Leave Cyclists Vulnerable to Injury. PR Newswire US. https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,sso&db=bwh&AN=201908151400PR.NEWS.USPR.PH43423&site=ehost-live&scope=site

The results of the Cicchino et al (2020) study is expanded in this IIHS article. They found protected bike lanes vary in terms of injury risk. Factors such as the number of driveways or alleys intersecting the lanes and **whether the lanes are one- or two-direction affect the likelihood of a crash or fall**. When looking at one two-way protected bike lane, the combination of busy intersections and junctions and a two-way bike lane likely contributed to the high risk because "intersections and junctions at a two-way bike lane can be particularly challenging for turning drivers. They need to look for oncoming traffic as they turn and must look in both directions for bicyclists." The paper's authors advise cities to locate protected bike lanes where there are fewer junctions if possible or to consider raised cycle crossings, which have been found to improve safety on protected bike lanes in Europe. They also suggest cities take measures to prevent pedestrians from entering bike lanes.

Lusk, Anne & Furth, Peter & Morency, Patrick & Miranda-Moreno, Luis & Willett, Walter & Dennerlein, Jack. (2011). Risk of injury for bicycling on cycle tracks versus in the street. Injury prevention : journal of the International Society for Child and Adolescent Injury Prevention. 17. 131-5. 10.1136/ip.2010.028696.

Lusk et al. (2011) found that 2.5 as many cyclists rode on cycle tracks as compared to non-protected alternative parallel routes in Montreal. [This statistic is used by the Canada Active Transportation Strategy to highlight a protected cycle lane increases users by 2.5 times.] The objective of this study was to compare bicyclist injury rates on cycle tracks versus in the street. For six cycle tracks and comparable reference streets, from January 1999 to July 2008, Lusk et al found that these cycle tracks had a 28% lower injury rate and that separated two-way paths "are safer or at least no more dangerous than bicycling on the street."

Table 3 Relative danger from vehicular traffic*

Cycle track street	Reference street	MVO injuries†		Relative traffic danger of cycle track street (95% CI)‡
		Cycle track street	Reference street	
1. Brébeuf	**St Denis (N)**	8	90	**0.09 (0.04 to 0.18)**
2. Rachel	Mont Royal	86	69	1.25 (0.91 to 1.73)
3. Berri	St Denis (S)	127	116	1.09 (0.85 to 1.41)
4. Maisonneuve	**Both**	13	59§	**0.22 (0.12 to 0.40)**
	Sherbrooke (W)		*72*	
	Ste Catherine		*46*	
5. Christophe Colomb	**Both**	367	217§	**1.69 (1.43 to 2.00)**
	Saint-Hubert		*268*	
	Christophe Colomb (S)		*166*	
6. René Levesque	Sherbrooke (E)	196	205	0.96 (0.79 to 1.16)
All	All	797	756	1.05 (0.95 to 1.16)

*Statistically significant comparisons are shown in **bold**.
†Injuries to motor vehicle occupants recorded by emergency medical response (EMR) services between 1 January 1999 and 31 July 2008.
‡95% CI calculated using the variance of log(RR) based on a Poisson distribution.
§For comparisons having two reference streets, the average number of injuries of the reference streets is used.
MVO, motor vehicle occupant.

However, when I look at the data (above), we don't see a 28% safer; the data shows the bi-directional protected AT pathway is safer at times, similar, or less safe than an unprotected parallel alternative street. There was no comparison of one-way cycle tracks in the same manner as a bidirectional. We would anticipate a one-way recording less injuries.

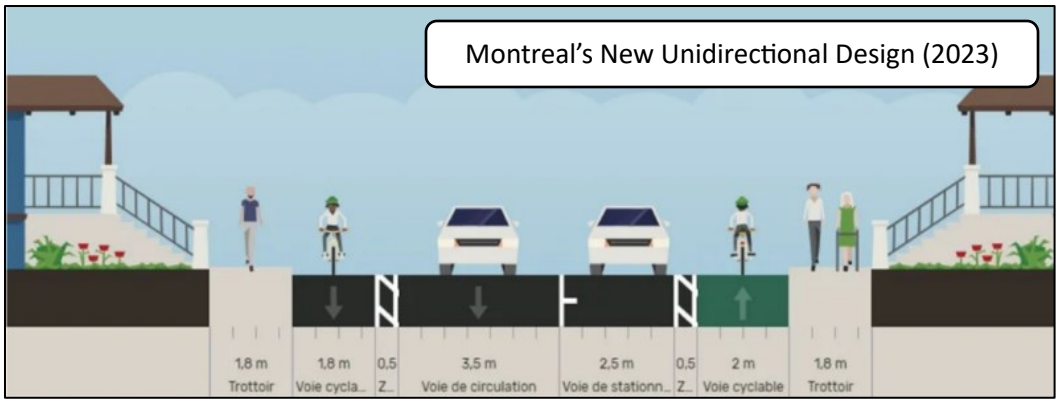
Cycle track	Configuration	Crashes/ year‡‡	Injuries per million bike-km	Crashes per million bike-km
1. Brébeuf (seasonal)	2-Way, 1 side of one-way street, street level	1.8	*4.1*	*1.9*
2. Rachel	2-Way, 1 side of two-way street, street level	17.0	*11.6*	*15.7*
3. Berri	2-Way, 1 side of two-way street, street/sidewalk level	10.2	*12.5*	*16.4*
4. Maisonneuve, w. island (seasonal)	2-Way, 1 side of one-way street, street level	2.6	*2.3*	*3.2*
5. Chr Colombe (seasonal)	2-Way, 1 side of two-way street, sidewalk level	9.2	*14.1*	*19.3*
6. René-Levesque	2-Way, 1 side of two-way street, street level	3.2	*12.3*	*13.9*
All		44.0	***8.5***	***10.5***

Marques, R. & Hernández-Herrador, V. & Calvo-Salazar, M. & García-Cebrián, J.A.. (2015). How infrastructure can promote cycling in cities: Lessons from Seville. Research in Transportation Econ omics. 53. 10.1016/j.retrec.2015.10.017.

Marques and Hernandez-Herrador studied the development of a fully segregated network of cycle paths in the period 2006-2011, with particular emphasis on its consequences for mobility in Seville, Spain. Apart from the obvious aim of achieving segregation from motorized traffic, the Seville network considered connectivity, continuity, visibility, uniformity, bi-directionality and comfort as criteria for the design of the infrastructure. They found that **most injuries in cycle tracks (protected off-street bike paths) occur at intersections and recommend ending the bidirectional cycle tracks before intersections**. We could not locate the published article but were able to read the pre-print article.

Montreal, The City (2023). A New Bike Lane Project on Rue de Terrebone. The City of Montreal website post, October 30, 2023: https://montreal.ca/en/articles/new-bike-lane-project-rue-de-terrebonne-58750

The borough of Côte-des-Neiges–Notre-Dame-de-Grâce borough is proposing an improved plan for Rue de Terrebonne following a recent mobility study. The main objective of the Rue de Terrebonne redesign project is to make travel safer for cyclists by creating a protected unidirectional bike lane on both sides of the street for the entire length of Rue de Terrebonne, while calming traffic along the artery.



Nosal, T., & Miranda-Moreno, L. (2012a). Cycle-Tracks, Bicycle Lanes, and On-street Cycling in Montreal, Canada: A Preliminary Comparison of the Cyclist Injury Risk. Presented at the 91st Annual Meeting of the Transportation Research Board, January 22-26, Washington, DC, 2012.

We have been unsuccessful in obtaining this presentation, but the findings have been referenced by the Transportation Research Board (https://trid.trb.org/view/1130063): This paper estimates the relative cyclist injury risk of bicycle facilities with respect to streets without bicycle provisions, and explores the differences in cyclist injury risk between different types of facilities, namely, cycle-tracks and bicycle lanes. The cyclist injury rates for a set of four cycle tracks (totaling 11.75 km) and

four bicycle lanes (totaling 3.76 km) in the City of Montreal are compared to injury rates for corresponding control streets using relative risk ratios. Nine control streets are used. Overall, it was found that most bicycle facilities in the analysis do indeed exhibit lower cyclist injury rates than the corresponding control streets. Furthermore, **factors that may affect the injury risk of a particular bicycle facility include whether or not it is bidirectional,** visibility, physical separation, presence and location of parking, vehicular traffic, and the direction of vehicular traffic. However, further research is required to determine the exact effect of these factors, and to address several limitations in data.

Further, as referenced by Crash Modification Clearinghouse (https://www.cmfclearinghouse.org/detail.php?facid=4099): This treatment involves the **installation of a unidirectional bicycle lane adjacent to traffic**, reported as the greatest expected reduction of crash modification factors with respect to all potential combinations of the control group.

Nosal, T., & Miranda-Moreno F, L. (2012b). Bicycle-Tracks, Bicycle Lanes, and On-street bicycling in Montreal, Canada: A Preliminary Comparison of the bicyclist Injury Risk. Trb, 19p. Retrieved from https://trid.trb.org/view/1130063 and summary provided by the Transportation Association of Canada:

Nosal et al. (2012) studied eleven two-way protected bicycle lanes and four painted bicycle lanes, along with nine control streets in Montreal, Quebec. The study expanded short duration bicycle counts into estimates of annual average daily bicycle volumes using continuous bicycle count data. Injury data was provided by the Department of Public Health for which an ambulance was sent. The authors found that the overall average relative risk values show that bicyclist injury rates along roads with bicycle facilities (two-way protected bicycle lanes and painted bicycle lanes) were considerably lower than on the roads without bicycle facilities. Findings include:

(1) Along roadways, the range in relative risk (RR) values between two-way protected bicycle lanes with parking and control streets is 0.05 – 0.80 with an average RR of 0.27. This indicates that two-way protected bicycle lanes with parking may reduce crash risk along roadways relative to streets without bicycle facilities.

(2) At intersections, the range in relative risk (RR) values between two-way protected bicycle lanes with parking and control streets is 0.06 – 0.71 with an average RR of 0.41. This indicates that two-way protected bicycle lanes with parking may reduce crash risk at intersections relative to intersections without bicycle facilities.

(3) At intersections, the range in relative risk (RR) values between two-way protected bicycle lanes without parking and control streets is 0.22 – 3.52 with an average RR of 1.57. This indicates that **two-way protected bicycle lanes without parking separation may increase crash risk** at intersections relative to intersections without bicycle facilities.

Ottawa, City of (2021) Protected Intersection Design Guide. City of Ottawa Transportation Services Department and Alta Planning & Design, Canada Inc.

The design of cycling facilities, including protected intersections, is rapidly evolving. The concept of protected intersections has been implemented throughout North America, including Ottawa, since 2015. However, there is not yet a consistent approach to their design. The purpose of this Guide is to provide guidance on the design of protected intersections. This Guide was developed based on a thorough review of best practices from other guidance documents, and is a living document that will be updated.

The Design Guide highlights several concerns regarding bidirectional:

- "One-stage protected corners may be challenging to design where there are bidirectional cycling facilities" (p. 17)
- "Higher conflict potential with bidirectional" (p. 75)
- "Where a right turn movement at a signalized intersection crosses a bidirectional cycle track, a fully protected right turn phase should be considered where right turn volumes exceed 100 vehicles in the peak hour. Where right turn volumes are less than 100 vehicles in the peak hour, the measures described in the "low right turn volumes" branch in Figure 7.4 should be considered" (p.81)

The Fully Protected Right Turn Phase (p. 81) includes:

- Fully prohibits right-turning vehicles except when a green right turn arrow is displayed;
- Right-turning vehicles are fully separated from the adjacent pedestrian and cycling phase, eliminating conflicts.
- This phase could operate concurrently with the left turn phase of the intersecting street, which would improve efficiency of intersection operations.

PEI Active Transportation Network Plan (2022, Draft): A province-wide Network Plan for human-powered transportation like walking, rolling, cycling, and more, which outlines a strategy to connect Island communities and promote healthy, sustainable lifestyles. UPLAND Planning. https://www.peiat.ca/

The Government of Prince Edward Island draft AT Network Plan states "bi-directional facilities can present design challenges, such as increased conflict at driveways and intersections" (p. 21)

Rasanen M, Summala H (1998) Attention and expectation problems in bicycle-car collisions: an in-depth study. Accident Analysis & Prevention 1998,30:657-666. https://doi.org/10.1016/S0001-4575(98)00007-4

Rasanen and Summala (1998) studied 188 bicycle-car collisions in four cities. The most frequent accident type among collisions between cyclists and cars at bicycle crossings was the result of contraflow traffic: A driver turning right and a bicycle coming from the driver's right along a two-way cycle track. Rasanen and Summala state: "A widely known problem is that cycle tracks are safe on road sections but dangerous at intersections" because drivers turning right hit cyclists because they looked left for cars during the critical turning phase. In fact, only 11% of drivers noticed the cyclist before impact. No Free PDF available but a summary of the findings is included in the DOI link above.

Reynolds, C. C. O., Harris, M. A., Teschke, K., Cripton, P. A., & Winters, M. (2009). The impact of transportation infrastructure on bicycling injuries and crashes: A review of the literature. Environmental Health: A Global Access Science Source, 8(1). http://doi.org/10.1186/1476-069X-8-47

Reynolds et al. (2009) reviewed 29 papers for the impact of transportation infrastructure on bicyclist safety. The results were tabulated within two categories of infrastructure, namely that at intersections (e.g. roundabouts, traffic lights) or between intersections on "straightaways" (e.g. bike lanes or paths). To assess safety, studies examining the following outcomes were included: injuries; injury severity; and crashes (collisions and/or falls). The evidence from the 23 papers reviewed (eight that examined intersections and 15 that examined straightaways) suggests that infrastructure influences injury and crash risk. Intersection studies focused mainly on roundabouts. They found that multi-lane roundabouts can significantly increase risk to bicyclists unless a separated cycle track is included in the design. Studies of straightaways grouped facilities into few categories, such that facilities with potentially different risks may have been classified within a single category. Results to date suggest that sidewalks and multi-use trails pose the highest risk, major roads are more hazardous than minor roads, and the presence of bicycle facilities (e.g. on-road bike routes, on-road marked bike lanes, and off-road bike paths) was associated with the lowest risk. It has been suggested that the reason for high rates of bicycle-motor vehicle collisions at intersections is that motor vehicle drivers may be making "looked-but-failed-to-see" errors, whereby they search for oncoming motor vehicles but do not recognize that a cyclist is approaching because they are not looking for them.

Strauss, J., Miranda-Moreno, L. F., & Morency, P. (2013). bicyclist activity and injury risk analysis at signalized intersections: A Bayesian modelling approach. Accident Analysis and Prevention, 59, 9–17.http://doi.org/10.1016/j.aap.2013.04.037

The aim of this study was to identify specific locations where bicycle lanes could most effectively reduce crash rates in Philadelphia. A total of 2,052 bicycle injury crashes were reported from 2011 to 2014. There were 3,851 (10.2%) segments with a bike lane. Approximately two-thirds of the 242 segments were connected to at least one intersection with 3 exits (66.8%) or 4 exits (66.8%), and 243 around two-thirds were connected to at least one intersection with a one or two-way stop sign 244 (65.9%). While the majority of collisions occurred at intersections, bicycle lanes were found to be effective at reducing risk of bicycle crashes (particularly at 4-exit intersections and one-and-two-way stop signs) compared to streets with no bicycle facilities. No discussion occurred to compare unidirectional vs bidirectional bike lanes.

Teschke, Kay M., Anne Harris, Conor C. O. Reynolds, Meghan Winters, Shelina Babul, Mary Chipman, Michael D. Cusimano, Jeff R. Brubacher, Garth Hunte, Steven M. Friedman, Melody Monro, Hui Shen, Lee Vernich, and Peter A. Cripton (2012) Route Infrastructure and the Risk of Injuries to Bicyclists: A Case-Crossover Study. American Journal of Public Health 102, 2336_2343, https://doi.org/10.2105/AJPH.2012.300762

This abstract is supplied by the Transportation Association of Canada, page A-8 (see citation), with additional descriptive data added by SAFE: Teschke et al. (2012) compared 2,335 cycling injury risks

of 14 route types found that bicycle tracks (one-way protected bicycle lane) (read this many times and can't see where it says this but we have to trust the Transportation Association of Canada) had significantly lower bicycling risk when compared to bicycling on major streets with parked cars and no bicycle infrastructure and adjusted for 13 other bicycle route types. One-way protected bicycle lanes were found to have the lowest risk of bicycling injury of all 14 bicycle routes types studied. They recruited 690 people from Toronto or Vancouver who were injured while cycling. A case-crossover design compared route infrastructure at each injury site to that of a randomly selected control site from the same trip. The site observation tool: https://cyclingincities.spph.ubc.ca/files/2011/10/SiteObservationFormFinal.pdf

Transportation Association of Canada (2020) Safety Performance of Bicycle Infrastructure in Canada. November 2020. Toronto, Ontario. https://bikehub.ca/sites/default/files/imce/safety_performance_of_bicycle_infrastructure_in_canada.pdf

TAC summarizes literature that indicates that along roadway segments, **one-way protected bicycle lanes have significantly lower risk of bicyclist collisions** compared to roadways without bicycle facilities. Further, two-way protected or buffered bicycle lanes with parking separation also reduce bicyclist collision risk along road segments and at intersections compared to no facility; however, **two-way protected or buffered bicycle lanes without parking separation tend to increase bicyclist collision risk at intersections**.

Table 3-1: Safety outcomes by bicycle facility types from literature

Facility type	Collision risk	Collision severity	Perceived safety
Off-road bicycle facility	●	○	●
Off-road multi-use path	●	□	●
Protected bicycle lane (one-way)	●	□	●
Protected bicycle lane (two-way)	○	□	●
Buffered bicycle lane			●
Painted bicycle lane	○	□	○
Bicycle accessible shoulder			
Major street shared lane	□	□	□
Bicycle boulevard	○	○	
Advisory bike lanes			

● Well supported positive safety outcome
○ General positive safety outcome
△ Neutral outcome
□ General negative safety outcome
■ Well supported negative safety outcome
Blank cells indicate limited research available

Note: Collision risk of two-way at intersections is a well supported negative safety outcome based on contraflow

Transportation Association of Canada (Nov 2020) Safety Performance of Bicycle Infrastructure in Canada: Appendices. November 2020. Toronto, Ontario. https://www.tac-atc.ca/sites/default/files/site/doc/Bookstore/2020/ptm-spbi-e-app.pdf

TAC provides a detailed literature review to understand the safety performance of bicycle infrastructure (including both bicycle facilities along roadways and bicycle intersection treatments) in terms of both actual safety and perceived safety. Specifically, the review attempts to understand: (1) best practices for measuring safety performance of bicycle facilities; (2) related data requirements and safety performance heuristics; (3) bicycle crash trends; and (4) the actual and perceived safety performance of bicycle infrastructure.

Transportation Association of Canada (2017) Geometric Design Guide for Canadian Roads

TAC's Geometric Design Guide for Canadian Roads has been a fundamental road design reference for decades. It has contributed to the development of regional, provincial, and national road and highway systems by helping planners and designers meet the needs of road users with safety and consistency. The Guide addresses freeways, arterials, collectors and local roads in both urban and rural contexts, as well as special roads and facilities for walking and cycling.

The BC Design Guide (2017) references the TAC in this passage: "When choosing between uni-directional and bidirectional protected bicycle lanes, the challenges associated with travel direction need to be weighed against the connectivity benefits. A bi-directional protected bicycle lane on a road with two-way motor vehicle traffic introduces additional conflict points at intersections. **Section 5.3.1.2 of the TAC Geometric Design Guide for Canadian Roads** notes that, along wide roads with long block lengths and intensive land use, bi-directional protected bicycle lanes can provide people cycling with more direct route choices by eliminating the need to cross the road in order to travel in the opposing direction. However, this would only be applicable if there were bi-directional lanes on both sides of the road, or if only one side of the road had land uses with destinations." (Page D44)

Transportation Research at McGill (2013). Montreal Cycling Behaviour Survey.

Unable to find the survey, but data from this survey used to create two reports: (https://tram.mcgill.ca/Research/Surveys/cyclingSurvey2013_english.html); the Montreal Cycling Behaviour Survey was cited by Wexler et al. (2017): "[R]espondents were asked to rate their feelings of safety for different types of bicycle facilities in the City of Montreal, at both midblock and intersection locations. Results showed that bicycle users felt safer using cycle tracks midblock than painted lanes or no infrastructure, but when located at intersections, bidirectional cycle tracks were perceived to be twice as dangerous (responses of "bad" and "very bad")—even more dangerous than painted lanes."

TABLE 1 Perception of Infrastructure Types by Montreal Bicycle Users

Type of Bicycle Facility	Negative Perception (%)	
	Midblock	Intersection
Arterial without facility	57	46
Painted bicycle lanes	26	20
Bidirectional cycle tracks	17	33
Calm residential street	9	9

NOTE: Data from 2013 TRAM Montreal Cycling Behaviour Survey.

Wall, S., Lee, D., Frangos, S., Sethi, M., Heyer, J., Ayoung-Chee, P., & DiMaggio, C. (2016). The Effect of Sharrows, Painted Bicycle Lanes and Physically Protected Paths on the Severity of Bicycle Injuries Caused by Motor Vehicles. Safety, 2(4), 26. http://doi.org/10.3390/safety2040026

Wall et al. (2016) analyzed data collected from 839 injured bicyclists who collided with motorized vehicles in New York City from 2008 to 2014. In 2014, NYC launched 'Vision Zero', a multidisciplinary traffic safety action plan with a strong government commitment aimed at eliminating traffic-related deaths and serious injuries [25]. Severe traffic-related injuries and deaths were no longer deemed 'acceptable' circumstances of urban living. As part of its Vision Zero Initiative, NYC focused significantly on bicycle safety [25] through construction of a comprehensive network of bicycle routes that includes "sharrows" (i.e., road lanes shared with bicycles and cars), bicycle lanes demarcated with painted lines (i.e., painted bicycle lanes) and over 30 miles of protected paths alongside streets having physical barriers that separate automobile traffic from bicyclists (i.e., physically protected paths). The authors sought to assess whether sharrows, painted bicycle lanes, and physically protected paths reduce injury occurrence and severity among urban bicyclists. The results found that in dense urban environments, sharrows, painted bicycle lanes, and physically protected paths were associated with fewer injuries, but when injuries occur, they tended to be more severe. Specifically, sharrows were associated with having 94% increase in log odds of incurring more than mild injury compared to having no bicycle route available (Adjusted Odds Ratio (AOR) 1.94 95% Confidence Interval (CI) 0.91–4.15). Proximity to painted bicycle lanes and physically protected paths was associated with having 52% (AOR 1.52 95% CI 0.85–2.71) and 66% (AOR 1.66 95% CI 0.85–3.22) increases in the log odds of having more than a mild injury respectively.

Table 3. Logistic Regression Modeling Injury Severity Score Categories [1].

Unadjusted Model	Odds Ratio	*p* Value	95% CI
Sharrow	2.02	0.040	1.03–3.94
Painted Bicycle Lane	1.50	0.130	0.89–2.53
Physically Protected Path	1.79	0.052	0.99–3.21
Adjusted Model			
Sharrow	1.94	0.086	0.91–4.15
Painted Bicycle Lane	1.52	0.159	0.85–2.71
Physically Protected Path	1.66	0.136	0.85–3.22
Female	0.68	0.172	0.39–1.18
Age 18–55	0.48	0.010	0.26–0.84
Alcohol Use	1.94	0.235	0.65–5.81
Bicycle Share	0.90	0.893	0.21–3.92
Wore Helmet [2]	0.93	0.731	0.60–1.44
Delivery Worker	0.35	0.000	0.21–0.61
Bicycle Speed 5–15 mph	0.77	0.415	0.41–1.45
Bicycle Speed >15 mph	1.37	0.633	0.37–5.12
Hit by Turning Vehicle	0.78	0.471	0.39–1.54
Distracted Riding	0.82	0.603	0.38–1.74
Salmoning	1.25	0.528	0.62–2.54
Hit by Taxi	0.59	0.068	0.34–1.04
Hit by SUV, Van, or Truck	1.59	0.102	0.91–2.78
Wet or Iced Road	1.09	0.819	0.53–2.25
Hit at Intersection [3]	1.47	0.102	0.93–2.34
Hit at Night	1.44	0.481	0.52–4.00
Hit During A.M. Rush	1.14	0.747	0.51–2.57
Hit During P.M. Rush	0.97	0.932	0.49–1.91
Hit on Avenue or Two Way Artery	1.27	0.462	0.67–2.42

[1] ISS was defined as four categories of ISS—Mild 0–8, Moderate 9–15, Severe 16–25, Critical >25—and then dichotomized into 0–8 (reference) or >8; [2] Helmet protection effect was likely attenuated from including all injuries; analysis on only those having head injury yields protective benefit [22]; [3] At intersection includes those incidents that occurred at a traffic signal or stop sign. Models run on multiply imputed data to preserve all 839 records and outcomes within each ISS category. The Hosmer–Lemeshow goodness of fit statistic, run on the first of 20 imputed data sets, was 0.415, indicating good model fit.

Wachtel, Alan and Diana Lewiston.(1994) “Risk Factors for Bicycle-Motor Vehicle Collisions at Intersections *.” Ite Journal-institute of Transportation Engineers 64: 30-35.

Wachtel and Lewiston study bicycle-motor vehicle collisions in the city of Palo Alto, California. 314 collisions occurred from 1985 to 1989, and collisions at intersections accounted for 74 percent (n=233). Accidents where a cyclist was hit from behind accounted for 1.5 percent (n=5) and 2.5 percent of sideswipes (n=8) of all collisions. They found a cyclist bicycling on the sidewalk is 1.8 times as great a risk than on the roadway, but against the flow of traffic sidewalk travel on the sidewalk is 4.5 times as dangerous as with the flow of traffic bicycling on the sidewalk travel.

Table 4. Against Traffic Compared to With Traffic

Category	Against Traffic			With Traffic			Risk Ratio, Against to With	p
	Bicyclists Observed	Accidents Reported	Risk	Bicyclists Observed	Accidents Reported	Risk		
All bicyclists	423	33	2.6	2553	56	0.7	3.6	<<0.00001
Roadway	108	5	1.5	1897	43	0.8	2.0	
Sidewalk	315	28	3.0	656	13	0.7	4.5	<0.00001
17	298	19	2.1	1135	11	0.3	6.6	<<0.00001
18	125	14	3.7	1418	45	1.1	3.5	0.0001
Female	118	9	2.6	734	13	0.6	4.3	0.001
Male	305	24	2.6	1819	43	0.8	3.3	<0.00001

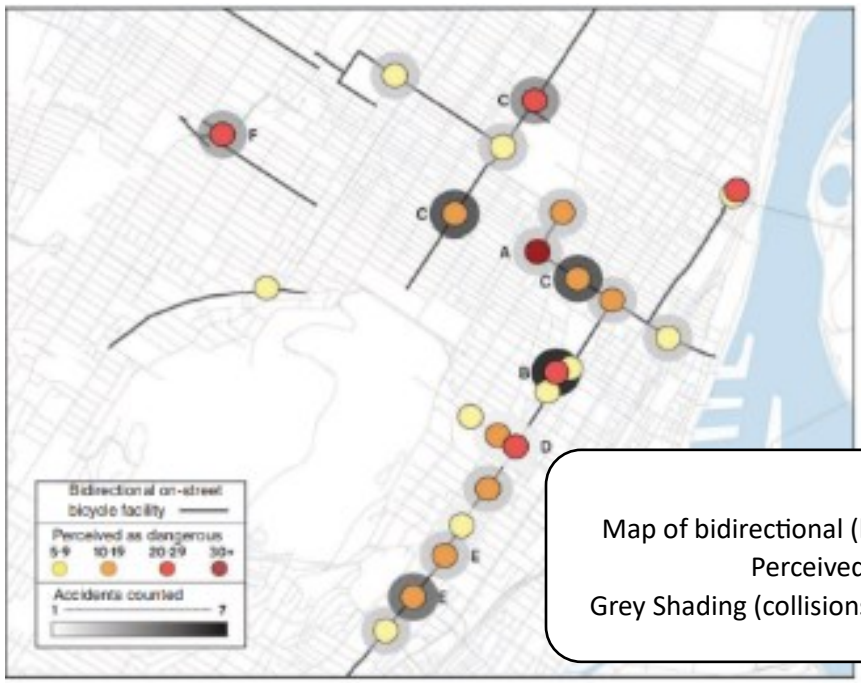
Table 4 shows that all categories of bicyclists traveling against the direction of traffic flow are at greatly increased risk for accidents—on average 3.6 times the risk of those traveling with traffic, and as high as 6.6 times for those 17 and under. This result is readily explained by Wachtel and Lewiston based on **contraflow traffic movement**: "Because motorists normally scan for traffic traveling in the lawful direction, wrong-way traffic is easily overlooked. To give only a single example, a motorist turning right at an intersection scans to the left for approaching traffic on the new road, and cannot see or anticipate a fastmoving wrong-way bicyclist approaching from the right. (This is the one of the most common types of bicycle-motor vehicle collisions in Palo Alto.)

Wachtel and Lewiston reinforce what they call the "compelling justification for current traffic law" and traffic planners:

> First, the conclusion is extremely robust: wrong-way bicycling is risky at an overwhelmingly high level of significance for the category as a whole. In the remaining subgroup, on the roadway, only 5 percent of bicyclists (108 of 2005) traveled against traffic, and only 5 accidents occurred there (compared to 2.5 expected); these small numbers limit any statistical significance.
>
> Second, wrong-way bicycling is dangerous for all subgroups of bicyclists—including those traveling on the sidewalk, who may at first seem to be protected against collisions with motor vehicles. In fact, sidewalk bicyclists enter into conflict with motorists at every intersection (including driveways), and these are exactly the points where most bicycle -motor vehicle collisions occur. Wrong-way sidewalk bicyclists are at particular risk because they enter the point of conflict from an unexpected direction, just as they would on the roadway. (Wachtel and Lewiston, Page 6)

Wexler, Michael Seth, & El-Geneidy, Ahmed. (2017). Keep 'Em Separated: Desire Lines Analysis of Bidirectional Cycle Tracks in Montreal, Canada. Transportation Research Record, 2662(1), 102-115. https://doi.org/10.3141/2662-12

The interplay between intersections and AT user behavior is important to analyze at 58% of bicycle collisions in Montral occur at an intersection. Conflicts were grouped into three major observed themes: counterflow interactions, priority confusion, and directional awareness. Bidirectional AT Pathways were more dangerous at intersections than unidirectional because of contraflow traffic of both (1) motor vehicles and (2) AT users themselves.



Montreal:
Map of bidirectional (black lines)
Perceived risk (dots)
Grey Shading (collisions reported)

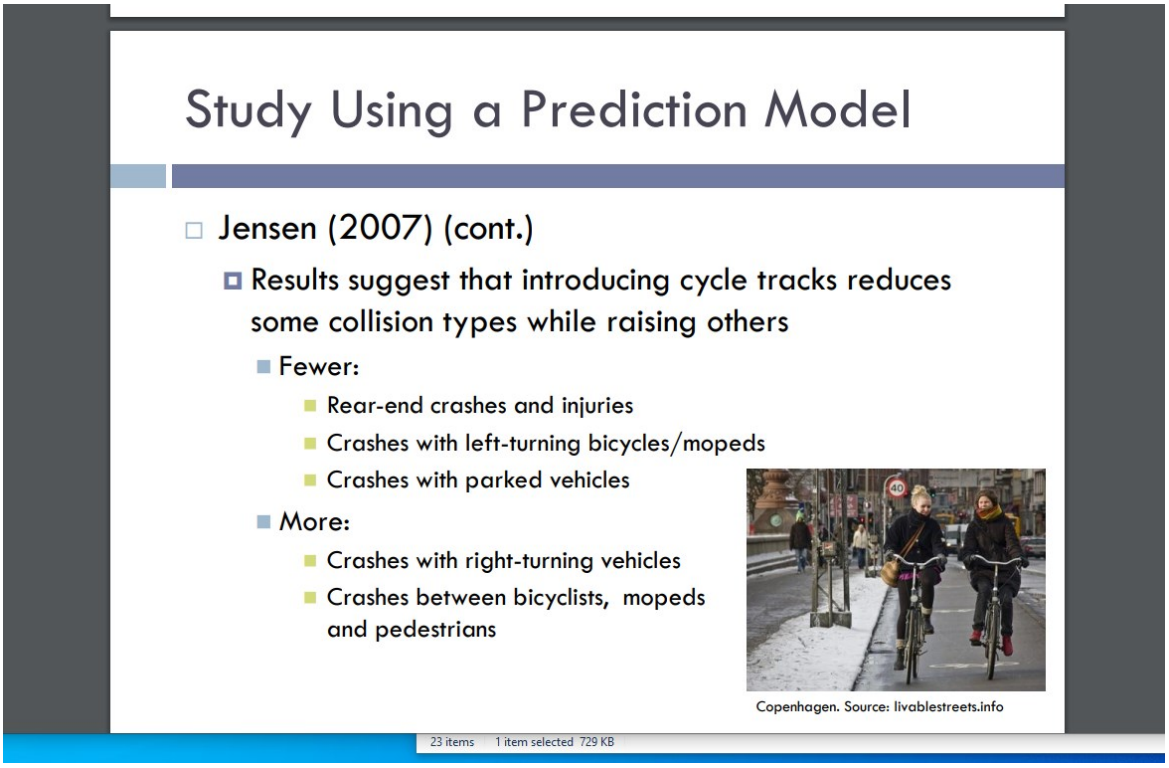
Two direct quotes:

"Directional awareness conflicts were observed in scenarios where road users were surprised by the arrival of a bicycle from an unanticipated direction. These surprising encounters seemed to be some of the most dangerous as they tended to be noticed only when users were already in motion . . . One recommendation to avoid these conflicts would be to keep all faster moving transport modes following the same directional logic; that is, if motorists travel on the right side of the street and subsequently turn right, so should bicycle users. Observing desire lines brings awareness to the conflicts generated by unexpected movements and suggests that intersections should follow a design that is predictable for all users." (p. 110)

"As the majority of observed conflict was concentrated around the bidirectional cycle track . . . the primary design intervention here is to separate directional flows into a more choreographic arrangement of unidirectional cycle tracks. . . . Unidirectional cycle tracks of adequate width rectify issues of bunching and two-way awkward maneuvers . . . ." (p. 113)

>MAY BE BIDRECTIONAL / UNIDIRECTIONAL STUDIES<

Studies Read



AASHTO. (2010). Highway Safety Manual (1st Edition). American Association of State Highway and Transportation Officials.

Abadi, M., Fleskes, K., Jashami, H., & Hurwitz, D. (2018). Bicyclist's Perceived Level of Comfort Level Traveling Near Urban Truck Loading Zones. TRB 2018 Annual Meeting, (18), 1–17.

Aguilar, E., & Hamdar, S. (2018). Estimating the effects of environmental conditions, built environment and traffic behavioral factors on pedestrian and bicyclist safety in Washington, DC. TRB 2018 Annual Meeting, (1351647), 1–17.

Bai, L., Liu, P., Chan, C. Y., & Li, Z. (2017). Estimating level of service of mid-block bicycle lanes considering mixed traffic flow. Transportation Research Part A: Policy and Practice, 101, 203–217. http://doi.org/10.1016/j.tra.2017.04.031

Bhatia, D., Richmond, S. A., Loo, C. K. J., Rothman, L., Macarthur, C., & Howard, A. (2016). Examining the impact of bicycle lanes on bicyclist-motor vehicle collisions in the city of Toronto. Journal of Transport and Health, 3(4), 523–528. http://doi.org/10.1016/j.jth.2016.04.002

Bíl, M., Bílová, M., & Müller, I. (2010). Critical factors in fatal collisions of adult bicyclists with automobiles. Accident Analysis and Prevention, 42(6), 1632–1636. http://doi.org/10.1016/j.aap.2010.04.001

Buehler, R., & Dill, J. (2016). bicycleway Networks: A Review of Effects on bicycling. Transport Reviews, 36(1), 9–27. http://doi.org/10.1080/01441647.2015.1069908

Burbridge, S. (2015). Identifying Characteristics of High Risk Intersections for Pedestrians and bicyclists: A case study from Salt Lake County, Utah Shaunna. In TRB 2015 Annual Meeting (Vol. 6).

Casello, J., Fraser, A., & Mereu, A. (2017). Enhancing bicycling Safety at Signalized Intersections: An Analysis of Observed Behavior. Transportation Research Record Journal of the Transportation Research Board, 2662(8x250), 59–66. http://doi.org/10.3141/2662-07

Caviedes, Alvaro; Figliozzi, M. (2018). Exploring the Determinants of Vulnerable Road Users' Crash Severity in State Roads.

Chaney, R. A., & Kim, C. (2014). Characterizing Bicycle Collisions by Neighborhood in a Large Midwestern City. Health Promotion Practice, 15(2), 232–242. http://doi.org/10.1177/1524839913505283

Chapman R, J. (2016). Evaluation of Lateral Clearance Distances Between Vehicles and Bicycles During Overtaking Maneuvers on Rural Roads. Trb, 19p. Retrieved from https://trid.trb.org/view/1392208

Chataway, E. S., Kaplan, S., Nielsen, T. A. S., & Prato, C. G. (2014). Safety perceptions and reported behavior related to bicycling in mixed traffic: A comparison between Brisbane and Copenhagen. Transportation Research Part F: Traffic Psychology and Behaviour, 23, 32–43. http://doi.org/10.1016/j.trf.2013.12.021

Chen, P., & Shen, Q. (2016). Built environment effects on bicyclist injury severity in automobile-involved bicycle crashes. Accident Analysis and Prevention, 86, 239–246. http://doi.org/10.1016/j.aap.2015.11.002

Cripton, P. A., Shen, H., Brubacher, J. R., Chipman, M., Friedman, S. M., Harris, M. A., … Teschke, K. (2015). Severity of urban bicycling injuries and the relationship with personal, trip, route and crash characteristics: analyses using four severity metrics. BMJ Open, 5(1), e006654. http://doi.org/10.1136/bmjopen-2014-006654

DiGioia, J., Watkins, K. E., Xu, Y., Rodgers, M., & Guensler, R. (2017). Safety impacts of bicycle infrastructure: A critical review. Journal of Safety Research, 61, 105–119. http://doi.org/10.1016/j.jsr.2017.02.015

Dill, J., Monsere, C. M., & McNeil, N. (2012). Evaluation of bike boxes at signalized intersections. Accident Analysis and Prevention, 44(1), 126–134. http://doi.org/10.1016/j.aap.2010.10.030

Elvik, R. (2009). The non-linearity of risk and the promotion of environmentally sustainable transport. Accident Analysis and Prevention, 41(4), 849–855. http://doi.org/10.1016/j.aap.2009.04.009

Feng, F., Bao, S., & Delp, M. (2018). Vehicle Lane Encroachment When Drivers Overtaking Bicyclists – An Examination Using Naturalistic Driving Data. In Transportation Research Board 97th Annual Meeting (pp. 1–4).

Ferenchak, N., & Marshall, W. (2019). Advancing healthy cities through safer cycling: An examination of shared lane markings. International Journal of Transportation, 136-145.

FHWA. (2010). A Guide to Developing Quality Crash Modification Factors. U.S. Federal Highway Administration. http://doi.org/10.15713/ins.mmj.3

Fitzpatrick, K., Chrysler, S. T., Van Houten, R., Hunter, W. W., & Turner, S. (2011). Evaluation of Pedestrian and Bicycle Engineering Countermeasures: Rectangular Rapid-Flashing Beacons, HAWKs, Sharrows, Crosswalk Markings, and the Development of an Evaluation Methods Report, (April), 70p. Retrieved from http://www.fhwa.dot.gov/publications/research/safety/pedbike/11039/11039.pdf

Furth, P. G., & Dulaski, D. M. (2011). More Than Sharrows: Lane-Within-A-Lane Bicycle Priority Treatments in Three US Cities. Transportation Research Board 90th Annual Meeting, (11–1357).

Goodno, M., McNeil, N., Parks, J., & Dock, S. (2013). Evaluation of Innovative Bicycle Facilities in Washington, D.C.

Transportation Research Record: Journal of the Transportation Research Board, 2387(January), 139–148. http://doi.org/10.3141/2387-16

Götschi, T., Castro, A., Deforth, M., Miranda-Moreno, L., & Zangenehpour, S. (2018). Towards a comprehensive safety evaluation of bicycling infrastructure including objective and subjective measures. Journal of Transport and Health, 8(December 2017), 44–54. http://doi.org/10.1016/j.jth.2017.12.003

Gustafsson, L., & Archer, J. (2013). A naturalistic study of commuter bicyclists in the greater Stockholm area. Accident Analysis and Prevention, 58, 286–298. http://doi.org/10.1016/j.aap.2012.06.004

Hamann, C., & Peek-Asa, C. (2013). On-road bicycle facilities and bicycle crashes in Iowa, 2007-2010. Accident Analysis and Prevention, 56, 103–109. http://doi.org/10.1016/j.aap.2012.12.031

Hurwitz, D., Jannat, M., Warner, J., Monsere, C., & A., R. (2015). Towards Effective Design Treatment For Right Turns At Intersections With Bicycle Traffic. Oregon Department of Transportation, SPR 767, 283.

Jensen, S. U. (2008). Safety effects of blue bicycle crossings: A before-after study. Accident Analysis and Prevention, 40(2), 742–750. http://doi.org/10.1016/j.aap.2007.09.016

Kaplan, S., & Giacomo Prato, C. (2015). A Spatial Analysis of Land Use and Network Effects on Frequency and Severity of bicyclist–Motorist Crashes in the Copenhagen Region. Traffic Injury Prevention, 16(7), 724–731. http://doi.org/10.1080/15389588.2014.1003818

Karsch, H., Hedlund, J., Tison, J., & Leaf, W. (2012). Review of studies on pedestrian and bicyclist safety, 1991-2007.

Minikel, E. (2012). bicyclist safety on bicycle boulevards and parallel arterial routes in Berkeley, California. Accident Analysis and Prevention, 45, 241–247. http://doi.org/10.1016/j.aap.2011.07.009

Monsere, C. M., Foster, N., Dill, J., & McNeil, N. (2015). User Behavior and Perceptions at Intersections with Turning and Mixing Zones on Protected Bicycle Lanes. Transportation Research Record: Journal of the Transportation Research Board, 2520, 112–122. http://doi.org/10.3141/2520-13

National Highway Traffic Safety Administration (Vol. 60). http://doi.org/10.1016/j.annemergmed.2012.07.019

Ng, A., Debnath, A. K., & Heesch, K. C. (2017). bicyclist' safety perceptions of bicycling infrastructure at unsignalised intersections: Cross-sectional survey of Queensland bicyclists. Journal of Transport and Health, 6, 13–22. http://doi.org/10.1016/j.jth.2017.03.001

McNeil, N., Monsere, C., & Dill, J. (2015). The Influence of bicycle Lane Buffer Types on Perceived Comfort and Safety of Bicyclists and Potential Bicyclists. Transportation Research Record, 1–12.

Oh, J., Jun, J., Kim, E., & Kim, M. (2008). Assessing Critical Factors Associated with Bicycle Collisions at Urban Signalized Intersections. Transportation Research Board, (July 2015), 1–17.

Osama, A., & Sayed, T. (2016). Evaluating the impact of bicycle network indicators on bicyclist safety using macrolevel collision prediction models. Accident Analysis and Prevention, 97, 28–37. http://doi.org/10.1016/j.aap.2016.08.010

Park, J., Abdel-Aty, M., Lee, J., & Lee, C. (2015). Developing crash modification functions to assess safety effects of adding bicycle lanes for urban arterials with different roadway and socio-economic characteristics. Accident Analysis and Prevention, 74(January 2015), 179–191. http://doi.org/10.1016/j.aap.2014.10.024

Pulugurtha, S. S., & Thakur, V. (2015). Evaluating the effectiveness of on-street bicycle lane and assessing risk to bicyclists in Charlotte, North Carolina. Accident Analysis and Prevention, 76, 34–41. http://doi.org/10.1016/j.aap.2014.12.020

Raihan, M. A., & Alluri, P. (2017). Impact of roadway characteristics: On bicycle safety. ITE Journal (Institute of Transportation Engineers), 87(9), 33–40.

PROPERTY VALUES

Asabere, P. and F. Huffman. 2009. "The relative impacts of trails and greenbelts on home price." The Journal of Real Estate Finance and Economics 38(4): 408-419.

This study found that trails and greenbelts in a San Antonio, Texas neighborhood are associated with higher home values, particularly if the trails are incorporated into a greenbelt. This effect is not just for homes immediately adjacent to the trail, but for all homes in the neighborhood.

Trails or green space of any type add value to homes, although the largest effect is when the trail is buffered by green space. All three types of trails were found to increase property values:

- Trails are associated with a 2 percent house price premium.
- Greenbelts are associated with a 3 percent house price premium.
- Greenways (trails with greenbelts) are associated with a 5 percent house price premium.

Other neighborhood amenities were also associated with higher property values:

- Playgrounds are associated with a 3 percent house price premium.
- Tennis courts are associated with a 2 percent house price premium.
- Neighborhood pools are associated with a 2 percent house price premium.

- Trails that allow horses are associated with a 1 percent house price premium.

Crompton, J., and S. Nicholls. 2006. "An Assessment of Tax Revenues Generated by Homes Proximate to a Greenway." Journal of Park and Recreation Administration 24(3): 103-108.

The study found that neighborhoods with access to and views of the trail command higher property values, and that these higher property values generate additional tax revenue for municipal and county governments. Trails may not pay for themselves based solely on higher property tax revenue, but the likely additional revenue would offset some of the expense.

The authors found a price premium for lots adjacent to the trail in two of the three neighborhoods studied, although variation in topography and physical layout determined the magnitude of price difference.

In the Barton neighborhood, properties close to the trail had a $44,332 (20% of mean sales price) premium. In the Travis neighborhood, properties adjacent to the trail fetched a $14,777 (6% of mean sales price) premium. The study found no effect on adjacent properties in the third neighborhood, Lost Creek. The lack of an effect in Lost Creek is attributed to the fact that properties adjacent to the trail are heavily wooded and have no views of, or access to, the trail.

The authors estimate the city received approximately $59,000 per year in taxes due to increased property values near the trail in the Barton and Travis neighborhoods. This amounted to approximately 5% of the city's annual debt payments of $1.1 million for the original land purchase and trail development. Although the additional tax revenue from these neighborhoods does not compensate for the trail's expense, the authors point out that many more Austin residents and visitors use the trail than just its neighbors. For a highly-valued community-wide resource such as the Barton Creek Greenbelt, the benefits will accrue far beyond the immediate neighborhoods.

Hearne, David and Yerushalmi, Erez (2023). Do Bicycle Networks Have Economic Value? A Hedonic Application to Greater Manchester CAFÉ WORKING PAPER NO.24 Centre for Applied Finance and Economics (CAFÉ) Birmingham City University November 2023. https://headwaterseconomics.org/trail/42-valuing-bicycle-facilities-benefits/

This paper quantifies the association between proximity to bicycle networks and house prices in Greater Manchester using hedonic and spatial regressions. Given the challenges of congestion and pollution, many cities across the world are implementing policies to improve bicycling facilities and other active modes of transport. Bicycle lanes are a solution that could potentially provide significant amenities to residents, but they require investment and the appropriation of limited land. Drawing on a large dataset of approximately 253,000 transactions, over a 9-year period, we find that a 1 km reduction in distance to the nearest bicycle network is associated with property values being around 3.2% higher, on average, and 7.3% higher in the central borough of Manchester. Property value rises by 3.2%-7.3% when close to bicycle lane compared to properties 1km away

To our knowledge, only three studies have attempted hedonic methods to value bicycle networks: Liu and Shi (2017) and Welch et al. (2016) in Portland Oregon, and Krizek (2006) in Minneapolis

Minnesota, in the USA. These used 20K to 35K observations and find that properties close to a bicycle network gained 0.6%-1% in value compared to similar properties 1 km away.

Karadeniz, D. (2008). The Impact of the Little Miami Scenic Trail on Single Family Residential Property Values (Unpublished Master's Thesis). University of Cincinnati School of Planning. https://headwaterseconomics.org/wp-content/uploads/Trail_Study_22-miami-scenic-trail.pdf

This study found that the Little Miami Scenic Trail in southwest Ohio is associated with higher property values for nearby properties, across the urban, suburban, and rural sections of the trail. On average, homes sell for an additional $7 for every foot closer to the trail, up to about a mile away from the trail. For example, a house a half mile away from the trail would sell, on average, for $18,612 less than a house that is identical in all other aspects but is adjacent to the trail.

The analysis suggests that each foot increase in distance away from the trail decreases the sale price of a sample property by $7.05. For example, a house a half mile away from the trail would sell, on average, for $18,612 less than a house that is identical in all other aspects but is adjacent to the trail.

In addition to the statistical model, the author conducts a thorough literature review and notes that $7 is within the range of price premiums found in other studies. Across several studies, the author finds that this price effect is common, but generally does not extend beyond a mile away from the trail.

The author mentions that the increase in revenue from property taxes on higher-valued homes may partially offset some of the community's investment in the trail, but does not attempt this calculation.

Krizek, K. J.: 2006, 'Two Approaches to Valuing Some of Bicycle Facilities' Presumed Benefits: Propose a session for the 2007 National Planning Conference in the City of Brotherly Love'. Journal of the American Planning Association 72(3), 309–320

Cyclists were most likely to go out of their way on their commute to use an on-street bicycle lane (an extra 16 minutes on a 20-minute commute), although they were also willing to go out of their way to use a route with no parking (an extra 9 minutes) or an off-road route (an extra 5 minutes). Women and those with higher incomes were more likely to choose longer, safer routes.

Cycling facilities had different effects on property values in urban versus suburban settings. In the city, prices were $510 higher for every 400 meters closer the house was to an off-road bicycle path. However, in the suburbs, home prices were $240 less for every 400 meters closer the house was to an off-road path. In both the city and suburbs, house prices were lower when they were closer to a roadside bike path: $2,272 lower in the city and $1,059 lower in the suburbs.

These results differ from findings in other studies (e.g., 22, 23, 26, 43) that found proximity to off-road bike paths to be generally associated with higher house prices. The author suggests that this result may be due to lower rates of bicycle use in suburban neighborhoods, or perhaps because houses near bicycle facilities are also near undesirable features such as railroad right-of-ways. Results from this analysis suggest that siting criteria should differ between urban and suburban areas.

Lindsey, G., Man, J., Payton, S., and K. Dickson. 2004. "Property values, recreation values, and urban greenways." Journal of Park and Recreation Administration, 22 (3): 69–90. https://js.sagamorepub.com/index.php/jpra/article/view/1465

This study found that in Indianapolis property values are higher when homes are located near conservation areas without trails or near high-profile, destination trails, but are not any different when they are located near less-popular trails. Individual trail users place a positive value on being able to use trails, which is sufficiently high to justify the expense of trail construction and maintenance.

This study's findings provide informative nuance to the argument that trails always increase property values. The effect of trails and greenways on property values is sensitive to how the researchers measure proximity. Other studies (see 22, 23, 26) find that close access to trails–either because they were adjacent or had easy access–results in higher property values, but trails in the broader neighborhood did not necessarily experience higher property values. This study measured proximity to trails as being within a half-mile of the trail. It would have found different effects if it only considered adjacent properties.

- Homes near the Monon Trail, a popular rail-trail, sold for 11 percent more than the average home.
- There was no difference in sale prices for homes near other trails.
- Homes near conservation corridors sold for 26 percent more than the average home. These findings are consistent with other research (see 23) that found that trails surrounded by green space had the greatest price premium.
- Monetized recreation benefits vary from $0.19 to $19.67 per trip, depending on how far the respondent lived from the trail. Across all users, **recreation benefits total $3.1 million per year.**
- Using a 10-year time horizon, the authors estimate that benefits would be $22.6 million and construction and maintenance costs would be $3.9 million.

Liu, Jenny, Shi, Wei (2016). Impact of Bike Facilities on Residential Property Prices. Toulan School of Urban Studies & Planning Portland State University. Transportation Research Record, 2662(1), 50-58 https://doi.org/10.3141/2662-06

Liu and Shi found that proximity to advanced bike facilities had a significant and positive effects on both single family and multi-family property values, which is consistent with previous research. Our results also show that the extensiveness of the bike network is a positive and statistically significant contributor to the property prices for all property types, even after controlling for proximity to bike facilities and other internal and external variables. Enhancing the model specifications with spatial autocorrelation effects to prevent overestimation yields similar but slightly tempered positive and statistically significant impacts of both proximity and density of advanced bike facilities on residential property values.

Nicholls, S., and J. Crompton. 2005. "The Impact of Greenways on Property Values: Evidence from Austin, Texas." Journal of Leisure Research 37(3): 321-341.

Nicholls and Crompton (2005) also provide an overview of older studies from 1978-1995 that have measured the effect of greenways on nearby property values and/or ability to sell properties.

Empirical assessment of the extent to which greenways impact property values and, hence, the local tax base is an important contribution to the debate on their economic effects. Though previous research has demonstrated more support than opposition among residents' and realtors' perceptions of the impact of greenways on property value and salability, only one analysis based on actual sales prices has been reported in the literature. The analyses presented here suggest that greenways may indeed positively affect proximate properties' sales prices, in the most positive case to the extent of one fifth of value, resulting in millions of dollars of increases in prices and subsequent enlargement of the property tax base. As demonstrated by Litde (1990), linear green spaces, of which greenways are a prime example, maximize the number of properties that can be positioned adjacent or nearby to them. As a result, a higher number of properties' values are enhanced and the impact on the property tax base is greater. In addition to the multiple environmental, social, aesthetic, health and recreation benefits they provide, greenways can also be considered highly efficient from an economic standpoint. From the perspective of urban planning, such amenities should, therefore, be recognized as valuable components of well-designed urban areas.

Welch, T. F., S. R. Gehrke, and F. Wang (2016) 'Long-term impact of network access to bike facilities and public transit. Journal of Transport Geography 54(1):264-272 https://www.sciencedirect.com/science/article/abs/pii/S0966692316303350?via%3Dihub

This study estimated a hedonic spatial panel model to determine the long-term impact of improved network access to bike and public transit facilities on housing sales prices in Portland, Oregon. Findings from this 12-year study revealed a substantial and negative effect of increased distance to the nearest regional off-street bike facility or rail station on residential market values. Accordingly, the closer a sold residence was to a regional multi-use path, light-rail station, or streetcar

ATV ACCESS

Trans Canada Trail's Statement on PEI'S Confederation Trail (2023). November 27, 2023 https://tctrail.ca/stories/trans-canada-trails-statement-on-peis-confederation-trail/

As the custodian of the world's longest trail network, Trans Canada Trail takes great pride in stewarding, supporting and advocating for greenway trail sections across Canada – including Prince Edward Island's Confederation Trail – that facilitate non-motorized uses such as cycling and walking.

The provincial government recently announced a consultation process to secure public input on the Confederation Trail. During this consultation, some have raised the idea of permitting motorized vehicles, including all-terrain vehicles (ATVs), on the Trail. Together, with our provincial and local trail groups, we have participated in the consultation process, and encourage the wider trail community to do so as well.

Trans Canada Trail has a long history of partnership with and contributions to the Confederation Trail. Since 1995, we have contributed $2.5 million to 55 different projects and initiatives on the Island.

So where do we stand? We are advocating for the Confederation Trail to remain a greenway, meaning that we would like to see the existing motorized vehicle ban upheld. We have written to the Minister of Transportation to share this perspective and to outline our concerns that any change to the existing policy would have a detrimental impact on trail user experience, trail infrastructure, trail quality, and in turn, on the tourism and economic development generated by the Trail.

Our recent study on the benefits associated with the Trans Canada Trail indicates that trail users spend money on goods and services related to active recreational activity during their trips, which generates additional economic activity in the regions surrounding the Trail, and supports local jobs and businesses. Nationally, this economic activity contributes to $13 billion in spending every year; as a province-wide greenway trail system, the Confederation Trail (and the communities it passes through) play a significant role in ensuring the continuation of those economic benefits. Permitting motorized vehicles on the Confederation Trail risks compromising the pristine and peaceful environment that makes it a leading trail tourism asset, ultimately altering the experience for visitors and threatening the economic impact of a thriving tourism industry.

We are also concerned that allowing motorized vehicles on the trail could lead to significant changes in maintenance requirements and cost, as we have seen in other jurisdictions in Canada. Due consideration must be given to how ATV use will impact trail infrastructure to ensure it remains viable and safe for all users.

As dedicated partners, we extend our collaborative hand to the community leaders and decision makers on Prince Edward Island to ensure the Confederation Trail remains a harmonious space that connects people to nature, communities, and the province's rich recreational and cultural offerings. However, Trans Canada Trail, in partnership with trail groups and communities in PEI – and the rest of Canada – is steadfast in its commitment to protecting and increasing the number of designated greenways to enhance the safety and enjoyment of non-motorized trail users.

We know that the decision regarding permitted uses on the trail ultimately rests with Islanders. We appreciate the opportunity to share our knowledge, skills and research, and to participate in the policy review process.

We would be pleased to extend any necessary support to preserve the unique charm of the Confederation Trail and its important contribution to quality of life and economic prosperity on Prince Edward Island – today and for generations to come.

Eleanor McMahon

President & CEO of Trans Canada Trail

CBC Maritime Noon (2023) Should ATVs be allowed on cycling and walking trails. A call-in show. Call in starts at 9:50 https://www.cbc.ca/player/play/2287580227581/

Bryson Guptill on PEI and Barry Barnet in NS are the guests. Reference to the creation of the Confederation Trail being spearheaded by pioneers Don Deacon, Gordon MacQueen, and Ian Scott.

Guptill, Brysen (2023). COMMENTARY: Will ATVs take over the Confederation Trail? Nov. 16, 2023 https://www.saltwire.com/atlantic-canada/opinion/commentary-will-atvs-take-over-the-confederation-trail-100912332/

Bryson Guptill, who served as a senior policy adviser to the federal and provincial governments in Ottawa and Charlottetown, provided the following opinion article.

The Confederation Trail was created by the Government of P.E.I. after CN Rail announced in 1989 that it was decommissioning its rail line in P.E.I. Private citizens under the leadership of P.E.I. Rails to Trails (now Island Trails) lobbied for the creation of a non-motorized hiking and cycling trail on this old rail line.

The rail bed was eventually acquired by the Government of P.E.I. and the Confederation Trail was formally established in 1994. The Confederation Trail will celebrate its 30th anniversary in 2024.

Initially the Confederation Trail extended from Tignish to Elmira, a distance of 273 k.m. In the years that followed, the Government of P.E.I., supported by financial contributions from the Trans Canada Trail, added a spur line from Cardigan to Georgetown, a spur line from Harmony Junction to Souris, and another spur line from Emerald Junction to Borden-Carleton.

Greenway condition

In 2014, thanks to a $1 million donation from the Garfield Weston Foundation and an additional $400,000 contribution from the Trans Canada Trail Foundation, the trail section from Iona to Charlottetown was completed. Subsequently, the spur from Lake Verde to the Pisquid River was completed, giving the Confederation Trail a total length of 450 k.m. The contribution from the Trans Canada Trail exceeded $3 million over this time period.

The $1 million gift from the Garfield Weston Foundation in 2014 came with strings attached. The Weston family wanted assurances that the trail would remain a greenway into perpetuity. Subsequently, the government passed the Trails Act and Trails Act regulations which stipulate that the Confederation Trail is a greenway that supports cycling and walking, but forbids the use of motorized vehicles such as dirt bikes and ATVs.

Changing the government policy on non-motorized use would require changes to Trails Act and Trails Act regulations as well as reversing a government commitment made in 2014 to keep the Confederation Trail a greenway into perpetuity.

The P.E.I. ATV Federation has stated they support the use of shared trails. However, shared trails are not possible when one group is using powerful machines capable of high speeds and the other group is vulnerable walkers and cyclists.

ATV collisions

In March, 2015, the Canada Safety Council reported 912 riders lost their lives on ATVs and other off-road vehicles between 2007 and 2011. Most of the deaths were on ATVs. In Ontario in 2005-06 more than 5,500 people were admitted to hospitals due to ATV injuries. In Alberta in 2010 the number injured was 5,200. The Canadian Institute for Health Information (CIHI) states that accidents involving ATVs are growing faster "than any other wheel- or water-based activity."

The CBC reported in 2018 that 178 people died in ATV or snowmobile crashes in Atlantic Canada (most were riding ATVs) between 2007 and 2011. The death toll was highest in New Brunswick (64 deaths) and the lowest was in P.E.I. (Six deaths — four on ATVs and two on snowmobiles).

The ATV Federation states that many provinces successfully share the trails. This is not what we are hearing and seeing on the trails in Atlantic Canada. At a recent meeting of the International Appalachian Trail in Fredericton, delegates heard that shared-use trails in northwestern N.B. are turning into exclusive-use trails for ATVs. Cyclists and walkers find the shared use trails are not safe. This is leading hiking and cycling groups to consider building new trails dedicated to non-motorized activities.

In Nova Scotia the same thing is happening. In a document titled, "The Myths and Facts About Shared Use Trails in Nova Scotia," Nova Scotians Promoting Active Transportation on Community Trails state "studies clearly indicate that off-highway vehicles displace physically active users from trails." A study conducted by Acadia University researchers concluded that displacement of walkers and cyclists occurs when there is an asymmetrical conflict between the user groups.

Walking and cycling

When their safety is at stake, pedestrians and cyclists simply abandon shared-use trails. This will also happen in P.E.I. if ATVs are given access to the Confederation Trail.

In 2011, Tourism P.E.I. coined the phrase "the Gentle Island" to describe what it feels like to be here. It's a sentiment that pervades Lucy Maud Montgomery's Anne of Green Gables books and it perfectly describes what it feels like to walk or cycle on the Confederation Trail.

When their safety is at stake, pedestrians and cyclists simply abandon shared-use trails. This will also happen in P.E.I. if ATVs are given access to the Confederation Trail.

Today the Government of P.E.I. is facing two challenges — how to improve Islanders' physical and mental health and how to fight climate change. Both of these challenges can be addressed by making walking and cycling more accessible to Islanders.

Allowing ATVs to access the Confederation Trail runs counter to both objectives. First, it would encourage more ATV use and therefore increase greenhouse gas emissions on P.E.I. Second, it would discourage walkers and cyclists from using the Confederation Trail and other linked active transportation routes.

For 30 years, P.E.I. has recognized the Confederation Trail as a special resource that needs protection. Lets not lose sight of this as we struggle to protect this piece of Island heritage that's a gift we give to future generations of Islanders.

Gill, Peter J, Thomas McLaughlin, Daniel Rosenfield, Charlotte Moore Hepburn, Natalie L Yanchar, Suzanne Beno, All-terrain vehicle serious injuries and death in children and youth: A national survey of Canadian paediatricians, Paediatrics & Child Health, Volume 24, Issue 1, February 2019, Pages e13–e18, https://doi.org/10.1093/pch/pxy059

All-terrain vehicles (ATVs) are a leading cause of serious paediatric injury in children and youth (1,2). In Canada between 1990 and 2009, 58% of ATV-related injuries leading to an emergency department (ED) visit were in youth under the age of 16 (3). Over one-third of ATV-related hospitalizations occur in children aged 5 to 19 years and 15% to 21% of ATV fatalities occur in those under the age of 16, usually due to head trauma (4–6). Youth under the age of 16 in Canada are at increased risk of head injuries compared to adults (3). Similarly, up to 21% of ATV-related deaths in the USA between 2000 and 2009 were in youth under the age of 16 (7). While Canada's overall injury death rate decreased by 10.9% between 1995 and 2004, ATV-related deaths increased (2,4). In Canada, the combined economic burden for ATV and snowmobile injuries was $507 million in 2010 (8). These findings highlight an urgent need for public health strategies, including legislation and education, to reduce the burden of ATV-related injuries among children and youth.

There were 181 reported cases of ATV-related injuries, including 6 deaths, reported by 80 physicians. Respondents were located across Canada, including Ontario (n=26, 33.3%), Quebec (n=15, 19.2%), Alberta (n=12, 15.4%), Saskatchewan (n=9, 11.5%), Manitoba (n=6, 7.7%), British Columbia (n=6, 7.7%) and Atlantic Canada (n=4, 5.1%). Where specified (5/6), deaths were reported from participants in Alberta, Quebec, Saskatchewan and British Columbia.

#'s in brackets are additional resource articles to review

The Guardian (2013). Funding will help finish P. E. I. trail- Donation worth $ 1.4M announced. The Guardian (Charlottetown)9 Oct 2013BY STEVE SHARRATT

VERNON RIVER — Comparing it to the last spike which united Canada by railroad, Tourism Minister Robert Henderson joined officials Tuesday in the announcement of a $ 1.4- million funding effort to fully complete the Trans Canada trail across P. E. I. by next year.

"The railroad across Canada was completed with the last spike, and we're completing our part of the Trans Canada Trail with the last hike,'' joked the minister during a presentation here to finalize the completion of the last 30 kilometres of the Confederation Trail.

A $ 1- million donation from the W. Garfield Weston Foundation and an additional $ 400,000 from Trans Canada will help the province become the second in Canada to complete its portion.

“This puts us ahead of the 2017 deadline,’’ said Transportation Minister Robert Vessey during the announcement pushed indoors at the St. Joachim church hall because of rain.

“The Confederation Trail is not only a premiere venue for hiking and cycling, but it is also an ever more important tourism draw for the province,” said Henderson. “This very generous donation means the trail will be fully complete from Tignish to Elmira and from Wood Islands to Borden-Carleton, and the timing couldn’t be better given the celebrations planned for 2014.”

The provincial politicians were thanking the W. Garfield Weston Foundation and Trans Canada Trail for making the project complete before the provincial sesquicentennial in 2014.

The donation means the TCT Confederation Trail will remain a greenway in perpetuity. No motorized vehicles will be allowed on the trail moving forward, with the exception of snowmobiles during winter.

Prince Edward Island will also become the second province to complete its portion of the trail after Newfoundland and Labrador. “We are delighted to support the Stratford to Iona portion of the Trans Canada Trail … significant to the Island and all Canadians,” said Nancy Baron, trustee, the W. Garfield Weston Foundation in a letter.

The bold plan to create a national recreational Trail that would celebrate the natural beauty of the country was born in Prince Edward Island just over 20 years ago said Baron. “We are thrilled that this generous commitment from Mrs. Nancy Baron will support the full connection of the province’s trail in time for 2014 celebrations,” said Deborah Apps, president of the Trans Canada Trail.

The largest section that remains unfinished is the 15- kilometre section between Vernon River and Iona. Construction is already underway on that section. There are also small sections to be completed near Lake Verde, Hazelbrook and within the town of Stratford.

“We are very grateful to these donors for enabling Stratford to become part of the Trans Canada Trail network,” said Stratford Mayor David Dunphy. “Giving residents more opportunities to become more active and improve their health is an important part of our plan to build the best community possible.”

Once all sections are complete, the Confederation Trail will measure 444 kilometres, including branch trails from Mount Stewart to Montague, Georgetown and Cardigan, from Harmony Junction to Souris and from Wood Islands to Murray Harbour.

CBC (2011) ATV trails lose Trans Canada status. CBC News · Jan 24, 2011
https://www.cbc.ca/news/canada/nova-scotia/atv-trails-lose-trans-canada-status-1.1042854

The Trans Canada Trail says it will no longer fund or promote trails that allow all-terrain vehicles. Trail spokesperson Tim Hoskin said shared use trails, as they're known, don't work."What we've discovered through this experiment is that on shared use trails, there is considerable user conflict," said Hoskin.

The move comes after contentious debate about ATV use on the national trail system. Many donors felt that ATVs presented a safety hazard. The issue became more complex when

Newfoundland and Labrador declared that ATVs were welcome on the trail in that province. Nova Scotia also endorsed ATVs on trails built on its land holdings.

While not outright banning ATVs, the Trans Canada Trail previously agreed that trail organizations would make every effort to route the trail where ATVs were not permitted. It reluctantly agreed to accept ATVs where there was no reasonable alternative.

The Trans Canada Trail said it's vision for the national greenway trail going forward will promote hiking, cycling, and sometimes snowmobiling, but not ATVs. The decision could have a big impact in Nova Scotia, where about half of the Trans Canada Trail built so far, allows ATVs.

Any part of the trail that allows ATVs and was built before the end of 2009 will still be considered part of the system, but will be designated a yellow trail. The Trans Canada Trail will only pay for improvements on yellow trails, if the work will help transform them into greenways.

In Nova Scotia, that amounts to 400 kms of trails.

A group that promotes active transportation in the province said not being a full part of the trail will be a blow, both in terms of attracting tourists, and promoting healthy living. Bob Connell is the president of Nova Scotians Promoting Active-Transportation on Community Trails. "In effect, what it means is a lost opportunity for Nova Scotians, to be able to realize the benefits of what that would bring to us," said Connell. There's still 260 kms of Trans Canada Trail to be built in Nova Scotia.

It's up to local trails groups to raise money, build sections of trail and decide who is allowed to use them.

The head of the Nova Scotia Trails Federation admits it will now be a challenge for communities to choose between being part of the national trail or allowing ATVs.

Janmaat, John and VanBlarcom, Brian(2009) 'Impact of all terrain vehicle access on the demand for a proposed trail',Managing Leisure,14:1,57 — 70. Department of Economics, Irving K. Barber School of Arts and Sciences, University of British Columbia, Canada and 2Department of Economics, Acadia University, Wolfville, Canada. https://doi.org/10.1080/13606710802551262

Trails are a recreational resource of growing importance. This paper reports on a contingent trip travel cost analysis of a proposed trail in Nova Scotia (Canada). The CTM was employed to estimate consumer surplus (net benefit values) for trips to the proposed trail. As noted by Betz et al. (2003), this approach is a cost-effective alternative to on-site sampling and more traditional travel-cost approaches in two ways. First, it incorporates data from non-users in formulating demand, therefore avoiding problems of zero truncation and endogenous stratification as identified by Siderelis et al. (1995) and Martı´nez-Espin˜eira and Amoako-Tuffour (2007). Secondly, it can provide information related to demand and management options about potential sites, for which there exist no comparable studies. CTM has however been criticized for basing the analysis on projected behavior and, as discussed by Betz et al. (2003), there is a need to develop experiments where CTM model estimates can be corroborated with actual counts.

The trail is estimated to attract approximately 160,000 trips per year (434 per day). The total annual consumer surplus for the proposed trail lies between C$1million and C$4 million depending

on trail surface and cost of travel. These aggregate benefit (value) estimates could be used in a benefit/cost analysis associated with trail development under various surface scenarios. Policy makers must try to accommodate various user groups when developing trail strategies, but at the same time must account for the impact that one set of trail users may have on another. Permitting ATVs to use the trail is expected to reduce the number of trips taken by almost 48% and reduce the consumer surplus by almost 41% for non-ATV users. The low percentage of respondents that are ATV users and the local geography suggest that this proposed trail may not attract many ATV users. However, the tension between ATV enthusiasts and those who wish to limit the use of these machines is such that the political atmosphere around this idea is already charged. While only 10% of the survey respondents indicated frequent ATV use, this represents 1200 household within 5 km and 400 households within 2.5 km of the trail. It appears that respondents' perception of actual ATV use on the proposed trail is sufficient to impact demand by non-ATV users.

From a policy perspective, we suggest that the most appropriate form of the trail is one that accepts the use of ATVs near the trail and on that portion east of Wolfville where there will likely be low non-ATV use. The trail between the towns of Kentville and Wolfville (the area of greatest population density) should restrict ATV use and be paved. The paved surface itself will dissuade ATV users, while enhancing the attractiveness of the trail to cyclists and other potential transportation users. The ATV restriction will likely be unpopular with ATV enthusiasts and may prove controversial. However non- ATV users, who represent the vast majority of survey respondents, have little desire to share the trail with ATVs, and **allowing ATVs will significantly reduce trail use.**

VanBlarcom, Brian and Janmaat, John (2008) Estimating the Health Benefits from a Proposed Rail Trail. Department of Economics, Acadia University, Wolfville, NS https://economics.acadiau.ca/tl_files/sites/economics/resources/ACEA/Papers%20and%20Proceedings/2008/B.Vanblarcom.et.al.2008.pdf

This study estimates the health benefits associated with a proposed rail trail from Grand Pre to Coldbrook in Nova Scotia. A survey of 550 households living within 50 kilometers of the proposed trail provided data. Survey respondents indicated their current levels of physical activity and the impact the trail would have (if any) on these levels. A contingent trip method (CTM) was employed to estimate projected use for the proposed trail. The trail is estimated to attract approximately 430 trips per day or 160 thousand trips per year. The monetary returns of increased physical activity are modeled after Wang et al. (2005). The total annual value of increased physical activity expected to emanate from the proposed trail is estimated to be approximately $456,000. On an annual basis, allowing ATV access will reduce the health benefits by almost $228,000 per annum.

The demand curve was created and used to estimate expected trail use based on the dispersion of the population. Other questions seek to: 1) measure whether the proposed trail will serve to increase physical activity and attach a dollar value to any increase, 2) compare the health related benefits of the trail to the construction and maintenance costs, 3) estimate the impact of allowing ATV access on the volume of non-ATV trail users.

Allowing ATV use is expected to double the operation costs due to the necessity of increased maintenance and monitoring costs. Allowing ATV access to the trail reduced use by approximately 50 percent (from an annual total of 158,405 to 82,083). Over the 30 year time horizon, the present

value of the health benefits under the ATV access scenario ranges from $2.2 million to $4.2 million, with a base case value of $3.5 million. The decline in the present value of health benefits if ATV access is allowed is $2.2 million (low case), $3.1 million base case and $3.8 million in the high case. The cost benefit ratios associated with ATV access (gravel surface) are subsequently reduced given increased maintenance costs and reduced benefits and equal 2.1 for the low case, 2.9 for the medium case and 3.6 for the high case. **On an annual basis, allowing ATV access will reduce the health benefits by between $160,000 and $280,000 per year**, with a medium case decline of almost $228,000. A reduction in health benefits of $228,000 per year is equivalent to approximately $9 per household and $4 per capita for Kings County.

>MAY BE ATV / TRAIL STUDIES<

Studies to Read:

Bateman, I. J., Day, B. H., Dupont, D. P., Georgiou, S. (2006). Incentive compatibility and procedural invariance testing of the one-and-one-half-bound dichotomous choice elicitation method: Distinguishing strategic behaviour from the anchoring heuristic. In: 16th Canadian Resource and Environmental Economics working group meetings.

Betz, C. J., Bergstrom, J. C., Bowker, J. M. (2003). A contingent trip model for estimating rail-trail demand. Journal of Environmental Planning and Management, 46 (1), 79–96.

Cameron, A. C., Trivendi, P. K. (1986). Econometric models based on count data: Comparisons and applications of some estimators and tests. Journal of Applied Econometrics, 1 (1), 29–53.

Cameron, A. C., Windmeijer, F. A. G. (1996). R-squared measures for count data regression models with appliations to health-care utilization. Journal of Business & Economic Statistics, 14 (2), 209–220.

Canada, H. (2006). Canada's guide to healthy eating and physical activity. Queens Press, Ottawa. Carothers, P.,

Vaske, J. J., Donnelly, M. P. (2001). Social values versus interpersonal conflict among hikers and mountain bikers. Leisure Sciences 23, 47–61.

Delaney, G., Groups not on same path on proposed rail trail. The Halifax Chronicle-Herald Newspaper, December 27, 2006 Dillman, D. A. (2007). Mail and internet surveys: the tailored design method, 2nd Edition.

Wiley, Hoboken, N.J. Englin, J., Shonkwiler, J. S. (1995). Estimating social welfare using count data models: an application to long-run recreation demand under conditions of endogenous stratification and truncation. The Review of Economics and Statistics, 77 (1), 104–112.

Evenson, K. R., Herring, A. H., Huston, S. L., 2005. Evaluating change in physical activity with the building of a multi-use trail. American Journal of Preventive Medicine, 28, 177–185.

Gardner Pinfold Consulting Economists Limited, (1999). A survey of nova scotia hiking trail users. Tech. rep., Nova Scotia Department of Economic Development and Tourism, Nova Scotia Sport and Recreation Commission, Human Resources Development Canada. URL http://www.gov.ns.ca/hpp/physicalactivity/publications/trails.pdf

Haider, W., Anderson, C., Beardmore, B., Anderson, D. A. (2004). Recreational trail use of residents in Jasper National Park, Canada. Working Paper 2, Finnish Forest Research Institute. URL http://www.metla.fi/julkaisut/workingpapers/2004/mwp002.htm

Hellerstein, D., Mendelsohn, R. (1993). A theoretical foundation for count data models. American Journal of Agricultural Economics, 75 (3), 604–611.

Herriges, J., Shogren, J. (1996). Starting point bias in dichotomous choice valuation with follow-up questioning. Journal of Environmental Economics and Management, 30, 112–131. Jackson, E. L., 1986. Outdoor recreation participation and attitudes to the environment. Leisure Studies, 5, 1–23. Keiran Pathway Society, http://www.valleycycling.ca/Kieran%20Pathways%20Society.html

Marcouiller, D., Scott, I., Prey, J. (2006). Compatibility and conflict as a conceptual basis for outdoor recreation planning. http://www.urpl.wisc.edu/people/marcouiller/publications/06litreview.pdf.

McFadden, D., 1974. Conditional logit analysis of qualitative choice behaviour. In: Zarembka, P. (Ed.), Frontiers in Economics. Academic Press, New York, pp. 105–142.

Morey, E. R., Buchanan, T., Waldman, D. M., 2002. Estimating the benefits and costs to mountain bikers of changes in trail characteristics, access fees, and site closures: choice experiments and benefits transfer. Journal of Environmental Management 64, 411–422.

Nova Scotia Finance, Economics and Statistics Division, (2006). Nova Scotia statistical review. http://www.gov.ns.ca/finance/statistics/agency/publications/publications.asp?id=Pub21

Peden, M et al.. (2004). The World Report on Road Traffic Injury Prevention Geneva: World Bank/World Health Organization.

Pool, Tim (2005), Rail-Trail Maintenance and Operation: Ensuring the Future of Your Trail- A Survey of 100 Rail Trails, Rail Trail Conservancy, Northeast Regional Office. http://www.railtrails.org/resources/documents/resource_docs/maintenance_operations_report.pdf

R Development Core Team, 2006. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria, ISBN 3-900051-07-0. URL http://www.R-project.org

Siderelis, C., Moore, R., Fourth (1995). Outdoor recreation net benefits of rail-trails. Journal of Leisure Research, 27 (4), 344-352 .

Venables, W. N., Ripley, B. D., 2002. Modern Applied Statistics with S, 4th Edition. Springer, New York, ISBN 0-387-954570. URL http://www.stats.ox.ac.uk/pub/MASS4 31

Voluntary Planning, November (2004). Final report of the voluntary planning off-highway vehicle task force. Tech. rep.,

Government of Nova Scotia. Wang, Guijing, et al. (2005). A Cost-Benefit Analysis of Physical Activity Using Bike/Pedestrian Trails. Health Promotion Practice, 6 (2), 174-179.

Wolter, S. A., Lindsey, G. (2001). Summary report: Indiana trails study. Tech. rep., Eppley Institute for Parks & Public Lands, Indiana State University, Bloomington, Indiana.

WIDTH STANDARDS

STANDARDS	Unidirectional		Bidirectional	
	Desired	Minimum	Desired	Minimum
PEI AT Network Plan (draft, 2022)	1.8m/5.9ft (p. 22)	1.5m/4.9ft (p. 22)	3.0m/9.8ft (p. 21)	2.4m/7.9ft (p. 21)
Two Previous Sside Drafts (2007, 2012)	NA	NA	3.0m/9.8ft	2.4m/7.9ft "unique circumstances" < 2.4m
BC AT Design Guide (2019) along the road	1.8m/5.9ft (p. B49)		3.0m/9.8ft (p. B49)	
Separated (p. E28)	2.0m/6.5ft If bicycle volumes greater than 150/hour or to include side-by-side cycling (2.5-3m) 0.6m buffer each side	1.8m/5.9ft 0.6m buffer each side	4.0m/13.1ft 0.6m buffer each side	3.0/9.8ft 0.6m buffer each side
Transports Quebec (15.4.2.4) based on + / - 1,500 cyclist/day	2.0 m > 1500 or beside parking 1.5m <1,500		3.0 m > 1,500 2.75 m < 1,500	2.4m/7.9ft
City of Ottawa (p 45)	1.8m or +/5.9ft	1.5m/4.9ft	3.0m/9.8ft	
National Association of City Transportation Officials (NACTO) Design Guide	7ft	1.5m/4.9ft	12ft	2.4m/7.9ft