

Cycling and risk



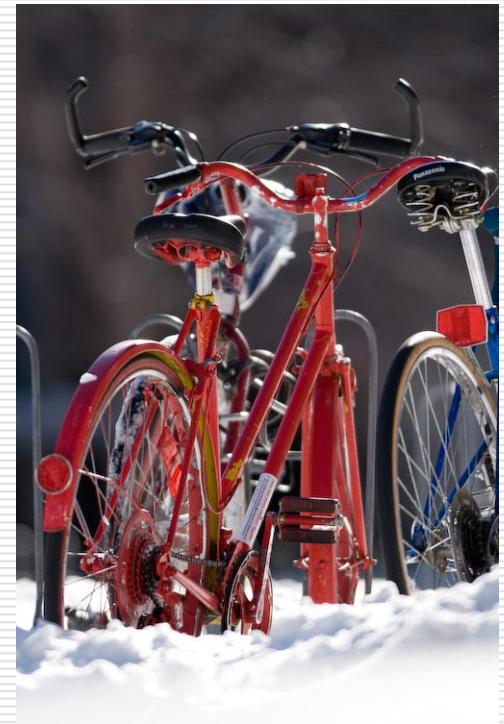
Cycle facilities and risk management

-
- ❑ Failure to recognize possibilities is the most dangerous and common mistake one can make.

Mae Jemison, astronaut

What we'll talk about today...

- ❑ Some policy context
- ❑ Cyclists as VRU's
- ❑ User needs & cycle facilities
- ❑ So... What works?
- ❑ A human-centered perspective
- ❑ Concluding thoughts



Some policy context ...



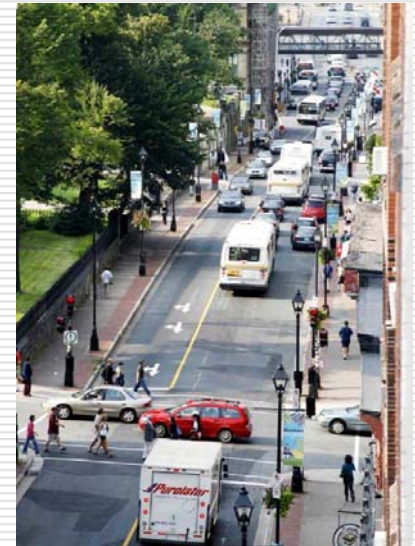
Accommodating all road users



The role of policies & guidelines

- Policies & guidelines:
 - A valuable tool
 - Often based on legacy science
 - Not necessarily current

- Don't account for some key issues:
 - Active transportation modes
 - Changing community priorities
 - The need for flexibility



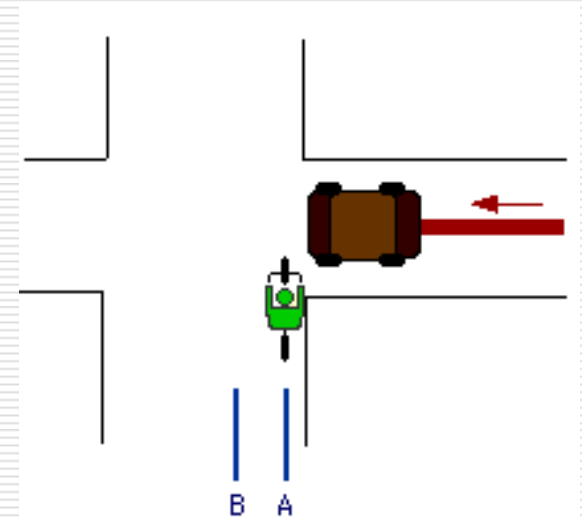
Emerging knowledge

□ Cycling facilities:

- Non-traditional
- A shifting target
- Require flexibility

□ The challenge:

- Dealing with road user expectancy
- Anticipating and identifying risk elements



Three key things to remember

- Context sensitive solutions:
 - Can support a level of design flexibility
 - Need to be defensible

- A policy commitment:
 - Willingness to compromise functionality

- An underdeveloped cycling culture:
 - Education & enforcement changes needed

The 3 E's of Safety and Cycling

- ☐ Engineering:
 - Emerging knowledge
 - Necessary but not sufficient

- ☐ Enforcement:
 - Effective only when present
 - Significantly lacking

- ☐ Education is absent



2 more E's

- ❑ Encouragement:
 - Building mode share
 - Perceived risk
 - The comfort factor
- ❑ Evaluation:
 - Learning from experience



Cyclists as VRU's



Vulnerable road users

☐ Pedestrians

- Adults
- Children & young adults
- Seniors
- Persons with disabilities

☐ Cyclists

- Various levels of expertise

☐ In-line skaters, skateboarders etc.



2007 Canadian collision stats

- ❑ 65 fatalities
- ❑ 425 serious injuries



Percentage of Fatalities and Serious Injuries by Road User Class 2007

Road User Class	Fatalities	Serious Injuries
Drivers	52.2	47.9
Passengers	22.0	24.5
Pedestrians	13.6	12.2
Bicyclists	2.3	3.1
Motorcyclists	8.0	10.1
Not Stated/Other	1.9	2.2
Total	100.0	100.0

Trends ...

Fatalities by Road User Class 2003–2007

Road User Class		2003	2004	2005	2006	2007
Drivers	#	1,427 ^f	1,388 ^f	1,507 ^f	1,516 ^f	1,444
	%	51.6	51.0	51.9 ^f	52.4 ^f	52.2
Passengers	#	658 ^f	648 ^f	677 ^f	614 ^f	609
	%	23.8 ^f	23.8 ^f	23.3 ^f	21.2 ^f	22.0
Pedestrians	#	379	363	344	382 ^f	377
	%	13.7	13.3	11.8	13.2 ^f	13.6
Bicyclists	#	45	56	52	73	65
	%	1.6	2.1	1.8	2.5 ^f	2.3
Motorcyclists*	#	177	198	229	212 ^f	220
	%	6.4	7.3	7.9	7.3 ^f	8.0
Not Stated/Other	#	82 ^f	69 ^f	96 ^f	98 ^f	52
	%	2.9 ^f	2.5 ^f	3.3 ^f	3.4 ^f	1.9
Total	#	2,768	2,722	2,905	2,895	2,767
	%	100.0	100.0	100.0	100.0	100.0

□ 2003 to 2007: No clear trends

Some York Region patterns (1)

□ Total cycling collisions:

Year	Numbers of Accidents
2004	74
2005	58
2006	64
2007	51
<i>Total</i>	<i>247</i>

Some York Region patterns (2)

❑ Collisions by type:

Accident Type	Numbers of Accidents	Percentage
Non-Fatal Injury	175	71%
Property Damage Only	56	23%
Fatal Injury	5	2%
Other	8	4%
<i>Total</i>	<i>247</i>	<i>100%</i>

Some York Region patterns (3)

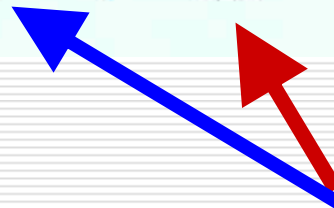
□ Where collisions happen:

Accident Location	Numbers of Accidents	Percentage
At Intersection and Intersection Related	176	71%
Midblock	39	16%
Near Private Driveway	30	12%
At Railway Crossing	1	0.5%
Other	1	0.5%
Total	247	100%

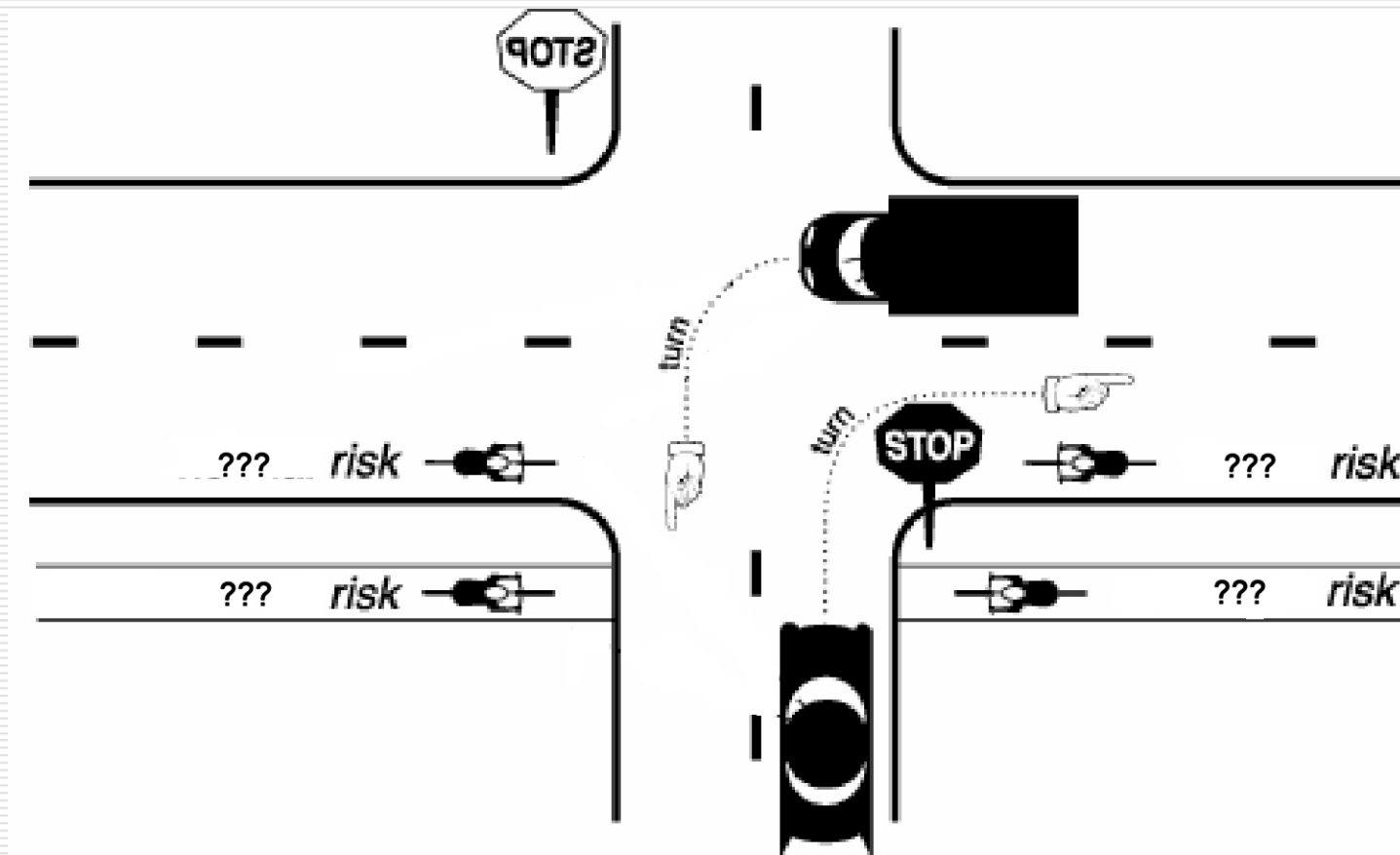
Some interesting Dutch numbers

Table 4. Number of dead and seriously injured cyclists in 2002 resulting from accidents between cyclists and motorised vehicles

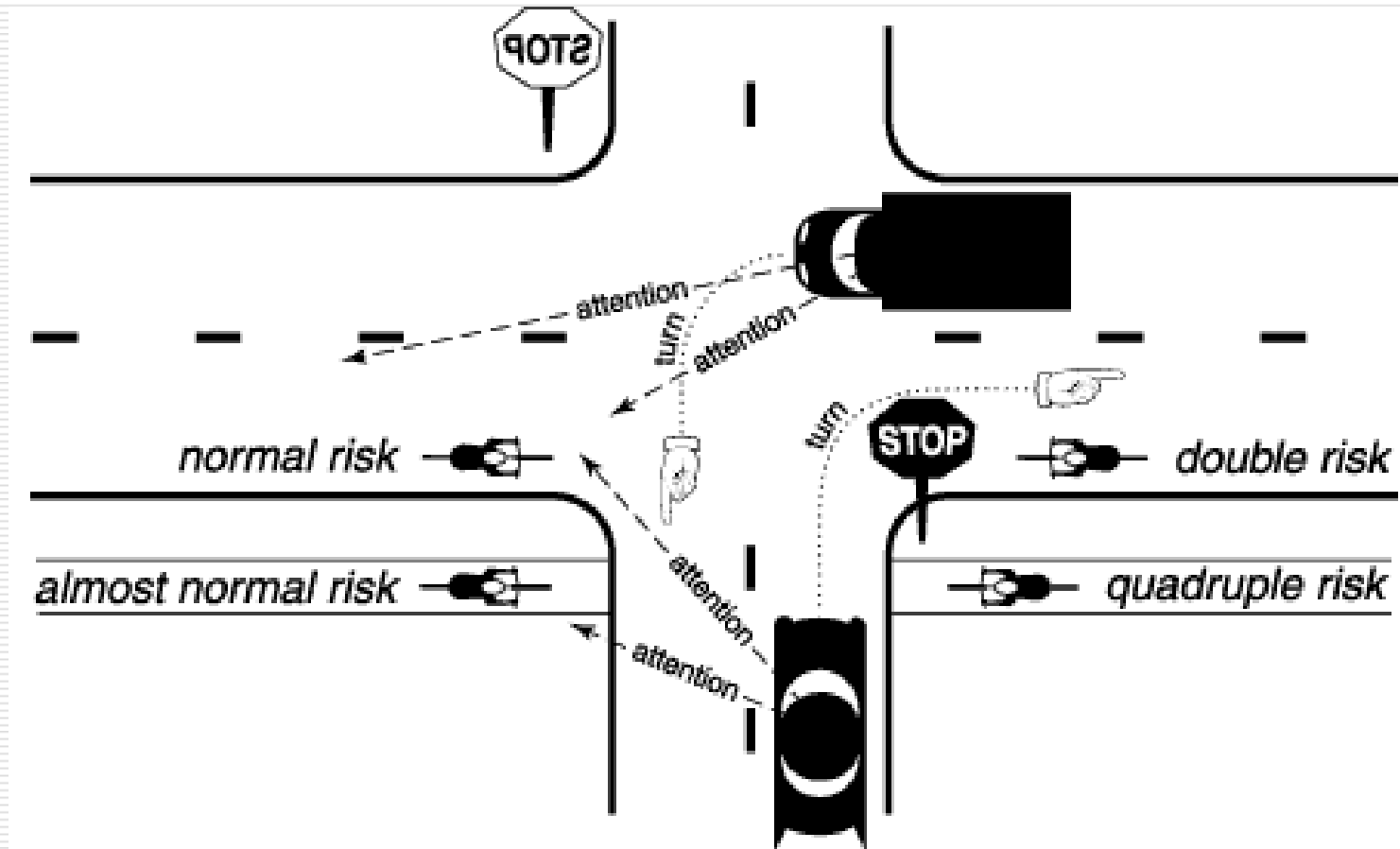
	50 km/h limit		80 km/h limit	
	road section	intersection	road section	intersection
deaths	15	56	19	31
hospitalised injuries	303	842	104	179
total	318	898	123	210



Pop quiz: What's the Risk?



Pop quiz: What's the Risk?



The tip of the iceberg

- ❑ Most statistics reflect on-road crashes
- ❑ Exclude:
 - Paths, parking lots, driveways etc
 - Falls & other non-collision events
- ❑ A US 3-state study:
 - 70% of injuries did not involve a motor vehicle
 - 31% were injured in non road locations



Cyclists most at risk

- Younger riders most vulnerable:
 - 10 -15 years old: highest fatality & injury rate
 - Rideouts from driveways & intersections
 - Riding in wrong direction
 - Crossing midblock
- Deaths of cyclists 25+ increasing:
 - More riding (exposure)

For all bicycle/vehicle collisions

- ❑ One-third on local streets
- ❑ 75% with speed limit < 60km/h

- ❑ Alcohol involvement:
 - One-third of fatal crashes
 - 24% of cyclists killed: >0.08
 - Older cyclists, weekends, nighttime

Primary crash factors

- ☐ Wrong-way riding
- ☐ Sidewalk riding
- ☐ Presence of driveways
- ☐ Night bicycle riding
- ☐ The “dooring” problem
- ☐ Cyclists not obeying TCD’s
- ☐ Crashes involving children



User needs & cycle facilities



All users are not created equal...

☐ **A**dvanced riders

☐ **B**asic adult riders

☐ **C**hildren



Space needs



Other needs ...

- ☐ Smooth Surface
- ☐ Connectivity



Cycling collision vectors (1)

- ☐ **Traffic volumes**
- ☐ **Operating speeds**
- ☐ Intersection complexity
- ☐ Parking
- ☐ Grades



Cycling collision vectors (2)

- ☐ Edge conditions
- ☐ Roadside
- ☐ Driveway frequency
- ☐ Pavement width constraints



Cyclists, traffic, and speed

- High volumes reduce cyclist comfort
- In heavy traffic – cyclists need space:
 - To pass
 - To take avoidance action
 - To be passed safely...

Cyclists, traffic, and speed (2)

- Speed critical to bikeability & safety:
 - @ 32 km/h – 5% fatal
 - @ 48 km/h – 45% fatal
 - @ 64 km/h – 85% fatal

The question of separation (1)

- ☐ Key influencing factors:
 - Speed of motorized traffic;
 - Intensity of motorized traffic;
 - Functional class:
 - ☐ Arterial, major collector;
 - ☐ Minor collector, local.
 - Intensity of cycle use:
 - ☐ Growing into higher level facilities



The question of separation (2)

- The Dutch philosophy:
 - The best situation for cyclists;
 - The entire traffic situation is relevant;
 - There are multiple possible solutions



Table 14. Option diagram for road sections inside the built-up area

Road category	Max. speed of motorised traffic (km/h)	Motorised traffic intensity (pcu/day)	Cycle network category		
			basic network ($I_{\text{bicycle}} > \text{work } 750/\text{day}$)	cycle route ($I_{\text{bicycle}} 500-2500/\text{day}$)	main cycle route ($I_{\text{bicycle}} > 2000/\text{day}$)
Estate access road	n/a	0	solitary track		
	walking pace or 30 km/h	1 - 2.500	combined traffic		cycle street or cycle lane (with right of way)
		2.000 - 5.000			
	> 4.000	cycle lane or cycle track			
District access road	50 km/h	irrelevant			
	2x1 lanes				
	2x2 lanes		cycle track or parallel road		
70 km/h	cycle track, moped/cycle track or parallel road				

Implications

- ❑ One size does not fit all;
- ❑ There are overlapping solutions:
 - Context is important
- ❑ Cycle infrastructure can evolve;
 - As cycling grows, facility needs change
 - Start smart & evolve
 - Sustainability is the key
- ❑ Network-level consistency critical

A key observation ...

- ❑ Increasing road segment complexity:
 - May increase conflicts;
 - May violate road user expectancies;
 - May increase potential for error;
 - Will increase intersection challenges;

- ❑ Road safety implications

So... What works?



Statistical studies

- Very little reliable data
 - Complexity & variety of treatments
 - Non-transferability of European experience
 - Difference in cycling culture

- Perception and fact are important

One recent Canadian review (UBC)

- ❑ Comprehensive literature review
- ❑ Some general conclusions:
 - Clearly marked bike-specific facilities provide improved safety over on-road cycling with traffic or off-road with peds & other users
 - Marked bike routes/lanes reduce injury & crash rates by half

One recent Canadian review (2)

- Some general conclusions (cont):
 - Roundabout safety still a question
 - Illuminate nighttime cycle routes
 - Well maintained surfaces essential
 - Under-reporting of crashes an issue

- Our understanding is still primitive

A human-centered perspective



It depends on what you measure

- ☐ Subjective feelings of comfort & safety are important to cyclists
- ☐ Affect
 - Stress levels;
 - Likelihood of modal choice;
 - Likelihood of route choice;
- ☐ Cyclists seek to minimize stress

What we know about design

□ Positive influences:

- Bike lane or paved shoulder
- Increasing width of bike lane or shoulder
- Increasing width of curb lane
- Presence of residential development



What we know about design (2)

☐ Negative influences:

- Increases in traffic volume
- Increases in vehicle speeds
- Presence of on-street parking



☐ Other negative factors:

- Presence of large trucks & buses
- Vehicles turning right into driveways
- Vehicles pulling into/out of on-street parking

Another perspective

□ Danish study:

- Subjective vs. objective safety
- Inconsistencies exist between the two
- Reinforces to some degree findings of Canadian work
- Highlights ambiguity and inconsistency of evaluations

Concluding thoughts



Concluding thoughts (1)

- ☐ Cycle facilities: an emerging technology
 - Reliable evaluations rare
 - Safety trends distinguishable
 - Design guidance still weak
 - Human centered approach critical
 - Risk management essential
 - ☐ Identify early warning signs
 - ☐ Monitor & evaluate
 - ☐ Road safety failures are temporal...

Concluding thoughts (2)

- ❑ The design process:
 - Network-level consistency important
 - ❑ Road user expectations
 - ❑ Network continuity
 - Consistent planning framework essential
 - Document the process: ensure defensibility
 - Multidisciplinary approach needed:
 - ❑ Design, traffic engineering, human factors
 - ❑ Enforcement, education, awareness

Concluding thoughts (3)

- ❑ The design process (continued):
 - Don't ignore interactions/tradeoffs
 - Check network effects: safety impacts leach spatially
 - Explicitly evaluate safety
- ❑ North American cycling culture is still nascent:
 - Follow the 5 E's
- ❑ Wayfinding is a missing link:
 - An important driver/cyclist cue



Concluding thoughts (4)

- Use the sustainable approach:
 - Don't temporize: commit & build
 - Safety gains from growing presence
 - Early successes nourish growth in use
 - Education & encouragement are key
 - Match facilities to growing use:
 - Start simple, build in flexibility, adapt
 - Early network connectivity is important
 - Monitor, learn, and ACT..

A last piece of advice

Move FORWARD...



Thanks



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