Adaptation of a Canadian Culpability Scoring Tool to Alberta Police Traffic Collision Report Data

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Background

- Objective: Adapt a tool to Alberta Police reports, building on previous work, to identify not-at-fault drivers who will be represent the Alberta Driving source population
- Quasi-induced exposure: Drivers who are in a collision and are considered not-at-fault are representative of the ‘typical driving population’
- Culpability analysis tool: A tool that can, based on the conditions of a crash and driver actions (usually found in police reports), determine fault in collision.
- When Culpability Analysis is sufficiently harsh, the drivers deemed not-at-fault will represent the typical driver

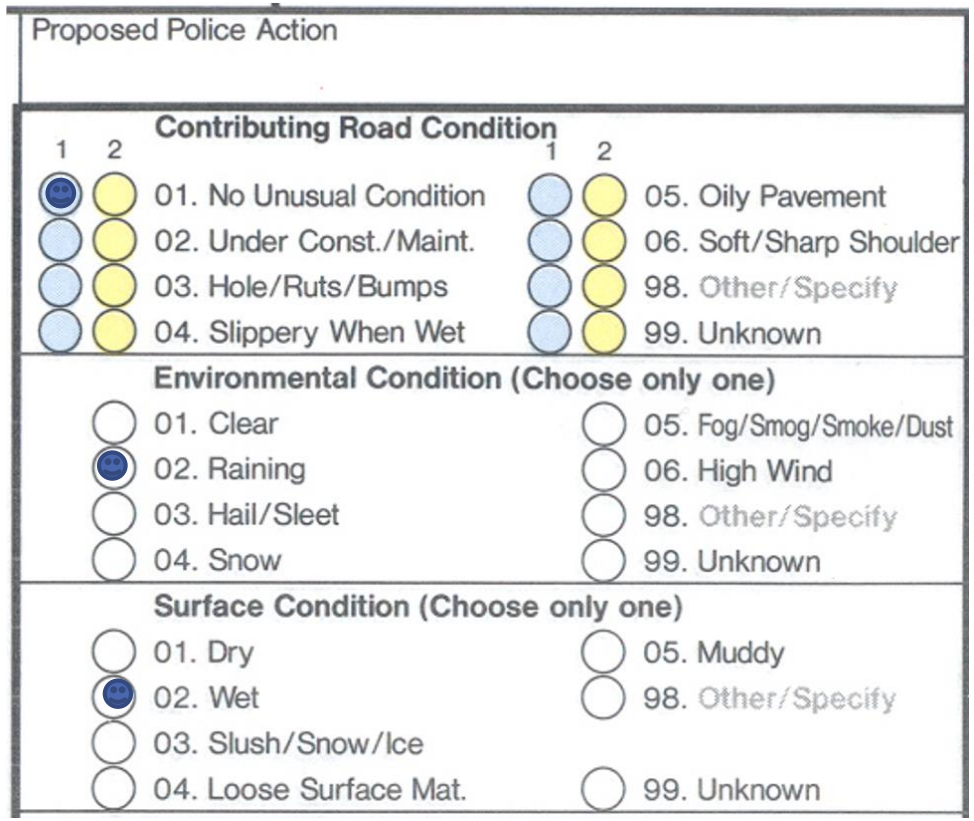
Fault/Culpability Analysis

- 7 categories scored from 1-5
- ≤13 is culpable
- ≥16 is non-culpable
- 14/15 is indeterminant
- “The cutoff score for a driver being nonculpable was chosen to indicate the presence of 2 or more factors that exonerate the driver from responsibility. Similarly, the cutoff for being culpable indicated the presence of at most one mitigating factor” (Brubacher et al. 2011)

Figure 1.
Canadian Culpability Scoring Tool

Canadian Tool	AB Report	Score
1. Road Type		
One Way Traffic	Road Class	
No Ramp	Special Facility or Description	1
Ramp	Special Facility or Description	2
Two Way Traffic	Road Class	
Between Intersection	Collision Location	2
Intersection	Collision Location	3
Ramp	Special Facility or Description	3
Police list roadside hazard or poor design as factor		5
2. Driving Condition		
Road Surface	Surface Condition	
Dry Asphalt	Dry Surface, road condition	1
Dry Gravel	Dry Surface, road condition	2
Wet asphalt	Wet Surface, road condition	2
Wet Gravel	Wet Surface, road condition	3
Road muddy/snow	Muddy Surface	4
Road surface listed as contributory	Contributing road condition	5
Visibility and Weather Conditions	Environmental / Light Condition	
Clear or Cloudy	Environmental Condition Clear	1
If lighting dark with partial or no illumination	Light Condition	2
Rain, smog, smoke, wind	Environmental Condition	2
If lighting dark with partial or no illumination	Light Condition	3
Snow, sleet, hail, fog	Environmental Condition	3
If lighting dark with partial or no illumination	Light Condition	4
Police list visibility or weather as contributory		5
3. Vehicle Condition		
Not a contributory factor in crash	Vehicle Condition	1
Contributory factor in crash	Vehicle Condition	5

Canadian Tool	AB Report	Score
4. Unsafe Driving Actions		
Not obeying laws or unsafe driving	Driver Action / Speed	1
Obeyed laws and driving safely	Driver Action (Driving Properly)	5
5. Contribution from other parties		
No Contribution	Driver Action / Impact Location	1
Contribution	Driver Action / Impact Location	5
6. Type of Collision		
Unsafe Driving	Driver Action / Speed	1
No Unsafe Driving	Driver Action (Driving Properly)	
Multivehicle crash	Vehicle Number	5
Stopped/Parked	Driver Action (Parked Vehicle)	
Lead vehicle in rear end	Vehicle Number	
Third or subsequent vehicle	Vehicle Number	
Loss of control prior to crash	Collision Description	1
Precollision Action	Primary Event	
Striking	Impact Location	*
Indeterminate	Impact Location	*
Struck	Impact Location	*
*Scoring varied based on the precollision action and the impact location		
7. Task Involved		
Unsafe Driving	Driver Action / Speed	1
No Unsafe Driving	Driver Action (Driving Properly)	
Parked, Stopped in traffic	Driver Action (Parked) / Description	5
Turning and backing	Primary Event	2
All other Precollision Actions	Primary Event	1



Proposed Police Action

Contributing Road Condition

1	2		1	2	
●	○	01. No Unusual Condition	○	○	05. Oily Pavement
○	○	02. Under Const./Maint.	○	○	06. Soft/Sharp Shoulder
○	○	03. Hole/Ruts/Bumps	○	○	98. Other/Specify
○	○	04. Slippery When Wet	○	○	99. Unknown

Environmental Condition (Choose only one)

○	01. Clear	○ 05. Fog/Smog/Smoke/Dust
●	02. Raining	○ 06. High Wind
○	03. Hail/Sleet	○ 98. Other/Specify
○	04. Snow	○ 99. Unknown

Surface Condition (Choose only one)

○	01. Dry	○ 05. Muddy
●	02. Wet	○ 98. Other/Specify
○	03. Slush/Snow/Ice	
○	04. Loose Surface Mat.	○ 99. Unknown

2. Driving Condition				
	Road Surface		Surface Condition	
		Dry Asphalt	Dry Surface, no unusual road condition	1
		Dry Gravel	Clear, Loose Surface Mat.	2
		Wet asphalt	Wet Surface, no unusual road condition	2
		Wet Gravel	Raining, Loose Surface Mat.	3
		Road muddy/snow	Muddy/Slush/Snow/Ice Surface	4
		Road surface listed as contributory	Contributing road condition	5

Use of Tool

- Randomly selected 175 collisions
- 2 raters scored each driver by hand
  - Only information that is necessary to score was provided
- Kappa: 0.95 [95% CI: 0.92-0.99] agreement of 97.8%
  - Use rules that worked to inform automation and discuss rules that were ambiguous

Adapting the tool – Issues

- Missing Data
  - Intersection status often missing
  - Road type (one way or two way) missing

Intersection Status

- Original data missing ~61% for location (intersection or not).
  - 47% of missing from Edmonton 53% of missing from Calgary
- Automated intersection status using what we know
  - E.g. TCD presence, the description includes ‘intersection’, traffic circle, stop/yield sign or driver turns across path it is coded as intersection
  - If the collision is on a ramp, in a back alley on their driveway it is considered not an intersection
- Used Google Maps to check each intersection status for the BMV collisions
  - Used Automated intersection file to determine intersection
  - 88.18% agreement between Automated Intersection and Google Maps

		Non-Culpable (%)	Culpable (%)	OR (95% CI)
Total Drivers		1,130 (37.54)	1,880 (62.46)	
Alcohol Use				
	Apparently Normal	1041 (99.14)	1018 (74.91)	1 (Reference)
	Had Been Drinking	5 (0.48)	102 (7.51)	**20.86 (8.46-51.41)**
	Impaired by Alcohol	4 (0.38)	239 (17.58)	**61.10 (22.66-164.75)**
	Had Been Drinking vs Impaired			**7.15 (5.80-8.50)**
Age				
	<25	154 (13.93)	435 (23.14)	**1.72(1.35-2.20)**
	25-39	364 (32.94)	610 (32.45)	1.02 (0.83-1.26)
	40-54	352 (31.86)	449 (23.88)	**0.78(0.63-0.96)**
	>=55	235 (21.27)	386 (20.53)	1 (Reference)
Sex				
	Female	480 (43.44)	657 (34.95)	1 (Reference)
	Male	625 (56.56)	1223 (65.05)	**1.43 (1.23-1.66)**
Crash Type				
	Single Vehicle	27 (2.44)	737 (39.20)	**25.74 (17.38-38.14)**
	Multi Vehicle	1078 (97.56)	1143 (60.80)	1 (Reference)
Time of Day				
	00:01-06:00	92 (8.34)	303 (16.18)	1 (Reference)
	06:01-12:00	337 (30.56)	458 (24.45)	**0.41 (0.31-0.54)**
	12:01-18:00	460 (41.70)	648 (34.60)	**0.43 (0.33-0.56)**
	18:01-24:00	214 (19.40)	464 (24.77)	**0.66 (0.50-0.87)**

Table I Crash responsibility according to risk factors in 2086 injured drivers

	Nonculpable drivers	Culpable drivers	Unadjusted odds ratio (95% CI)
Blood alcohol level (%)			
0	483 (36.5%)	840 (63.5%)	1.00
0.001–0.049	28 (25.2%)	83 (74.8%)	1.70 (1.10–2.65)
0.050–0.099	13 (15.9%)	69 (84.1%)	3.05 (1.67–5.58)
0.100–0.149	8 (6.1%)	123 (93.9%)	8.84 (4.29–18.23)
0.150–0.199	8 (5.1%)	149 (94.9%)	10.71 (5.21–22.00)
≥0.200	10 (3.5%)	272 (96.5%)	15.64 (8.24–29.69)
Age group			
<25	129 (19.5%)	533 (80.5%)	2.10 (1.54–2.86)
25–39	156 (23.8%)	499 (76.2%)	1.62 (1.20–2.20)
40–54	168 (34.9%)	313 (65.1%)	0.95 (0.70–1.29)
≥55	97 (33.7%)	191 (66.3%)	1.00
Sex			
Female	182 (34.3%)	349 (65.7%)	1.00
Male	368 (23.7%)	1187 (76.3%)	1.68 (1.36–2.08)
License status			
Full license	520 (27.0%)	1405 (73.0%)	1.00
Graduated license	30 (18.6%)	131 (81.4%)	1.62 (1.07–2.43)
Crash type			
Single vehicle	51 (6.4%)	744 (93.6%)	9.19 (6.78–12.47)
Multivehicle	499 (38.7%)	792 (61.3%)	1.00
Crash location			
Street	398 (27.8%)	435 (75.4%)	1.00
Highway	142 (24.6%)	1033 (72.2%)	1.18 (0.95–1.47)
Rural road	10 (12.8%)	68 (87.2%)	2.62 (1.34–5.14)
Crash time block			
00:01–06:00	94 (16.7%)	470 (83.3%)	1.00
06:01–12:00	144 (37.5%)	240 (62.5%)	0.33 (0.25–0.45)
12:01–18:00	158 (29.4%)	379 (70.6%)	0.48 (0.36–0.64)
18:01–24:00	148 (25.8%)	425 (74.2%)	0.57 (0.43–0.77)

Study	Location	Authors	Study Population	Culpability Measure	Percent Non-culpable
Mind wandering and driving: responsibility case-control study	France	Galera et al.	955 Drivers injured in crashes 2010-2011	Robertson & Drummer responsibility analysis	52.56%
Risk of injurious road traffic crash after prescription of antidepressants	France	Orriols et al.	72,685 Drivers involved in injurous crashes	Adapted from Robertson & Drummer	51.90%
Road traffic crash risk associated with prescription of hydroxyzine and other sedating H1-antihistamines: A responsibility and case-crossover study	France	Orriols et al.	142,763 Drivers involved in injurious crashes 2005-2011	Adapted from Robertson & Drummer.	51.40%
Risk factors for injury accidents among moped and motorcycle riders	France	Moskal et al.	181, 228 Motorcycle Users 1996-2005	Adapted from Robertson & Drummer	46.47%
Risk factors for injury accidents among moped and motorcycle riders	France	Moskal et al.	181, 319 Moped Users 1996-2005	Adapted from Robertson & Drummer	41.70%
Cell phone use and traffic crash risk: a culpability analysis	British Columbia	Asbridge et al.	1,248 Drivers, 312 cellphone users and 936 matched controls 2005-2008.	Adapted from Robertson & Drummer	37%
Cannabis intoxication and fatal road crashes in France: population based case-control	France	Laumon et al.	9,772 Drivers, who were involved in fatal crashes in France 2001-2003.	Adapted from Robertson & Drummer	30.76%
Responsibility study: Main illicit psychoactive substances among car drivers involved in fatal road crashes	France	Gadekbeku et al.	6,932 Drivers involved in a fatal crash, 2001-2003	Robertson & Drummer responsibility analysis	28.60%
Development and Validation of a Crash Culpability Scoring Tool	British Columbia	Brubacher et al.	2086 Drivers in hospitalized collisions with known BAC, 1992-2005	Adapted from Robertson & Drummer	26.40%
The involvement of prescribed drugs in road trauma	Victoria, Australia	Drummer & Yap	1105 Drivers who were killed in a collision (not involving drugs/alcohol) 2000-2013.	Robertson & Drummer responsibility analysis	21.54%
The culpability of drivers killed in New Zealand road crashes and theiruse of alcohol and other drugs	New Zealand	Poulsen et al.	1046 Drivers killed from 2004-2009	Robertson & Drummer responsibility analysis	16%

Results of tool

		Non-Culpable (%)	Culpable (%)	OR (95% CI)
		243,935 (38.11)	396,133 (61.89)	
Sex				
	Female	98,693 (40.85)	125,922 (38.06)	1 (Reference)
	Male	142,894 (59.15)	204,905 (61.94)	**1.12 (1.11-1.14)**
Age				
	<25	34,312 (14.32)	68,600 (21.16)	**1.52 (1.49-1.55)**
	25-39	83,912 (35.02)	111,510 (34.40)	1.01 (0.99-1.02)
	40-54	74,381 (31.05)	82,203 (25.36)	**0.85 (0.84-0.86)**
	>=55	46,982 (19.61)	61,891 (19.09)	1 (Reference)
Crash Type				
	Single Vehicle	4,242 (1.74)	140,689 (35.52)	**31.12 (30.17-32.10)**
	Multi Vehicle	239,693 (98.26)	255,444 (64.48)	1 (Reference)
Time				
	00:01-06:00	9,892 (4.09)	21,548 (5.52)	1 (Reference)
	06:01-12:00	80,067 (33.09)	127,003 (32.56)	**0.73 (0.71-0.75)**
	12:01-18:00	122,695 (50.70)	181,500 (46.53)	**0.68 (0.66-0.70)**
	18:01-24:00	29,334 (12.12)	60,022 (15.39)	**0.94 (0.91-0.97)**
Alcohol Use				
	Apparently Normal	213,346 (99.81)	244,403 (97.04)	1
	Had Been Drinking	287 (0.13)	2,908 (1.15)	**8.84 (7.83-9.99)**
	Impaired by Alcohol	121 (0.06)	4,542 (1.80)	**32.77 (27.35-39.25)**
Drug Use				
	Apparently Normal	213,346 (99.99)	244,403 (99.85)	1
	Impaired by Drugs	27 (0.01)	357 (0.15)	**11.54 (7.80-17.07)**
Injury Severity				
	None	224827 (94.00)	314178 (96.89)	1
	Minor Injury	13171 (5.51)	8149 (2.51)	**0.44 (0.43-0.46)**
	Major Injury	1160 (0.48)	1828 (0.56)	**1.13 (1.05-1.21)**
	Fatal	24 (0.01)	106 (0.03)	**3.12 (2.03-4.92**
Note: bold indicates significant at alpha level of 0.05				

Conclusion

- Results of adapted tool fairly consistent with original culpability tool
- Results are the same in direction when applied to all injuries
- Future directions could include testing those admitted to hospital with blood tests
- Could be used in the future for culpability analysis studies and/or choosing representative control group

THANK YOU!