

Utilization of SHRP2 NDS Adverse Weather Data to Evaluate Driver's Behavior

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7TH INTERNATIONAL SYMPOSIUM on NATURALISTIC DRIVING RESEARCH

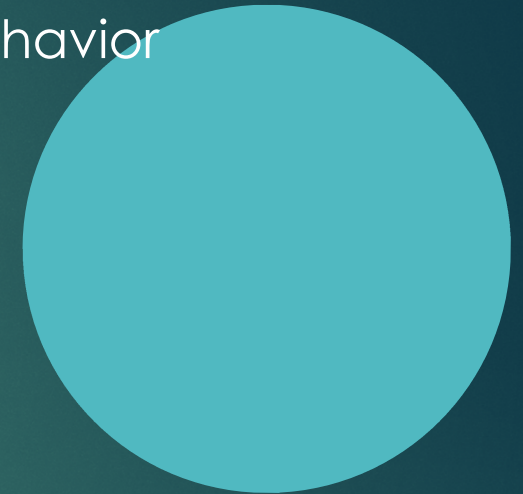
Background

- ▶ Assess how inclement weather affects driver's performance and behavior (SHRP2 NDS)
 - ▶ 90% of crashes attributed to driver behavior
 - ▶ Relation to crashes
- ▶ How drivers respond to adverse weather/road conditions?
 - ▶ Driver dynamics (speed and headway selection)
 - ▶ Drivers adapt to existing weather/road conditions
- ▶ Seek "transitional pattern" from normal to inclement driving
 - ▶ Speed
 - ▶ Maneuvers



Driver Responses

- ▶ Effects of adverse weather conditions on driver behavior
 - ▶ Drivers adjust/not adjust their driving behavior
 - ▶ Adjusting in an unsafe manner (driving too slow or too fast)
- ▶ Assess different environment conditions
 - ▶ Traffic flow/level
 - ▶ Roadway features (divided, two-way)
- ▶ Assess the change of normal driving
 - ▶ Visibility
 - ▶ Road condition
 - ▶ Distractions



Research Approach

- ▶ Use existing naturalistic data (SHRP2 NDS)
 - ▶ Identify specific factors leading to crash/near-crash situations
 - ▶ Speed, headway, visibility, braking
 - ▶ Sites: FL, IN, NC, NY, PA, WA
- ▶ Data mining procedure
 - ▶ Weather-related crash, near-crash events, and baseline events
 - ▶ Categorize findings for subsequent relational analysis
 - ▶ Select **relevant** crash and near-crash events (speed related)
 - ▶ Select similar non-adverse-weather driving scenarios (dry surface)
 - ▶ Evaluate normal driving baselines (dry & wet)
 - ▶ Perform analyses (speed adjustment, attention)



Data Mining

Vehicle ID = All Values

Site Name = Florida, Indian...

Trip ID = All Values

Weather = Mist/Light Rai...

Participant ID = All Values

Event Severity 1 = Crash, Near-C...

Select All | Select None

- Crash
- Near-Crash
- Crash-Relevant
- Non-Conflict
- Non-Subject Conflict

Select All | Select None

- No Adverse Conditions
- Fog
- Mist/Light Rain
- Raining
- Snowing
- Sleet
- Rain and Fog
- Snow/Sleet and Fog
- Other

Load	Query1	
Load	Query2	Vehic-Trip-Partic-IDs
Load	Query3	AdditionalEventSeverity-2

Query Results

493 Total linked records matched your query criteria. These records represent:

400 Vehicles 402 Drivers 489 Trips 493 Events


Cross Tabulation Graph Records

[Click to View Event Details and Video](#)

Participant ID	Vehicle ID	Trip ID	Site	Event Severity 1	Weather
715143	12742	1775330	Florida	Near-Crash	Raining
854214	17840	45763078	Florida	Crash	Raining
412510	76887	36884483	Florida	Near-Crash	Raining
276896	38900	97213622	Florida	Crash	Raining
997347	11869	86140984	Florida	Crash	Mist/Light...
125330	49701	15514901	Florida	Crash	Raining
780216	45955	59448288	Florida	Near-Crash	Raining
994639	51616	10825840	Florida	Near-Crash	Raining
407125	81405	83452588	Florida	Near-Crash	Raining
987199	20790	44280318	Florida	Crash	Raining
868437	71827	46249349	Florida	Crash	Raining
998260	75105	65306033	Florida	Crash	Raining
871308	74465	11712045	Florida	Crash	Mist/Light...
329508	24930	104379674	Florida	Crash	Mist/Light...
776794	19975	53137136	Florida	Near-Crash	Raining
572469	34336	95743881	Florida	Near-Crash	Mist/Light...
791000	48504	93570618	Florida	Near-Crash	Raining

Event Details and Video

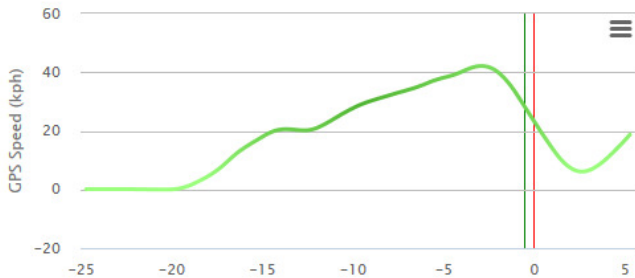
SHRP 2 Safety video for InSight web viewing only
<http://doi.org/10.15787/VTR1H590> eventid:128888414 2015-07-15T17:15:56



1592126
1592178

0:24 / 0:30

Time Series Data Event Analysis



GPS Speed (kph)

Event Timeline (sec)

<input checked="" type="radio"/> GPS Speed	28.2	Distance into Trip	32.400
<input type="radio"/> Network Speed	8.3	Brake	1
<input type="radio"/> Lon Accel	-0.3	Turn Signal	-1
<input type="radio"/> Lat Accel	0.0	Wiper Status	0
<input type="radio"/> Yaw Rate	0.2	Headlight Status	-1
<input type="radio"/> Throttle Pos	0.0	ABS Status	1
<input type="radio"/> Steering Pos		ESC Status	-1
		Trac Control Status	0

Event Analysis

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Event ID: 128888414

Event Severity 1: Near-Crash

Event Severity 2: Not Applicable

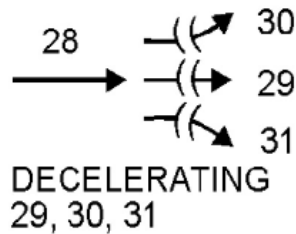
Event Nature 1: Conflict with a lead vehicle

Event Nature 2: None

Vehicle 1 Config: 28

Vehicle 2 Config: 29

Vehicle 3 Config: 9999



Final Narrative: Subject vehicle is traveling in the leftmost through lane of an undivided commercial road. It is lightly raining, and the roadway is wet. Subject follows a lead vehicle (V2). Both vehicles approach an intersection controlled by a traffic signal. The two through lane lights are green, while two dedicated left turn lane lights are red. V2 approaches the intersection and stops, apparently confused about which lanes have a green and which must stop. Subject does not expect the complete stop of V2 and must brake hard to avoid rear-ending V2. Subject sounds the horn and V2 eventually proceeds through the intersection.

Precipitating Event: Other vehicle ahead - decelerating

Surface Cndtn: Wet

Thru Trvl Lanes: 2

Traffic Control: No traffic control

Traffic Density: Level-of-service B: Flow with some restrictions

Traffic Flow: Not divided - simple 2-way trafficway

V1 Evasive Maneuver 1: Braked (no lockup)

V1 Evasive Maneuver 2: Not Applicable

V1 Lane Occupied: 1

V1 Post-Maneuver Control 1: Control maintained

V1 Post-Maneuver Control 2: Not Applicable

Vehicle Factors: None

Vehicle Rollover: Not Applicable

Vis Obstructions: No obstruction

Weather: Mist/Light Rain

Variable Database (Crash/Near-Crash)

Driver ID	Vehicle ID / Trip ID	Weather Condition	Surface Condition	Event Type / Incident Type	Vehicle Maneuver, Road Alignment	Speed Variation (kph)	Avg speed (kph)	Distraction (Driving Behavior)	Maneuver Judgment	Crash Type (Speed Event Occurred)	Visibility Obstruction	Traffic	Time of Day
176372	94838 / 97589293	Mist / Light Ra	Wet	Cr, RD (left or right	Steer Right, Curv	91-13, 78	78	Exceed safe sj	Unsafe but Leg 3 (13 kph)	None	ND, 2W, FF	Day	
181510	47795/40136460	Rain/Fog	wet	NrCr, SS Avoid	Steer R	127-90	116	None	Safe & Legal	96	None	D, FF	Day
230382	65841/39060563	Mist / Light Ra	Wet	NrCr, Obj/Avoid	Steer L	122-92	118	None	Safe & Legal	95	None	D, FF	Day
313668	97160 / 40821499	Mist / Light Ra	Wet	NrCr, Other	Brake, Steer Left	89-20, Dec	72	Exceeded safe	Unsafe but Leg 0 27	None	1W, FF	Day	
400390	98378 / 23679038	Mist / Light Ra	Wet	Cr, RE striking	Brake (lockup), S	66-0, Dec	65	None	Safe & Legal	1, 27	None	ND, 2W, RF	Day
403022	12926 / 84667560	Mist / Light Ra	Wet	NrCr, RE Avoid	Brake, Straight	20-70, Dec	105	Talking / Sing	Safe & Legal	0, 100	None	D, RF	Day
502063	91617 / 55727930	Mist / Light Ra	Wet	NrCr, Other	Steer Right, Strai	0-80, Acc	65	Distracted	Unsafe but Leg 0, 76	None	D, FF	Night, Light	
748838	82577 / 81398498	Mist / Light Ra	Wet	Cr, RE striking	Brake, Steer Right	84-0, Dec	75	Going straight	Unsafe but Leg 1, 33	None	ND, 2W, FF	Day	
811993	91211 / 97556427	Mist / Light Ra	Wet	NrCr, Opposite Dir	Brake, Steer Right	50-22, Dec	40	Holding Cell P	Unsafe but Leg 4, 32	None	ND, 2W, FF	Day	
811993	91211 / 54697764	Mist / Light Ra	Wet	Cr, RD (left or right	Steer Right, Stee	74-30, Dec	70	Talking / Sing	Unsafe but Leg 3, 48	None	D, FF	Night, Light	
108436	47819/ 60665969	Raining	Wet	NrCr, RE	Brake, Steer Left	55, Dec, 80	85	Biting Nails/C	Safe & Legal	0, 64	None	DH, UF	Dusk
125330	49701 / 15514901	Raining	Wet	Cr, RD (left or right	Brake, Steer Right	97-0, 90	95	None	Unsafe but Leg 2, 26	Rain, Snow,	D, RF	Day	
297012	97983 / 81146093	Raining	Wet	Cr, RD (left or right	Brake, Steer Left	14, Dec, 55	58	Cell phone loc	Unsafe but Leg 3, 30	None	ND, 2W, FF	Day	
297012	97983 / 81241707	LRain	Wet	NrCr, RE Avoid	HB	86-30	81	Looking out w	Unsafe but Leg 0, 50	None	D, RF	Day	
332677	39021 / 18480146	Raining	Wet	Cr, RE struck	None, Straight	56-0, Dec	56	None	Safe & Legal	3, 20	None	D, RF	Day
345780	16068/19636962	Raining	Wet	Cr, Median strike	Left turn	65	65	None	Safe & Legal	4, 60	None	D, RF	Night, Light
357282	96775/79765950	Raining	Wet	NrCr	None, Straight	80	80	None	Safe & Legal	0, 60	None	D, RF	Day
357835	81888/94182036	Raining	Wet	NrCr	None, Straight	66-70	70	None	Unsafe but Leg 0, 10	None	D, RF	Day	
407125	81405/214200038	Raining	Wet	NrCr, SS Same Dir	None, Straight	95-100	96	None	Safe & Legal	0, 60	None	D, RF	Day
407125	81405 / 83452588	Raining	Wet	NrCr, SS same dire	Brake, Steer Right	20-50, Dec	110	Drowsy, Sleep	Safe & Legal	0, 93	None	D, FF	Night, Light
409337	77375/102383496	Raining	Wet	NrCr	Curb strike	65	65	Checking phor	Unsafe	0, 30	None	2W, NF	Day
412510	76887 / 36884483	Raining	Wet	NrCr, RE then RD (l	Brake (lockup) th	01-42, Dec	95	Moving Object	Unsafe but Leg 0, 95	None	D, RF	Day	
416945	52281/85253321	Raining	Wet	Cr, NrCr	Lane change	62-45, 50	60	Another vehic	Safe & Legal	0, 45	None	D, RF	Day
462761	31497/82146384	Mist / Light Ra	Wet	NrCr, RE avoid	HB, Str L	120-5	88	None	Safe & Legal	0, 12	None	D, RF	Day
	31497/43406862	Mist / Light Ra	Wet	NrCr, RE avoid	HB, Str L	105-56	92	None	Safe & Legal	0, 66	None	D, RF	Day
491529	50967 / 42957725	Raining	Wet	Cr, RD (left or right	Brake (lockup), S-	0, Dec, 95	95	None	Unsafe & Ill Leg 3, 91	None	ND, 2W, FF	Night, Light	
491529	50967 / 97540623	Raining	Wet	Cr, RD (left or right	Brake (lockup), S-	0, Dec, 80	80	Talking on hai	Unsafe but Leg 1, 54	Rain, Snow,	D, FF	Day	
491529	50967 / 42943423	Raining	Wet	Cr, RD (left or right	Steer Right, Strai	10, Dec, 60	60	Talking / Sing	Safe & Legal	4, 28	None	D, FF, LdTrf	Night, Light
520327	81813/83390736	Raining	Wet	NrCr, RE avoid	Lane change	115-80, 95	95	None	Safe & Legal	0, 90	None	D, FF	Night, Light
525465	61949/102381713	Light Rain	Wet	Cr, RD (left or right	Lane change, Lat	75-25, 50	68	None	Unsafe but Leg 0, 25	None	ND, 2W, FF	Day	
532527	69206/59532016	Light Rain	Wet	NrCr, RE avoid	Lane change, Lat	25-78, 54	78	None	Unsafe but Leg 0, 26	None	ND, 2W, FF	Day	
791000	48504/93570618	Raining	Wet	NrCr, RE avoid	Lane change, Lat	82-66	75	None	Unsafe but Leg 0, 55	None	D, FF	Night, Light	
811993	91211/54697764	Raining	Wet	Cr, Curb strike	Lane change, Lat	65-14	62	None	Unsafe but Leg 0, 50	None	D, FF	Night, Light	
851847	67412/70113419	Raining	Wet	NrCr, RE avoid	None, Straight	125	125	None	Safe & Legal	0, 100	None	D, FF	Night, Light
854214	17840/45763078	Raining	Wet	Cr, RE	None, Straight	75-51	60	None	Safe & Legal	3, 12	Mist, smoke	D, RF, UF	Day
868437	71827 / 46249349	Raining	Wet	Cr, RD (left or right	Brake (lockup), S	139-0, Dec	125	Exceeding spe	Unsafe and Ill 2, 100	Rain, Snow,	D, RF	Day	
886450	86810 / 10253200	Raining	Wet	NrCr, RE striking	Brake, Steer Right	85-0, Dec	82	Exceeded safe	Unsafe but Leg 0, 39	None	D, FF	Day	

- ▶ Some Cr/N-Cr not weather related (lane change, marking cross)
- ▶ Speed > 60kph
- ▶ Inadequate speed adjustments
- ▶ Limited data before an event

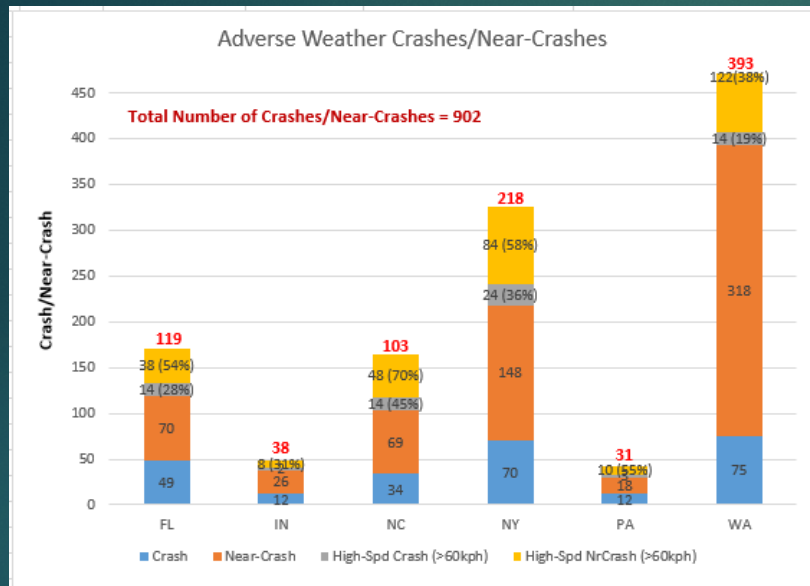
Baseline Events (wet & dry)

Driver ID	Vehicle ID / Trip ID	Weather Condition	Surface Condition	Event Type / Incident Type	Vehicle Maneuver, Road Alignment	Speed Variation (kph)	Avg speed (kph)	Distraction (Driving Behavior)	Maneuver Judgment	Crash Type (Speed Event Occurred)	Visibility Obstruction	Traffic	Time of Day
176372	94838 / 9758929	Mist / Light Rain	Wet	Cr, RD (left or right)	Steer Right, Curve Left	91-13, 78	78	Exceed safe speed but not	Unsafe but Legal 3 (38 kph)	None	None	ND, 2W, FF	Day
181510	47795/40136460	Rain/Fog	Wet	NrCr, SS Avoid	Steer R	127-90	116	None	Safe & Legal	96	None	D, FF	Day
230382	65841/39060563	Mist / Light Rain	Wet	NrCr, ObjAvoid	Steer L	122-92	118	None	Safe & Legal	95	None	D, FF	Day
313668	97160 / 4082149	Mist / Light Rain	Wet	NrCr, Other	Brake, Steer Left, Curve Right	89-20, Dec	72	Exceeded safe speed but	Unsafe but Legal 0, 27	None	1W, FF	Day	
400390	98378 / 2367903	Mist / Light Rain	Wet	Cr, RE striking	Brake (lockup), Straight	66-0, Dec	65	None	Safe & Legal	1, 27	None	ND, 2W, RF	Day
403022	12926 / 8466756	Mist / Light Rain	Wet	NrCr, RE Avoid	Brake, Straight	120-110, Dec	105	Talking / Singing, Holdin	Safe & Legal	0, 100	None	D, RF	Day
502063	91617 / 5572793	Mist / Light Rain	Wet	NrCr, Other	Steer Right, Straight	0-80, Acc	65	Distraction	Unsafe but Legal 0, 76	None	D, FF	Night, Light	
748838	82577 / 8139849	Mist / Light Rain	Wet	Cr, RE striking	Brake, Steer Right, Straight	84-0, Dec	75	None	Unsafe but Legal 1, 53	None	None	ND, 2W, FF	Day
811993	91211 / 9755642	Mist / Light Rain	Wet	NrCr, Opposite Dire	Brake, Steer Right, Curve Right	50-22, Dec	40	Holding Cell Phone in on	Unsafe but Legal 4, 38	None	None	ND, 2W, FF	Day
811993	91211 / 5469776	Mist / Light Rain	Wet	Cr, RD (left or right)	Steer Right, Steer Left, Curve	74-30, Dec	70	Talking / Singing	Unsafe but Legal 3, 48	None	None	D, FF	Night, Light
108436	47819 / 60665969	Raining	Wet	NrCr, RE avoid	Brake, Steer Left, Straight	90-55, Dec, 80	85	Biting Nails/Cuticles	Safe & Legal	0, 64	None	DH, UF	Dusk
125330	49701 / 1551490	Raining	Wet	Cr, RD (left or right)	Brake, Steer Right, Curve Right	97-0, 90	95	None	Unsafe but Legal 2, 56	None	Rain, Fog, Sm	D, RF	Day
297012	97983 / 8114609	Raining	Wet	Cr, RD (left or right)	Brake, Steer Left, Curve Right	30-14, Dec, 55	58	Cell phone locating / rea	Unsafe but Legal 3, 34	None	None	ND, 2W, FF	Day
297012	97983 / 8124170	Rain	Wet	NrCr, RE Avoid	HB	86-30	81	Looking out window	Unsafe but Legal 0, 50	None	D, RF	Day	
332677	39021 / 1848014	Raining	Wet	Cr, RE struck	None, Straight	56-0, Dec	56	None	Safe & Legal	3, 28	None	D, RF	Day
345780	16068/19636962	Raining	Wet	Cr, Median strike	Left turn	65	65	None	Safe & Legal	4, 60	None	D, RF	Night, Light
357282	96775/79765950	Raining	Wet	NrCr, RE avoid	None, Straight	80	80	None	Safe & Legal	0, 60	None	D, RF	Day
357835	81888/94182096	Raining	Wet	NrCr, RE avoid	HB, Straight	66-70	70	None	Unsafe but Legal 0, 26	None	None	D, RF	Day
407125	81405/21420003	Raining	Wet	NrCr, SS Same Dir	None, Straight	95-100	96	None	Safe & Legal	0, 60	None	D, RF	Day
407125	81405 / 8345258	Raining	Wet	NrCr, SS same direct	Brake, Steer Right then Left, Steer	120-50, Dec	110	Drowsy, Fatigued	Safe & Legal	0, 93	None	D, FF	Night, Light
409337	77375/10238349	Raining	Wet	NrCr, RE avoid	Curb strike	65	65	Checking phone	Unsafe	0, 32	None	ND, 2W, NF	Day
412510	76887 / 3688448	Raining	Wet	NrCr, RE then RD (let	Brake (lockup) then Brake, Steer	101-42, Dec	95	Moving Object in Vehicle	Unsafe but Legal 0, 95	None	None	D, RF	Day
416945	52281/8525321	Raining	Wet	NrCr, RE avoid	Lane change	62-45, 50	60	None	Safe & Legal	0, 45	None	D, RF	Day
462761	31497/82146384	Mist / Light Rain	Wet	NrCr, RE avoid	HB, Str L	120-5	88	None	Safe & Legal	0, 12	None	D, RF	Day

- ▶ Matching Cr/NrCr events
- ▶ Conflict-free events
- ▶ No adverse conditions
- ▶ Speed variability

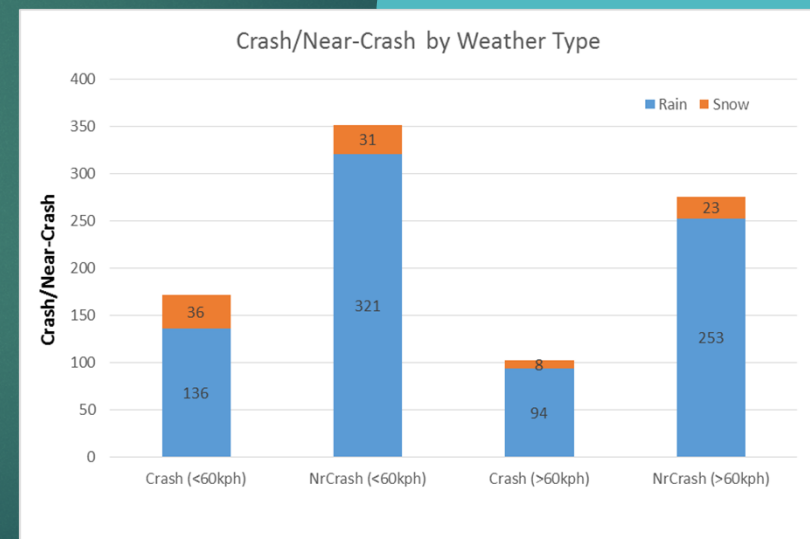
Driver ID	Vehicle ID / Trip ID	Weather Condition	Surface Condition	Speed (kph)	Road Type	State
108436	47819/79905037	NonAdv	Dry	112 D, RF	FL	
108436	80437549	NonAdv	Dry	122 D, FF	FL	
	60663242	NonAdv	Dry	115 D, SF, RF	FL	
125330	79096631	NonAdv	Dry	116 D, SF, RF	FL	
	15510500	NonAdv	Dry	112 D, RF	FL	
	15493796	NonAdv	Dry	100 D, SF, RF	FL	
	64604769	NonAdv	Dry	124 D, FF, Ld Traff	FL	
	64606796	NonAdv	Dry	110 ND, 2W, FF	FL	
176372	94838/20273489	NonAdv	Dry	76 D, RF	FL	
	/20289360	NonAdv	Dry	75 ND, @w, FF, LTrfc	FL	
181510	47795/18568771	NonAdv	Dry	116 D, FF, No LTrfc	FL	
	/18551144	NonAdv	Dry	115 D, FF, LTrfc	FL	
230382	65841/39060563	NonAdv	Dry	117 D, FF, Ld Traff	FL	
297012	97983 / 81158820	NonAdv	Dry	83 ND, FF	FL	
313668	97160/78937912	NonAdv	Dry	78 D, RF	FL	
	/78797131	NonAdv	Dry	98 D, RF	FL	
332677	39021 / 72544788	NonAdv	Dry	67 D, RF	FL	
345780	16068/4126689	NonAdv	Dry	70 D, FF	FL	
357282	96775/79740996	NonAdv	Dry	87 D, RF	FL	
357835	81888/56492068	NonAdv	Dry	76 D, FF LdTraff	FL	
407125	81405/69695151	NonAdv	Dry	96 D, RF	FL	
	/21410554	NonAdv	Dry	113 D, RF	FL	
409337	77375/48119218	NonAdv	Dry	68 D, RF	FL	
416945	52281/75341530	NonAdv	Dry	71 D, RF	FL	
491529	50967/42945251	NonAdv	Dry	70 ND, FF, LdTrfc	FL	
	/65653816	NonAdv	Dry	81 D, FF, Ld Traff	FL	
520327	81813/83456132	NonAdv	Dry	104 D, FF, No LTrfc	FL	
525465	61949/45210872	NonAdv	Dry	79 D, RF	FL	
532527	69206/59532016	NonAdv	Dry	80 D, SF, RF	FL	
608275	43757 / 45920416	NonAdv	Dry	82 1W, FF	FL	
791000	48504/6552093	NonAdv	Dry	85 D, FF, No LTrfc	FL	
886450	86810/79048630	NonAdv	Dry	81 D, RF	FL	

Crash/Near-Crash Events

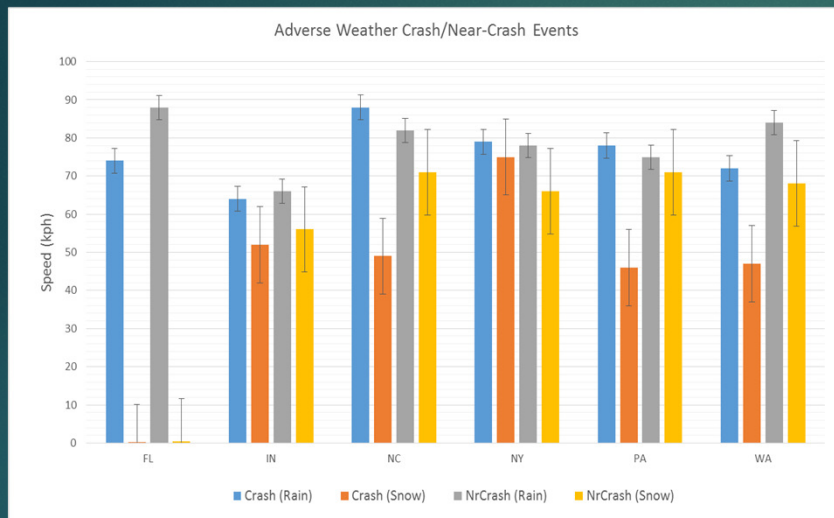


- ▶ 40% of low speed incidents occurred at 35 kph or lower
- ▶ Minimal traffic, no restrictions or obstacles

- ▶ High/Low speed events
- ▶ Few fog incidents

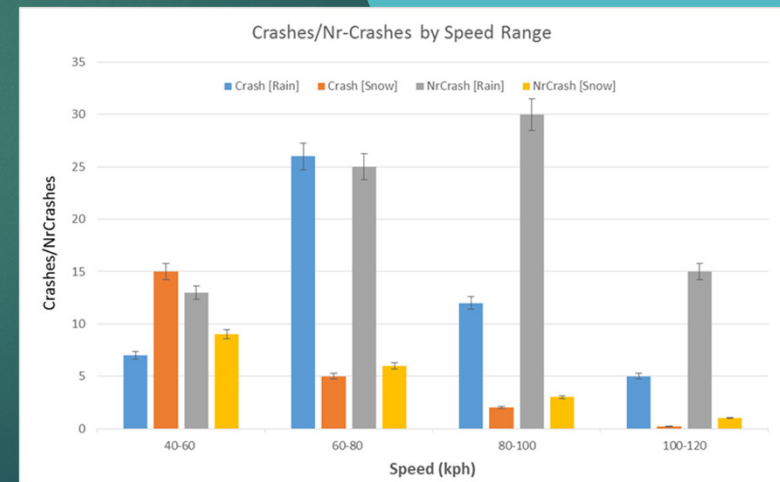


Speed Data Analysis

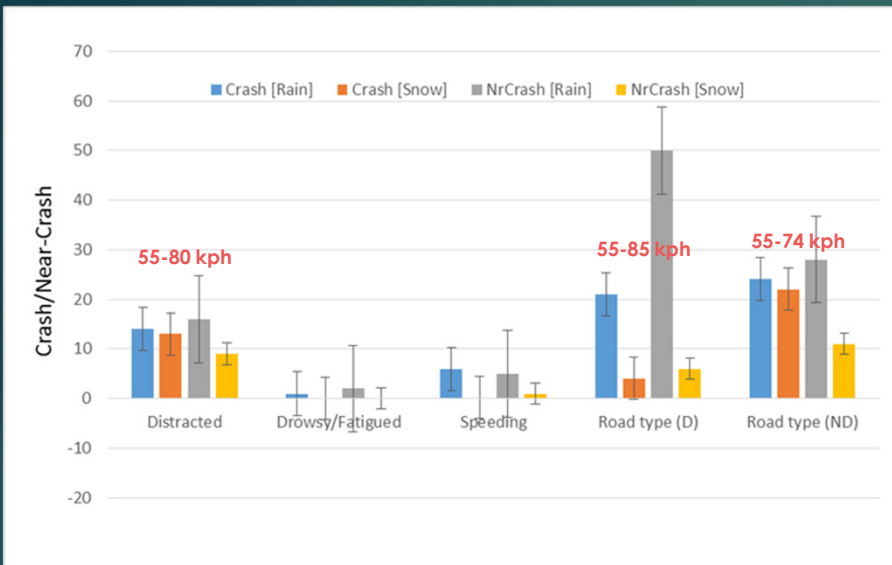


- ▶ Drivers may have relied on vehicle safety features
- ▶ Drivers did not know how to safely adjust their behavior

- ▶ Drivers did not reduce speed as expected
- ▶ Higher speeds during near-crashes
- ▶ ~45% of drivers engaged in risky maneuvers

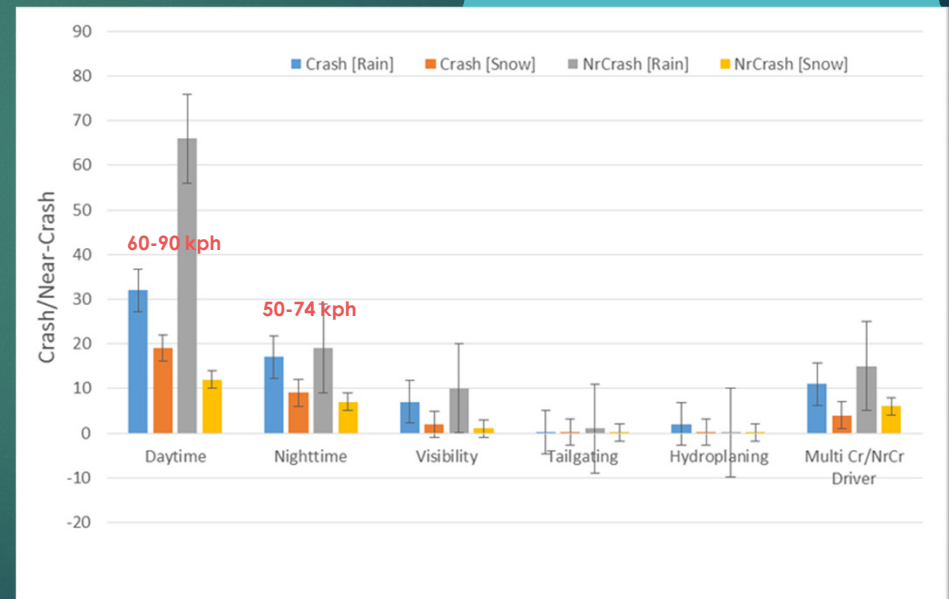


Crash/Near-Crash Distribution



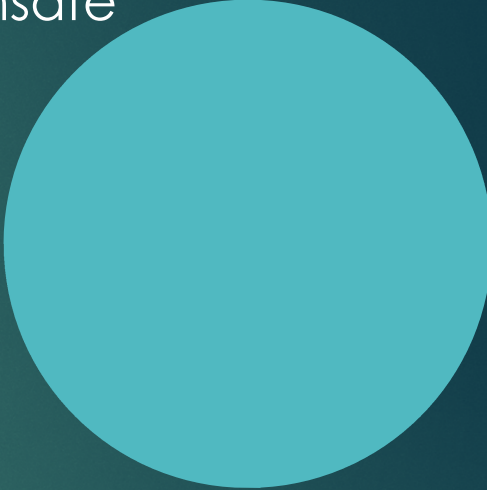
- ▶ 90% minor crashes
- ▶ Undivided roads present increased risks

- ▶ Drivers take more risks during daytime
- ▶ Visibility not a major issue during certain maneuvers



Key Findings

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- ▶ Some Cr/Nr-Cr not weather related (inattention, unsafe passes)
 - ▶ Speed/headway not major crash causes
 - ▶ Drivers not aware of slick roads
 - ▶ Prior adverse weather data not readily available
 - ▶ Unsafe speed adjustments (critical factor)
- 

Conclusions

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- ▶ NDS data mining/analysis good indicator of driver behavior
- ▶ Quantify the extent of inclement weather impact on crash occurrence
- ▶ Identify adequate alternative measures for weather-related crashes (headway)
- ▶ Minor impact on speed selection
- ▶ Low speed data not a critical factor



Potential Future Research

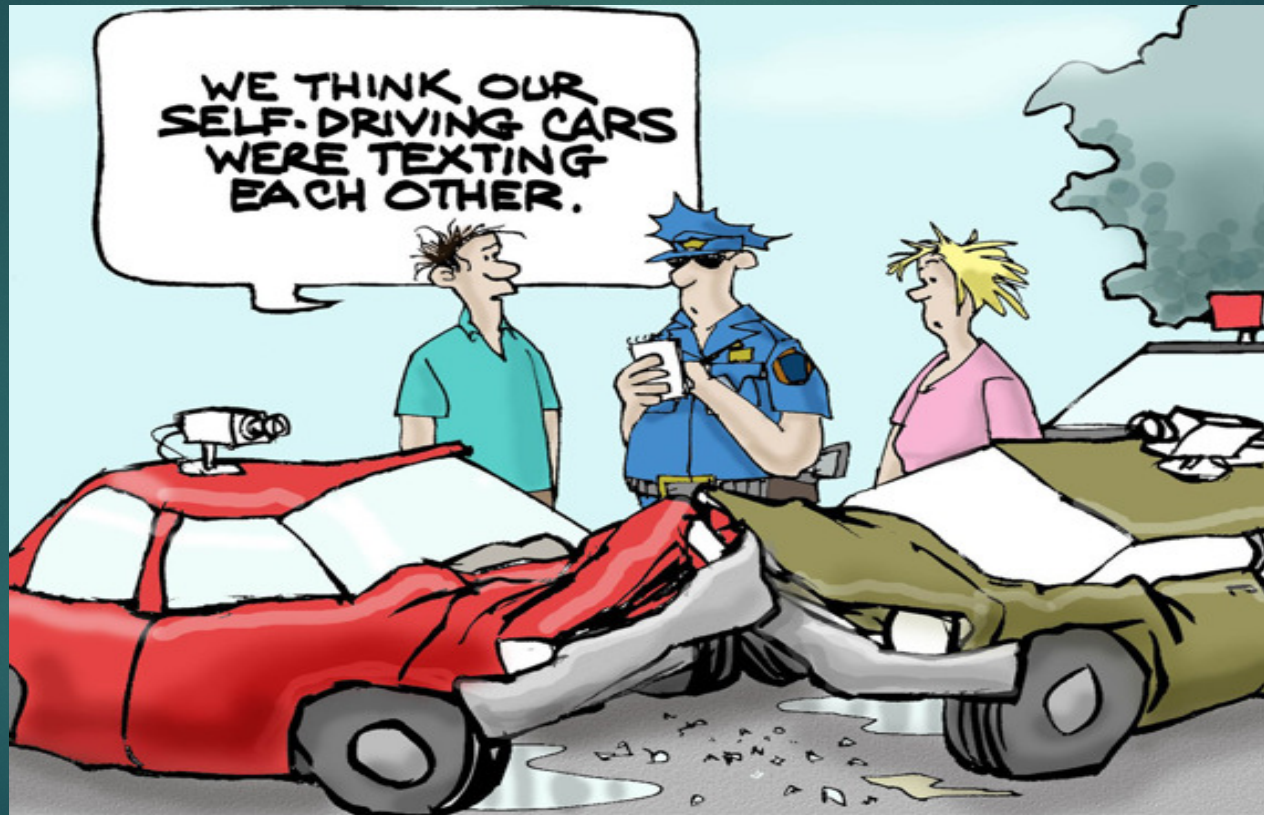
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- ▶ Address/Reduce improper driver behavior during inclement weather
- ▶ Develop safety countermeasures to inform drivers
- ▶ Support travelers information through data fusion
- ▶ Develop intelligent in-vehicle systems for CVs, AVs

Thank You!



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Additional Information

<p>Crash Relevant</p>	<p>Any circumstance that requires an evasive maneuver on the part of the subject vehicle or any other vehicle, pedestrian, cyclist, or animal that is less urgent than a rapid evasive maneuver (as defined above in Near Crash), but greater in urgency than a "normal maneuver" to avoid a crash. A crash avoidance response can include braking, steering, accelerating, or any combination of control inputs. Crash Relevant Conflicts must meet the following four criteria 1. Not a Crash. The vehicle must not make contact with any object, moving or fixed, and the maneuver must not result in a road departure 2. Not pre-meditated. The maneuver performed by the subject must not be pre-meditated. This criterion does not rule out Crash Relevant Conflicts caused by unexpected events experienced during a pre-meditated maneuver (e.g., a premeditated aggressive lane change resulting in a conflict with an unseen vehicle in the adjacent lane that requires a non-rapid evasive maneuver by one of the vehicles). 3. Evasion required. An evasive maneuver to avoid a crash was required by either the subject or another vehicle, pedestrian, animal, etc. An evasive maneuver is defined as steering, braking, accelerating, or combination of control inputs that is performed to avoid a potential crash. 4. Rapidity NOT required. The evasive maneuver must not be required to be rapid. Rapidity refers to the swiftness of the response required given the amount of time from the beginning of the subject's reaction to the potential time of impact. Depending on the study, events classified as Crash Relevant Conflicts may or may not undergo further analysis.</p>	<p>Ex. Any conflict with another vehicle, object, pedestrian, etc. that requires a response from the involved parties but the response required is not rapid. Also includes the driver loses control of vehicle in the snow or rain, but regains control with little risk of impact and does not rotate more than 30 degree in either direction.</p>
<p>Near Crash</p>	<p>Any circumstance that requires a rapid evasive maneuver by the subject vehicle or any other vehicle, pedestrian, cyclist, or animal to avoid a crash. Near Crashes must meet the following four criteria: 1. Not a Crash. The vehicle must not make contact with any object, moving or fixed, and the maneuver must not result in a road departure. 2. Not pre-meditated. The maneuver performed by the subject must not be pre-meditated. This criterion does not rule out Near Crashes caused by unexpected events experienced during a pre-meditated maneuver (e.g., a premeditated aggressive lane change resulting in a conflict with an unseen vehicle in the adjacent lane that requires a rapid evasive maneuver by one of the vehicles). 3. Evasion required. An evasive maneuver to avoid a crash was required by either the subject or another vehicle, pedestrian, animal, etc. An evasive maneuver is defined as steering, braking, accelerating, or combination of control inputs that is performed to avoid a potential crash. 4. Rapidity required. The required evasive maneuver must also require rapidity. Rapidity refers to the swiftness of the response required given the amount of time from the beginning of the subject's reaction and the potential time of impact. Events classified as Near Crashes generally undergo further analysis.</p>	<p>Evasive maneuvers can occur with varying degrees of severity and thus will not always seem extreme. Also, evasive maneuvers are sometimes made that are greater in severity than what is really required to avoid a collision. The Near Crash classification is concerned with the type of maneuver that is required, not the type of maneuver that is made. If the driver over-reacts with a rapid maneuver when a less severe maneuver would have been sufficient, the event would NOT be a Near Crash unless the evasive maneuver itself contributed further to the event (e.g., leading to a loss of control or creating a new conflict). To distinguish between a Near Crash and Crash Relevant conflict, the deciding factor is the amount of time necessary for the driver to avoid a crash. A braking evasive maneuver reaching -0.3g can be a near crash if the object being avoided is extremely close, whereas a brake reaching -0.8g performed 20 meters away might not meet the rapidity requirement. The required rapidity and urgency depends on a combination of several factors, including proximity, relative speeds, trajectories, and other environmental factors. For light vehicles, a good guideline for determining Near Crashes is a less-than-2-second "Time to Collision" measurement. For example, if the subject is braking behind a vehicle that is 10 meters away and the subject is travelling 6 meters per second faster than the lead vehicle, then there is less than 2 seconds of "time to collision". However not all Time to Collision measurements that are less than two seconds are guaranteed to be Near Crashes. Other vehicle types (e.g., trucks and buses) may require a different guideline. Pre-meditated maneuvers can also lead to a Near Crash if the maneuver creates a new or more urgent situation. For example, the subject maneuvers around a speed bump coming close to a parked vehicle and mid-maneuver the parked vehicle unexpectedly begins to pull into the roadway nearly striking the subject and forcing a rapid evasive maneuver. Or, the subject intentionally takes an aggressive left turn and loses traction or mistakenly over-steers causing a conflict with oncoming vehicles on the new roadway.</p>