Special Study Summary Report Analysis of ADAS Forward Collision Warning (FCW) David B. Brown, PhD <u>brown@cs.ua.edu</u> December 17, 2020

Introduction

This study is similar to the Lane Departure Warning study. In fact, it was found that all of the LDW standard equipment Toyota models also required Forward Collisions Warning (FCW). Finding a large enough alternative subset that had no FCW as standard equipment was not trivial, but fortunately, Ford put out a sufficient number of vehicles that just three of their models in years 2018 and 2019 could serve this purpose.

Other ADAS studies can be found here: <u>http://www.safehomealabama.gov/caps-special-studies/</u> under the "Vehicle-Related" category.

Technical Details

The filter used for the FCW standard is identical to that for the Lane Departure Warning (LDW) study, since both ADAS features were standard in these models. This filter (for the IMPACT "Other" column) is in the LDW folder of the 2018-2020 Alabama Integrated Driver-Vehicle Data, and its name is:

Toyota MY 2019-2021 Ln Dep Wrng LDW.

Ford Ecosport, Fiesta and Transit in model years 2018 and 2019 were used as the non-FCW comparison subset. This filter (for the IMPACT "Subset" column) is in the FCW folder of the 2018-2020 Alabama Integrated Driver-Vehicle Data, and its name is:

Ford 2018-2019 Non-FCW models.

This filter was probably created by first forming a filter of Fords for 2018 and 2019 that follows:

Filter Logic: Ford 2018-2019 No FCW Frwd Coll Warning	_	\times
Logic Tree Logic Text		
One or more of the following are true (OR) One or more of the following are true (AND) One or more of the following are true (AND) One or MI of	2018 2019	
6756 records selected by this filter.		:

And then reducing this list to the applicable models.

Summary of Findings and Results

The time frame of this study was slightly different for the FCW and the non-FCW vehiclecrashes. The major portion of the FCW crashes (Toyotas) were in 2019 (full year) and 2020 (about 8.3 months). For the Ford non-FCW crashes, the time frame was 2018 (about 6 months), 2019 (full year), and 2020 (about 8.3 months). The fact that the time frames are not exact is not a problem in that some such studies might even be of a before and after nature. To simplify the discussion below, we will call the time frames to be comparable at "two years," which will provide a good sense for the duration of the crash savings by type. The following lists the major findings by attribute corresponding to the IMPACT studies in the next section.

- D015, Primary Contributing Circumstances (PCC) contains several crash types that would be affected by FCW. Of these, the PCC showed improvement (reductions in the proportions as measured by the Max Gain) in crashes caused by: (1) Following too Close Max Gain = 10.3; (2) Unseen Object/Person/Vehicle 5.3; (3) Other Distraction Outside the Vehicle 3.8; and (4) Other Distraction Inside the Vehicle 1.1. While the proportional reduction of each of these was not large, collectively, the total Max Gain in reduced crashes from all four applicable crash types was about 21 crashes over the two year period in which these vehicle-crashes occurred.
- D023 Manner of Crash. The relevant crash types in this attribute, with their crash reductions, would include the following: (1) Rear End (front to rear) 13.8; (2) Sideswipe, Same Direction 7.0; (3) Single Vehicle Crash (all types) 6.7. Collectively, this reduction during the two-year period of the study was 27.5 crashes, which is quite close to those reduced according to the PCC discussed above.
- D025 Crash Severity. All of the injury severities were reduced. This could be due to the warnings enabling the drivers to take preventive action to mediate the effects of the crashes if the crash was not prevented altogether by the FCW. The savings indicated are 4.0 Fatal Injury crashes, 2.7 Suspected Serious Injury, 30.3 Suspected Minor Injury (statistically significant). The collective of these were also significant as given by the increase in the Property Damage Only crashes, which amounted to 33.3 crashes in the relevant vehicles over the two years of data.

IMPACT Displays

D015 Primary Contributing Circumstances

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6	2018-2020 Alabama Integrated Driver-Vehicle Data	~	F	ord 2018-201	9 Non-FCV	V models		✓ ♥ 1/1/2018 ∨ 9/14/2		
Order	Max Gain V Descending V	🛛 🖂 Suppi	ress Zero-V	alued Rows		Significa	ance: Over	Representation V Threshold: 2.0		
D015:	Primary Contributing Circumstance	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds	Max Gain	D015: Primary Contributing Circumstance		
	Followed too Close	141	22.17	473	20.56	1.078	10.262			
	DUI	24	3.77	52	2.26	1.670	9.627			
	Unseen Object/Person/Vehicle	70	11.01	234	10.17	1.082	5.322			
	E Other Distraction Outside the Vehicle	22	3.46	66	2.87	1.206	3.757			
	E Failed to Yield Right-of-Way from Driveway	20	3.14	60	2.61	1.206	3.416			
	E Other Distraction Inside the Vehicle	20	3.14	64	2.78	1.131	2.310			
	E Ran Traffic Signal	29	4.56	98	4.26	1.071	1.913			
	E Failed to Yield Right-of-Way from Traffic Signal	18	2.83	62	2.69	1.050	0.863			
	E Crossed Centerline	12	1.89	41	1.78	1.059	0.668			
	Driving too Fast for Conditions	15	2.36	54	2.35	1.005	0.074			
	Made Improper Turn	17	2.67	63	2.74	0.976	-0.413			
	E Swerved to Avoid Vehicle	14	2.20	57	2.48	0.889	-1.755			
	E Other Improper Action	12	1.89	51	2.22	0.851	-2.096			
	Improper Lane Change/Use	57	8.96	218	9.47	0.946	-3.256			
	E Failed to Yield Right-of-Way Making Left or U-T	32	5.03	128	5.56	0.904	-3.379			
	E Failed to Yield Right-of-Way from Stop Sign	42	6.60	167	7.26	0.910	-4.159			
	Misjudge Stopping Distance	73	11.48	304	13.21	0.869	-11.026			
	Improper Backing	18	2.83	109	4.74	0.597	-12.128	Sort by Sum of Max Gain		
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		2018-2	2020 Alabar	na Integrated	d Driver-Vel	hicle Data				
		D	015: Primar	y Contributir	ng Circumst	tance				
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Right-of-Way from Driveway Making Left or Ū-Turn										
D015: Primary Contributing Circumstance										

The above display had all crash types with less than 10 crashes eliminated.

D023 Manner of Crash

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	2018-2020 Alabama Integrated Driver-Vehicle	e Data	~ <u>~</u> inc	Ford 2018-	-2019 Non-F(CW models		✓ ♥ 〒 1/ 1/2018 ∨ 9/14/2		
Order:	Max Gain V Descending	~ 🗆	Suppress Ze	ero-Valued Ro	ws	Signific	ance: Over	Representation V Threshold: 2.0		
D023:	E Manner of Crash	Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain	D008: Time of Day of Crash A D009: Data Source		
•	Rear End (front to rear)	345	41.22	1203	39.56	1.042	13.888	D011: Highway Classifications		
	Other	30	3.58	81	2.66	1.346	7.706	D015: Primary Contributing Circumstanc		
	Sideswipe - Same Direction	102	12.19	345	11.34	1.074	7.043	D017: First Harmful Event		
	Single Vehicle Crash (all types)	78	9.32	259	8.52	1.094	6.713	D019. E Distracted Driving		
	Sideswipe - Opposite Direction	17	2.03	52	1.71	1.188	2.688	D023: E Manner of Crash		
	Record from Paper System	0	0.00	0	0.00	0.000	0.000	D024: School Bus Related		
	Head-On (front to front only)	17	2.03	62	2.04	0.996	-0.065	D025: Crash Severity		
	Angle Oncoming (frontal)	20	2.39	75	2.47	0.969	-0.643	D035: EMS Arrival Delay D042: Highway Patrol Troops		
	Side Impact (90 degrees)	81	9.68	298	9.80	0.988	-1.021	D043: Highway Patrol Posts		
	Non-Collision	3	0.36	19	0.62	0.574	-2.230	D045: ALDOT Area		
	Unknown	3	0.36	24	0.79	0.454	-3.606	D046: ALDOT Region		
	Causal Veh Backing: Rearto Rear	5	0.60	33	1.09	0.550	-4.083	D047: ADECAAHSO Region		
	Angle (front to side) Same Direction	19	2.27	86	2.83	0.803	-4.671	D053: Number of Persons in this Vehicle		
	Angle (front to side) Opposite Direction	26	3.11	114	3.75	0.829	-5.377	D058: Number Injured (Non-Fatal) in this		
	Causal Veh Backing: Rearto Side	16	1.91	81	2.66	0.718	-6.294	D059: Number Injured (Includes Fatalitie		
	Side Impact (angled)	75	8.96	309	10.16	0.882	-10.049	D060: Number Killed in this Vehicle Sort by Sum of Max Gain		
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	Sid	eswipe - Op	posite Direc	tion	Nor	n-Collision		Causal Veh Backing: Rear to Side		
	D023: E Manner of Crash									

D025 Crash Severity

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\$	😵 2018-2020 Alabama Integrated Driver-Vehicle Data 🗸 Ford 2018-2019 Non-FCW models 🗸 🖓 😨 1/ 1/2018 🗸 9/14											
Order	Order: Natural Order Ascending											
D025:	Crash Severity		Subset Frequency	Subset Percent	Other Frequency	Other Percent	Odds Ratio	Max Gain	D019: E Most Harmful Event D020: E Distracted Driving	^		
•	Fatal Injury		7	0.84	11	0.36	2.312	3.972	D023: E Manner of Crash			
	Suspected Serious	Injury	17	2.03	52	1.71	1.188	2.688	D024: School Bus Related			
	Suspected Minor In	jury	79	9.44	175	5.75	1.640*	30.833	D025: EMS Arrival Delay			
	Possible Injury		79	9.44	287	9.44	1.000	0.007	D042: Highway Patrol Troops			
	Property Damage O	nly	643	76.82	2457	80.80	0.951*	-33.261	D043: Highway Patrol Posts	~		
	Unknown		12	1.43	59	1.94	0.739	-4.239	Sort by Sum of Max Gain			
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	2018-2020 Alabama Integrated Driver-Vehicle Data - Filter = ADAS Forward Collision Warning (FCW)/Ford 2018-2019 Non-FCW models vs. ADAS Lane Departure Warning - LDW/Toyota MY 2019-2021 Ln Dep Wrng LDW D025: Crash Severity											
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	0		l Fatal Injury	Suspected Serious Injury	Suspe Minor I	cted Po njury	l ssible Injury	Property Damage Only	Unknown			
	D025: Crash Severity											