Electronic Throttle Control Systems In Toyota Consumer Complaints to NHTSA

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Introduction

In the fall of 2008, Quality Control Systems Corp. analyzed data from the National Highway Traffic Safety Administration's Early Warning Reporting system through the first quarter of 2008. Our analysis showed that injuries allegedly related to vehicle speed control failures in the 2007 Lexus ES 350 had risen to first place in our rankings of unusual patterns of claims. In fourth place on the list was the twin vehicle to the Lexus ES 350, the 2007 Toyota Camry. The Camry claims were also related to vehicle speed control. Our analysis was published on October 24, 2008 by the Vehicle Safety Information Resource Center on its web site. [1]

A widely publicized crash related to speed control failure in a 2009 Lexus ES 350 killed a family of four in Santee, California on August 28, 2009.[2] This crash was followed on September 29, 2009 [3] by a consumer safety advisory from Toyota Motor Sales, U.S.A., Inc. and an announcement on November 25, 2009 [4] of a very large recall related to potential accelerator pedal entrapment by the floor mats in certain Toyota and Lexus vehicles. Addressing the possibility of other sources of speed control failure in these vehicles, Mr. Irv Miller, Group Vice President of Toyota Motor Sales, U.S.A., Inc. reportedly stated, "We can come up with no indication whatsoever that there is a throttle or electronic control system malfunction."[5]

We have tested Toyota's conclusion that there is "no indication" of a throttle or electronic control system malfunction in some of the recalled vehicles as an hypothesis using data taken from consumer complaints made to the National

Highway Traffic Safety Administration (NHTSA). This conclusion was tested on the basis of consumer complaints about specific vehicles known to be equipped with electronic throttle control systems compared to similar model vehicles not so equipped. Our study was limited to the period beginning in 1999 until just before the Santee, California crash to avoid the possibility that publicity about that crash – and the ensuing recalls – could influence our results.

Methods and Materials

We analyzed consumer complaints made to NHTSA through August 24, 2009 in order to study model year 1999 through 2009 Toyota, Lexus, and Scion light duty passenger vehicles.[6] We determined the make, series, and model year of these vehicles using the Highway Loss Data Institute's VINDICATOR program, based on the first ten characters of the reported Vehicle Identification Number recorded in the complaint database.[7] JMP software produced by the SAS Institute was used for the purposes of data management and analysis.[8] The statistical confidence intervals given in this report were calculated based on equations given by Fleiss.[9]

Because our analyses depend on the identification of a vehicle's make, model, and engine we analyzed only those complaints in which the make, series, and model year of the vehicle as decoded by VINDICATOR were not incompatible with the make, model, and model year of the vehicle as reported by NHTSA. For example, we allowed vehicles into our analyses that were coded by NHTSA as "Lexus ES" which matched the "Lexus ES 300 4D" or the "Lexus ES 330 4D" as decoded by VINDICATOR based on the VIN. However, an "ES" model as recorded by NHTSA was removed from the analysis because it was decoded by VINDICATOR as an "RX 300 4D 2WD."

We counted complaints by unit, based on the "ODINO" assigned by NHTSA. Most of these units are individual Vehicle Owner Questionnaires (VOQs). Using this counting method, we found 3,802 unique complaints of all types related to Toyota Camrys, Lexus ES 300s, Lexus ES 330s, Lexus ES 350s, Toyota Tacomas, and Toyota RAV4s for the 1999 through 2009 model years. We employ the term, "Speed Control Complaints," in our analyses to refer to discrete

VOQs with any component ("CMPLID") of the VOQ coded as "VEHICLE SPEED CONTROL."

Some of our analyses involve the "recall status" of specific Toyota and Lexus models. This refers to the model years and models in our study involved in the recall announced on November 25, 2009 (and amended on January 27, 2010) as well as the recall of January 21, 2010. These include 2007 to 2009 Toyota Camrys, 2005 to 2009 Toyota Tacomas, and 2007 to 2009 Lexus ES 350s.[4] Note that these models and model years are only a subset of all of the models and model years for the recalled vehicles.

In the analyses that follow, we used the term, "Camry," to include only the Toyota Camry 4-door sedan. In this report, we differentiate Camrys from the "Solara" (which is sometimes popularly referred to as the Camry Solara). The "Lexus ES 300 Series" includes the ES 300, ES 330, and ES 350 models. The term, "Tacoma,"covers all of the variates of this truck regardless of the cab configuration, wheelbase, grade, or number of driving wheels.

It is frequently possible to determine whether an electronic throttle control system is used in an engine in a specific vehicle once the make, the model, the model year, and the corresponding Toyota Engine Family are identified. Toyota has referred to such systems as "Electronic Throttle Control System-intelligent" or "ETCS-i." We have relied on materials compiled by Safety Research & Strategies, Inc. to identify these engine families. [10] This ETCS-i list was then linked to a second list we compiled from materials submitted to NHTSA by Toyota which specifically relates engine codes in the VIN to an engine family or type for a given model "line" and model year. [11] We are have been unable to obtain this information for some specific combinations of model line and model year; in these instances the availability of ETCS-i is coded as "Uncertain." Appendix A shows our coding of ETCS-i by model, model year, engine code, engine family and recall status.

Our coding of ETCS-i is very conservative. For example, we have made no assumptions regarding the association of an engine code with an engine family that is not specifically supported by documentation which originates from

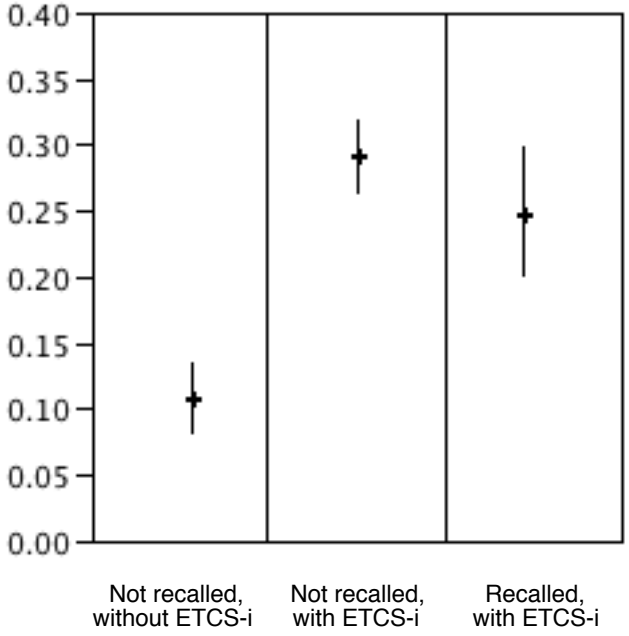
Toyota and is available from NHTSA. We have also not attempted to "correct" any of the data in the consumer complaints. Although we aimed to study all eligible vehicles in the model year range, 1999-2009, our analyses were restricted to the model years for which we could make these engine-related determinations. Readers should consult Appendix A for details of the data included in our analyses.

Results

Including all components, we found 3,346 complaints related to the three models in our study: Toyota Camry, 2,093 complaints; Lexus ES 300 Series, 433 complaints; and Toyota Tacoma, 820 complaints. For the Toyota Camry, 481 were related to speed control. For the Lexus ES 300 Series, 150 were related to speed control. 136 were related to speed control for the Toyota Tacoma. For these three model groups, we were able to determine the use of ETCS-i in the engines of 2848 out of the 3346 total studied (85 percent). Note, however, that the distribution of "unknowns" varied considerably by model (see Appendix A for details.)

The proportion of speed control related complaints for the Toyota Camrys found in the complaint data was strongly associated with the engine type. 11% (63 of 593; 95% Confidence Interval [CI]: 8-13%) of the unrecalled Camrys without ETCS-i were related to speed control. This proportion was less than half that for the unrecalled Camrys with ETCS-i (29%; 318 of 1,092; 95% CI: 26-32%) and also less than half that of the recalled Camrys with ETCS-i (25%; 78 of 316; 95% CI: 20-30%). Figure 1 shows the comparative proportions as well as the 95% Confidence Intervals for each class of the Camry.

Figure 1. Toyota Camry: Proportion of Complaints Related to Speed Control by Recall Status and Engine Type, Model Years 1999-2005, 2007.



Note that data for Toyota Camrys in model years 2006, 2008, and 2009 are missing because documentation of the engine codes could not be obtained from NHTSA.

We estimated a multiple logistic regression equation in order to clarify the differences in the likelihood of reported speed control failures between Camry engines with and without Toyota's Electronic Throttle Control System-intelligent. The estimated effect of ETCS-i is adjusted for Toyota's choice of model years to include in the recall. Both independent effects are parameterized as indicator variables: "ETCS-i" equals one if the engine has electronic throttle control and equals zero if it does not; "Recall" equals one if the model year is included in the recall and equals zero otherwise.

When both effects are included in the model, we found that the estimated, adjusted odds ratios for ETCS-i compared to the engines without ETCS-i was 3.76 (95% CI: 2.44-6.06). This can be compared to the adjusted odds ratio of 0.22 (95% CI: 0.1-0.39) for the recalled model years compared to the non-recalled. Details about the estimated parameters in the model and the model fit are shown in

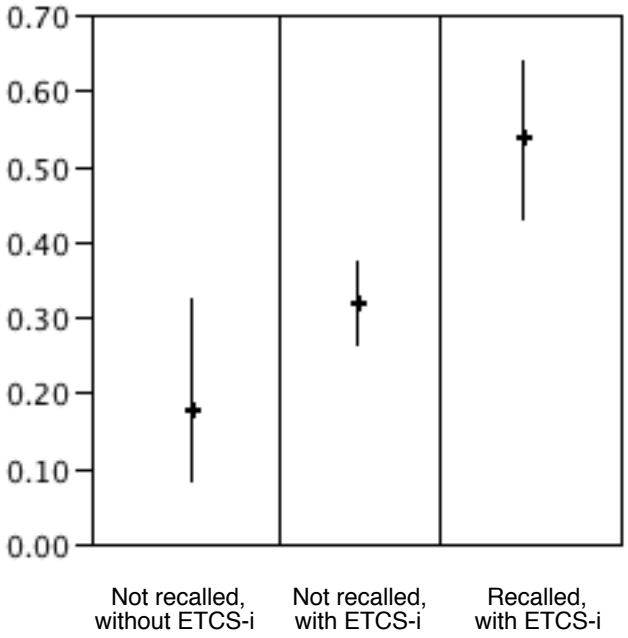
Table 1. The estimated equation is based on 2,001 consumer complaints related to the Camry with information about the engine type.

Table 1. Logistic Model of Speed Control Complaint Probability for the Toyota Camry, Model Years 1999-2005, 2007.

Term	Esti-mate	S.E.	χ^2	p-value	d.f.	-Log Likelihood
Intercept	-3.21	0.21	227.82	<0.0001	1	
ETCS-i	1.33	0.23	33.01	<0.0001	1	
Recall	-1.54	0.33	21.22	<0.0001	1	
Whole Model:						
Difference			61.48295	<0.0001	2	30.74148
Full						567.45829
Reduced						598.19977

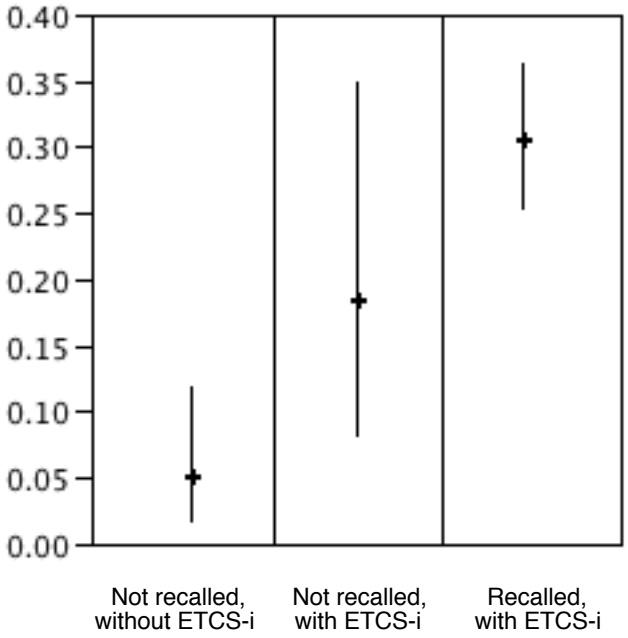
The proportion of speed control related complaints for the Camry's sister vehicle, the Lexus ES 300 Series, are higher than the Camry – especially for the recalled vehicles with ETCS-i. 18% (8 of 45; 95% CI: 9-33%) of the unrecalled ES 300 Series without ETCS-i were related to speed control. This proportion was a little more than half that for the unrecalled ES 300 Series with ETCS-i (32%; 89 of 280; 95% CI: 26-38%) and less than half that of the recalled ES 300 Series with ETCS-i (54%; 50 of 93; 95% CI: 43-64%). Figure 2 shows the comparative proportions as well as the 95% Confidence Intervals for each class of the ES 300 Series. Documentation for the engine codes in the VINs could not be obtained from NHTSA for 2006, 2008, and 2009.

Figure 2. Lexus ES 300 Series: Proportion of Complaints Related to Speed Control by Recall Status and Engine Type, Model Years 1999-2005, 2007.



For the Toyota Tacomas in our study, 5% (5 of 100; 95% CI: 2-12%) of the unrecalled Tacomas without ETCS-i were related to speed control. This proportion was less than one third of that for the unrecalled Tacomas with ETCS-i (18%; 7 of 38; 95% CI: 8-35%) and less than one sixth that of the recalled Tacomas with ETCS-i (31%; 89 of 291; 95% CI: 25-36%). Figure 3 shows the comparative proportions as well as the 95% Confidence Intervals for each class of the Tacoma. Documentation for the usage of ETCS-i for some engines could not be obtained for model years 1999-2001. Engine code documentation was unavailable from NHTSA for model years 2004, 2008, and 2009.

Figure 3. Toyota Tacoma: Proportion of Complaints Related to Speed Control by Recall Status and Engine Type, Model Years 2002-2003, 2005-2007.



Discussion

The category of vehicle speed control covers more than complaints related only to sudden, unintended acceleration. This is true for vehicles with ETCS-i and well as those without ETCS-i. Also, our examination of these complaints by keyword shows that the substantial majority are coded in this category.

The categories of "Not recalled, without ETCS-i," "Not recalled, with ETCS-i," and "Recalled, with ETCS-i" differ by vehicle age. It may be the case that the proportion of complaints involving vehicle speed control failures is affected by the number of years vehicles have been in service. As a practical consideration, we believe consumer safety complaints to NHTSA may be affected by whether or not a particular consumer may have a vehicle warranty that is honored by the dealer, insurance, or an outstanding loan. For these reasons, we conducted additional analyses limited to vehicles estimated to have two or fewer years of service based on the model year and the failure date reported in the complaint. These analyses confirmed our basic results.

Consumer complaints are very frequently cited to support the opening and closing of NHTSA investigations of potential vehicle defects. However, there is no certainty that any vehicle identified as a candidate for further engineering and statistical review through this analysis of consumer complaints will have a safety related defect. Nor is it likely that only those vehicles identified in these data could have a safety related defect. That is because our statistical methods do not take into account legally required standards or performance standards that are economically achievable with the best available design, manufacturing, and testing practices.

Conclusion

We do not question Toyota's decision as stated in their proposed sample notice to certain Toyota and Lexus owners as part of the original NHTSA Recall Campaign 09V388, "that a defect which relates to motor vehicle safety exists in certain... model year... [vehicles]... The defect is the potential for an unsecured or incompatible driver's floor mat to interfere with the accelerator pedal and cause

it to get stuck in the wide open position."[12] Neither do we question their decision to conduct a second campaign, NHTSA Recall Campaign 10V017, "because there is a possibility that certain accelerator pedal mechanisms may mechanically stick in a partially depressed position or return slowly to the idle position." [13]

Nevertheless, we have tested Toyota's conclusion that there is "no indication" of a throttle or electronic control system malfunction in the recalled vehicles as an hypothesis using data taken from consumer complaints made to NHTSA. On the basis of the consumer complaint data, we believe there is evidence both to question and to reject this hypothesis for the recalled vehicles in our study. The proportion of reported speed control failures among complaints in the non-recalled Toyota Camrys compared to the recalled Camrys in our study is particularly troubling.

There are consumer complaint data for numerous vehicles involved in these recalls which we have not yet analyzed. At this time, our conclusions regarding Toyota's belief that there is no indication of a throttle or electronic control system malfunction in the recalled vehicles is limited to those models and model year vehicles analyzed for this study.

Rankings of early warning reporting data can help to detect potential motor vehicle safety defects, as we believe it did in this case. Even so, preventing injuries, deaths, and adverse commercial impacts requires a willingness to act on these warnings. And a willingness to act on scientific facts.

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Appendix A

Model Group	Model Year	Engine Code	Engine Family	Recall Status	ETCS-i	Total	Speed Control
Camry	1999	6	Undocumented	Not recalled	Uncertain	1	0
Camry	1999	F	1MZ-FE	Not recalled	No	45	4
Camry	1999	G	5S-FE	Not recalled	No	233	23
Camry	2000	F	1MZ-FE	Not recalled	No	41	5
Camry	2000	G	5S-FE	Not recalled	No	152	23
Camry	2001	F	1MZ-FE	Not recalled	No	20	2
Camry	2001	G	5S-FE	Not recalled	No	102	6
Camry	2002	E	2AZ-FE	Not recalled	Yes	271	83
Camry	2002	F	1MZ-FE	Not recalled	Yes	151	35
Camry	2003	E	2AZ-FE	Not recalled	Yes	239	82
Camry	2003	F	1MZ-FE	Not recalled	Yes	43	17
Camry	2004	A	3MZ-FE	Not recalled	Yes	10	2
Camry	2004	E	2AZ-FE	Not recalled	Yes	164	40
Camry	2004	F	1MZ-FE	Not recalled	Yes	35	10
Camry	2005	A	3MZ-FE	Not recalled	Yes	12	3
Camry	2005	E	2AZ-FE	Not recalled	Yes	135	38
Camry	2005	F	1MZ-FE	Not recalled	Yes	32	8
Camry	2006	E	Undocumented	Not recalled	Uncertain	46	12
Camry	2006	F	Undocumented	Not recalled	Uncertain	7	3
Camry	2007	E	2AZ-FE	Recalled	Yes	242	67
Camry	2007	K	2GR-FE	Recalled	Yes	74	11

Model Group	Model Year	Engine Code	Engine Family	Recall Status	ETCS-i	Total	Speed Control
Camry	2008	E	Undocumented	Recalled	Uncertain	20	5
Camry	2008	K	Undocumented	Recalled	Uncertain	12	2
Camry	2009	E	Undocumented	Recalled	Uncertain	5	0
Camry	2009	K	Undocumented	Recalled	Uncertain	1	0
ES 300	1999	F	1MZ-FE	Not recalled	No	17	2
ES 300	2000	F	1MZ-FE	Not recalled	No	18	3
ES 300	2001	F	1MZ-FE	Not recalled	No	10	3
ES 300	2002	F	1MZ-FE	Not recalled	Yes	85	22
ES 300	2003	F	1MZ-FE	Not recalled	Yes	62	24
ES 330	2004	A	3MZ-FE	Not recalled	Yes	75	25
ES 330	2005	A	3MZ-FE	Not recalled	Yes	58	18
ES 330	2006	A	Undocumented	Not recalled	Uncertain	8	1
ES 350	2007	J	2GR-FE	Recalled	Yes	93	50
ES 350	2008	J	Undocumented	Recalled	Uncertain	6	2
ES 350	2009	J	Undocumented	Recalled	Uncertain	1	0
Tacoma	1999	L	2RZ-FE	Not recalled	Uncertain	14	0
Tacoma	1999	M	3RZ-FE	Not recalled	Uncertain	48	3
Tacoma	1999	N	5VZ-FE	Not recalled	Uncertain	46	0
Tacoma	2000	L	2RZ-FE	Not recalled	Uncertain	15	0
Tacoma	2000	M	3RZ-FE	Not recalled	Uncertain	23	3
Tacoma	2000	N	5VZ-FE	Not recalled	Uncertain	44	0
Tacoma	2001	L	2RZ-FE	Not recalled	Uncertain	13	1

Model Group	Model Year	Engine Code	Engine Family	Recall Status	ETCS-i	Total	Speed Control
Tacoma	2001	M	3RZ-FE	Not recalled	Uncertain	32	0
Tacoma	2001	N	5VZ-FE	Not recalled	Uncertain	58	4
Tacoma	2002	L	2RZ-FE	Not recalled	No	11	0
Tacoma	2002	M	3RZ-FE	Not recalled	No	14	0
Tacoma	2002	N	5VZ-FE	Not recalled	No	45	3
Tacoma	2003	L	2RZ-FE	Not recalled	No	17	1
Tacoma	2003	M	3RZ-FE	Not recalled	No	13	1
Tacoma	2003	N	5VZ-FE	Not recalled	Yes - except Sport grade	38	7
Tacoma	2004	L	Undocumented	Not recalled	Uncertain	6	0
Tacoma	2004	M	Undocumented	Not recalled	Uncertain	4	0
Tacoma	2004	N	Undocumented	Not recalled	Uncertain	33	8
Tacoma	2005	U	1GR-FE	Recalled	Yes	97	12
Tacoma	2005	X	2TR-FE	Recalled	Yes	22	2
Tacoma	2006	U	1GR-FE	Recalled	Yes	79	31
Tacoma	2006	X	2TR-FE	Recalled	Yes	24	6
Tacoma	2007	U	1GR-FE	Recalled	Yes	53	30
Tacoma	2007	X	2TR-FE	Recalled	Yes	16	8
Tacoma	2008	U	Undocumented	Recalled	Uncertain	28	12
Tacoma	2008	X	Undocumented	Recalled	Uncertain	3	1
Tacoma	2009	U	Undocumented	Recalled	Uncertain	21	3
Tacoma	2009	X	Undocumented	Recalled	Uncertain	3	0