May 2016

Content Analysis of Professional Automotive Reviews: Model Year 2015

Work Assignment 4-08

Final Report

Prepared for

Gloria Helfand
U.S. Environmental Protection Agency
Office of Transportation and Air Quality (OTAQ)
2000 Traverwood Drive
Ann Arbor, MI 48105

Prepared by

Mandy Sha
Amanda Smith
Robert Beach
3040 E. Cornwallis Road
Research Triangle Park, NC 27709

EPA Contract Number EP-C-11-045
RTI Project Number 0213244.004.008

RTI INTERNATIONAL

EPA Contract Number EP-C-11-045
RTI Project Number 0213244.004.008

Content Analysis of Professional Automotive Reviews

Work Assignment 4-08 (RTI)

Final Report

May 2016

Prepared for

Gloria Helfand
U.S. Environmental Protection Agency
Office of Transportation and Air Quality (OTAQ)
2000 Traverwood Drive
Ann Arbor, MI 48105

Prepared by

Mandy Sha
Amanda Smith
Robert Beach
3040 E. Cornwallis Road
Research Triangle Park, NC 27709

CONTENTS

FIGURES

TABLES

[This page intentionally left blank.]

1. INTRODUCTION

Work Assignment 4-08 consists of a content analysis of professional vehicle reviews for Model Year 2015 (MY 2015), following the methodology used in a previous analysis of vehicle reviews for Model Year 2014 prepared under Work Assignment 3-01 (Sha and Beach, 2015). According to Krippendorff (2013), content analysis is "a research technique for making replicable and valid inferences from texts to the contexts of their use." RTI International assisted the U.S. Environmental Protection Agency (EPA) with developing a methodology to perform the content analysis, assembled the auto reviews that would be included in the analysis, coded a large scale of unstructured data in the form of 1,253 reviews and summarized the results.

EPA identified the three following research questions for this study:

1. How do professional auto reviewers assess their experiences of fuel-saving technologies and vehicle operational characteristics? Do they have negative assessments of technologies or characteristics, or do they view them positively?
2. Are there identifiable circumstances that distinguish positive from negative assessments for each technology and characteristic (e.g., do negative assessments occur in certain manufacturers, or certain review sources)?
3. What do the vehicle reviews say in the assessments about the particular technologies and vehicle operational characteristics?

The results of the analysis are used to examine how professional auto reviewers assess their experiences of fuel-saving technologies and vehicle operational characteristics, with the goal of providing insight into potential hidden costs which may affect consumer acceptance of vehicles equipped with fuel-saving technologies.[1]

[1] Throughout this document, the terms "vehicle characteristics" and "vehicle operating characteristics" are used interchangeably to refer to any attribute of the vehicle that can only be evaluated by the reviewer based on sensory perception or instrumented measurement while driving the vehicle.

2. METHODS

Content analysis is an established technique for summarizing written, spoken, or visual information in a systematic manner (Moeller 1963, Carney 1972, Weber 1990, Berg & Lune 2012, Krippendorff 2013). This method is unobtrusive and can be replicated. The text is coded and categorized by human or by computer, and results can also be quantified for statistical analysis. Although computer coding is not as time consuming as human coding, the human brain is well-suited to handle the coding of content beyond the accounting of words and phrases. This is crucial when part of the content is contextually based or may contain "hidden" meaning that is not readily apparent. For example, professional auto reviews often provide an evaluation relative to another vehicle using language such as "quieter than," "not as quiet as," or "not as noisy as." The coder needs to examine the context to determine if it was a positive, negative, or neutral evaluation. Thus, we used human coders when evaluating professional auto reviews. Yet, the human approach is subject to coder bias if left unchecked. We minimized the inherent variability among human coders by (1) using experienced coders, (2) conducting comprehensive training on reading and capturing context of auto reviews and assigning appropriate codes, and (3) measuring inter-coder reliability. In addition, an RTI content analysis expert regularly met with the coders and adjudicator to resolve unanticipated issues, such as when the auto review content did not appear to correspond with the existing coding frame. In these cases, we provided additional instruction on the use of existing codes or in some instances the EPA chose to revise or add to the coding frame. A well-structured content analysis methodology enabled us to systematically evaluate a large quantity of information contained within the materials.

This section describes the details of the methodology used to perform the content analysis, which generally includes the following steps (see Krippendorff 2013 for more details):

- Unitizing: defining the units of analysis (in this case, auto reviews);
- Sampling: defining a manageable subset of units that are statistically or conceptually representative of the set of all possible units, the population, or universe of interest;
- Recording/coding: relying on coding instructions, including identifying key words, phrases, or ideas in a text (e.g., mention of a technology) and coding evaluations of how they are used in the text using predetermined guidelines (e.g., "easy" or "smooth" may indicate a positive evaluation of the technology, while "difficult" or "choppy" may indicate a negative evaluation); and
- Reducing or analyzing the data to manageable representations by relying on established methods for summarizing or simplifying data.

2.1 Unitizing

For the purpose of this analysis, one auto review equals one sampling unit. A coded unit is a phrase or sentence within a sampling unit (review) that is a description of one of the characteristics of interest. Each coded unit is treated separately, and a review therefore may contain multiple records/coding units. Consequently, the number of sampling units does not necessarily equal the number of recording/coding units.

Some reviews (sampling units) include updates provided by the same author. These sampling units were assigned unique "chain" IDs so they could be linked with the initial reviews and can be treated as one analysis unit (see Table 3-1.List of Variables for Each Auto Review). Some Websites publish reviews of the same model of vehicle but by different authors. In this case, the reviews (sampling units) are treated separately. Finally, if the same reviewer provides assessments of more than one vehicle model in the same article, the assessment for each model is treated as a different sampling unit.

2.2 Sampling

The first part of the study included the selection of Websites and professional auto reviews to be analyzed by applying inclusion and exclusion criteria. As described in more detail below, EPA identified seven Websites containing professional auto reviews. About 1,461 reviews were accessed for content analysis, with dates through August 2015.[2] Some of these were later classified as being out of the scope of this study because they did not meet the criteria for significant reviews discussed below, or were found to be republished reviews of previous model years. As noted above, reviews were split if more than one model of vehicle was assessed. Ultimately, the content analysis was performed on 1,253 auto reviews. These reviews were subsequently read and coded using a coding frame detailed in the next section.

2.2.1 Identification of Relevant Websites

EPA followed a set of specific procedures to identify which Websites' reviews would be analyzed using content analysis methodologies. The goal of these procedures was to identify Websites that consumers are most likely to consult when making car buying decisions. In the Model Year 2014 (MY 2014) analysis, EPA followed a conceptual hierarchy using Google and Yahoo search engines to systematically narrow the search of relevant Websites in multiple stages, consistent with the practice of relevance sampling described in Krippendorff (2013). For the MY 2015 analysis, EPA began with the websites used in MY 2014 and reviewed their use with the following procedure:

[2] Most reviews of Model Year 2015 (MY2015) vehicles were written early in the model year or in previous years. Collection of reviews was completed at this point so coding could begin.

1. Started with the 6 Websites used in the MY 2014 analysis, plus 12 additional Websites considered but not used in that analysis.
2. Among those 18 Websites we excluded Websites that did not have national and professional auto reviews. This returned 9 websites.
3. Obtained monthly unique views from Quantcast.com and Compete.com to gauge Website popularity (accessed May 2015), and then excluded 3 Websites that had less than one million unique views in both Quantcast.com and Compete.com.
4. This process resulted in 5 Websites that were included in the analysis of MY 2014 auto reviews, plus one new Website, Cars.com. Automobilemag.com was used in the MY 2014 analysis but did not meet the criteria for inclusion in this round. The decision was made to add Cars.com because it met the criteria, and to continue to include Automobilemag.com for continuity with the previous analysis.
5. The reviews from the remaining 7 Websites were screened to include only reviews that evaluated vehicles and technologies. Each reviewer must have gone beyond a basic specification list, have an independent assessment of vehicle quality, and have test-driven the vehicle. The 7 Websites shown in Table 2-1 satisfied each of these criteria and constitute the final set of Websites used in this study.

Table 2-1. Monthly Unique Views per Website, as Reported by Quantcast.com and Compete.com for May 2015

Website	Quantcast.com	Compete.com
	Monthly Unique Views (M=million; K=thousand)	
Automobilemag.com	889 K	519.4 M
Caranddriver.com	2.3 M	3.8 M
Motortrend.com	4.3 M	2 M
Autotrader.com	3.8 M	5.8 M
Consumerreports.org	2.7 M	4.5 M
Edmunds.com	4.7 M	6 M
Cars.com	2.9 M	5.2 M

2.2.2 Sampling Substantive Auto Reviews for Model Year 2015

EPA chose to analyze only "substantive" reviews from manufacturers that are subject to EPA's greenhouse gas standards in the content analysis, as these reviews are likely to contain more detailed assessments of fuel-saving technologies than reviews which solely list vehicle specifications. EPA defined a substantive review using the following criteria:

1. The vehicle is test driven.
2. The review evaluates the vehicle and its technologies. The reviewer must go beyond a basic specification sheet and have some independent assessment of vehicle operational characteristics.
3. Assessments of some technological features are included (e.g., transmission, engine, aerodynamics, mass reduction, hybrid technologies, or stop-start).

4. The review identifies configuration (e.g., engine and transmission type) or trim level (i.e., the specific version of the model when there may be multiple versions of the model).
5. The vehicle is available in the United States for sale to the general consumer and is not a prototype or development/concept vehicle. This also includes vehicles that were altered with after-market parts or enhancements.
6. The manufacturers are subject to EPA's greenhouse gas standards (except for small volume manufacturers that produce fewer than 5,000 vehicles per year have more flexibility in complying with EPA's greenhouse gas standards). Small vehicle manufacturers are not included in the study, because they do not face the same incentives to add fuel-saving technologies as manufacturers who are subject to the standards.

Although we attempted to include only substantive reviews in the sample, we discovered during the process of reading and assessing that there were 271 reviews that did not meet the inclusion and exclusion criteria for being "substantive" reviews, as discussed earlier. An additional 143 reviews were also identified as prior model year reviews that were republished for MY2015. Once identified, these 414 reviews were excluded from the coding because they were out of scope for this study. **Table 2-2** shows the number of auto reviews that were determined to be out of scope and by Website.

Table 2-2. Out of Scope Reviews by Website

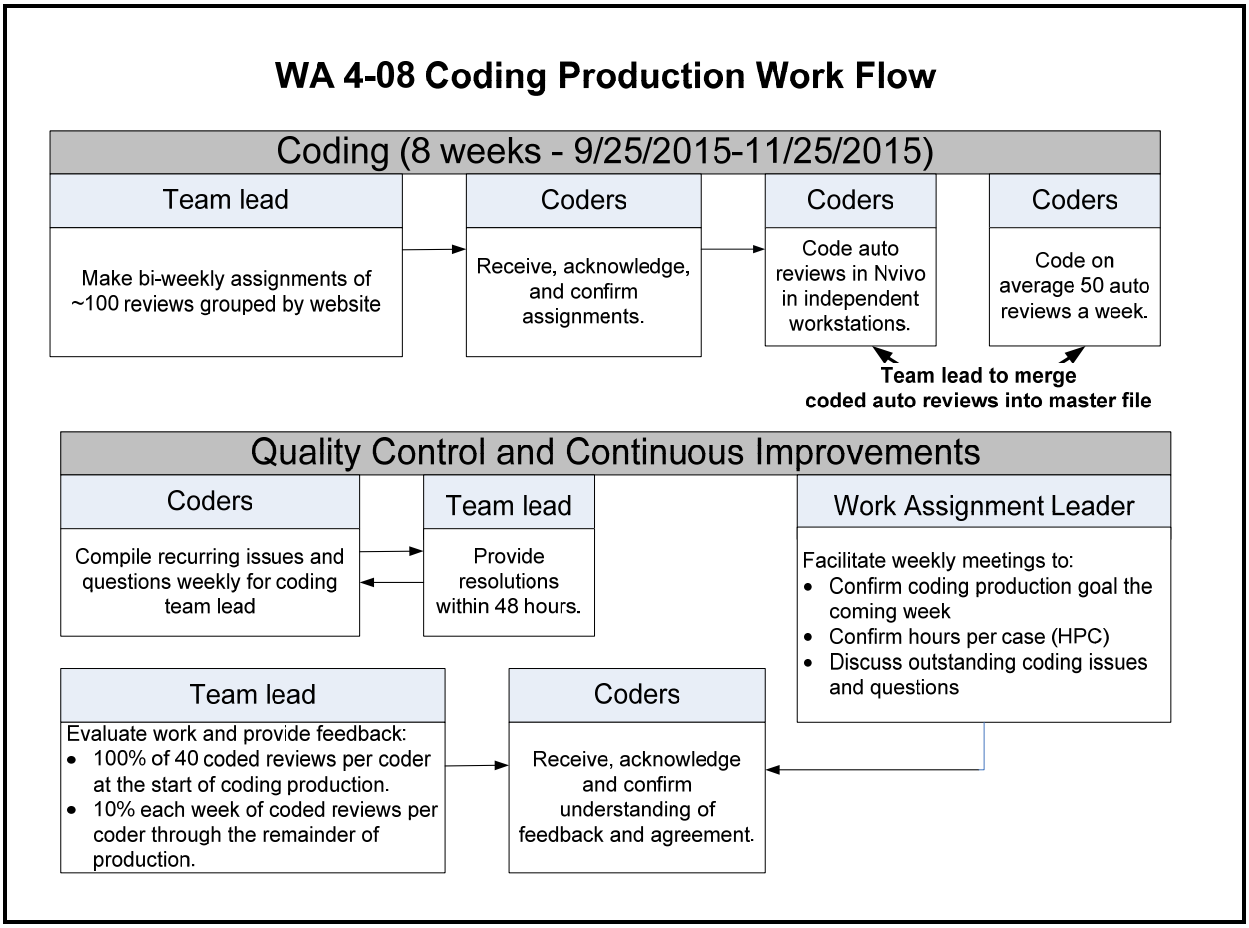
Website	Counts
Autotrader.com	138
Motortrend.com	54
Caranddriver.com	41
Automobilemag.com	27
Edmunds.com	80
Cars.com	73
Consumerreports.org	1
Total	**414**

In addition, when the same reviewer provided assessment of more than one model of a vehicle in the same article, the assessment for each model was coded. This adjustment added 198 separate reviews. At the end of the coding phase, a total of 1,253 auto reviews were coded for analysis. The articles in the analysis were accessed between September 10, 2015, and September 25, 2015.

2.3 Recording/Coding

Reviews (i.e., sample) were assigned to human coders by website in blocks of ~100 reviews on a bi-weekly basis with the goal of coding, on average, 50 auto reviews per week. Once an assignment was opened, it was fully coded before a new assignment was made and distributed to the coder. The coders read each review and then identified and coded the recording units. Recording units are defined as a contiguous passage of text that captures a reviewer's evaluation of a vehicle characteristic. To track the recording units, we used NVivo 10, one of the leading software programs for coding and organizing unstructured data (QSR International).[3] Figure 2-1 shows the coding production workflow

Figure 2-1. WA 4-08 Coding Production Work Flow



2.3.1 Coding Framework and Coding Process

The coding frame was developed by EPA based on an assessment of the key characteristics to address, and is shown in ***Table 2-3***. One new code (Fuel Cell) was added during the coding phase. During the coding phase, human coders read each review, identified

[3] For more information about the NVivo 10 software, see http://www.qsrinternational.com/default.aspx.

recording units, and assigned a code to the recording unit. Each code could be Positive, Negative, or Neutral. For instance, a passage of text containing a negative assessment of fuel economy would be coded as *Negative - Fuel economy*, while a positive assessment was coded as *Positive – Fuel economy*. As described earlier, a recording unit is defined as the shortest possible passage of text that still captures the context of a reviewer's evaluation of a vehicle characteristic. Because multiple ideas are often contained within a single passage of text, a recording unit can contain evaluations of more than one characteristic. In addition, positive and negative assessments are clear sentiments, while a neutral assessment cannot be clearly described as positive or negative. The "Neutral" value is coded when the reviewer does not demonstrate an intensity of opinion that can be clearly discerned to be positive or negative.

Coding occurred at the lowest coding level ("child codes"), as shown in Table 2-3. An example from an auto review of the Honda Accord Hybrid[4] is as follows:

- "Class leading energy conservation" is coded *Positive-Fuel Economy* for the vehicle's operational characteristics.
- "There is a prominent wail when the car accelerates briskly or climbs a grade" is coded *Negative- Noise-Powertrain* for the vehicle's operational characteristics.
- "Low-rolling-resistance tires do sacrifice some grip, but the hybrid's 184-foot, 70-to-zero stopping distance was only four feet longer than that of the last nonhybrid Accord we tested" is coded *Neutral-Low rolling resistance tires* for vehicle technology and also *Neutral-Braking* for the vehicle's operational characteristics.

Detailed coding guidelines and a glossary were developed for coder training and can be viewed in **Appendix A**.

In addition to having recording units generated from within each review, the review in its entirety (sampling unit) was also assigned a Positive, Negative, or Mixed assessment after it was coded to capture the overall sentiment of the review. That is, based on the reading of the review as a whole, taking into account the coded recording units, we assigned a category (Positive, Negative, or Mixed) to each review at the sampling unit level.

Once the recording units for each auto review were coded, we constructed a database containing the count of Positive, Negative, and Neutral coded values.

2.3.2 Coder Training and Inter-Coder Reliability Evaluation

We used two coders and one adjudicator ("team lead" in **Figure 2-1**), each of whom is experienced with coding professional auto reviews in a defined time period and has demonstrated the ability to understand the coding instructions and apply them consistently throughout the repetitive coding process. The adjudicator's skills had been approved by EPA ahead of time by coding auto reviews for EPA's direct evaluation and feedback. The coder

[4] http://www.caranddriver.com/reviews/2014-honda-accord-hybrid-test-review

training included in-person and independent learning components. The coding team attended a 1-day in-person training, with most of the time spent on coding exercises, and evaluating inter-rater reliability. Materials were approved by EPA prior to training and included the following:

- Coding frame (see **Table 2-3**)
- Glossary and guidelines (see **Appendix A**)
- A list of the 2015 vehicles and the Websites that were sampled
- Relevant technologies and vehicle operational characteristics
- A set of 9 example coded auto reviews were used for lecture, coding exercises, and "checkout" exams. Examples were coded by the RTI adjudicator and submitted to EPA for approval prior to the training. These example auto reviews were selected purposely to represent different vehicle makes, models, and Websites

During the training phase, codes assigned by the coders were compared against the example coded reviews as a way to set a baseline for inter-coder reliability. Inter-coder reliability was examined in two ways:

- Percentage agreement: the number of units of agreement divided by the total units of measure within the data item, displayed as a percentage.

- Kappa coefficient[5]: a statistical measure that takes into account the amount of agreement that could be expected to occur through chance. To calculate Kappa coefficient, NVivo analyzes each code assigned in an auto review for instances of coding agreement. Kappa is scored between 0 and 1, with 0=no agreement and 1=perfect agreement. Since some variation in the portion of text highlighted was likely always going to happen (coders may determine to highlight more text for contextual reasons), confidence standards at or above 0.75 are accepted as an indicator of "excellent agreement."

The adjudicator first evaluated both the Kappa coefficient and the percentage agreement between coders and the example coded auto reviews. The adjudicator also examined each code assigned by the coder and debriefed on whether and why it was accurate or not accurate based on the guidance provided after each evaluation. This step is crucial to provide feedback to the coders that they can use to improve their future coding. The inter-rater reliability for the whole group (adjudicator and coders) was also assessed. At the end of the group training, the coders reached above 90% agreement and a Kappa coefficient of 0.79 (excellent agreement), followed by a final code-by-code review and debriefing. The coding operation officially started after training.

Table 2-3. Coding Frame

Parent Hierarchy	Coding Level (Child Codes)
Low rolling resistance tires	Low rolling resistance tires

[5] See Cohen (1960). For quick reference, see http://en.wikipedia.org/wiki/Cohen's_kappa.

	Electronic power steering		Electronic power steering
	Powertrain	*Engine*	Turbocharged
			GDI
			Cylinder deactivation
			Diesel
			Hybrid
			Plug-in hybrid electric
			Full electric
			Fuel cell
			Stop-start
			General engine
		Transmission	High-speed automatic
			CVT
			DCT
			General transmission
		General Powertrain	General powertrain
	Electric assist or low drag brakes		Electric assist or low drag brakes
	Lighting-LED		Lighting-LED
	Mass reduction		Mass reduction
	Active ride height		Active ride height (active aerodynamics)
	Active grill shutters		Active grill shutters (active aerodynamics)
	Active air dam		Active air dam (active aerodynamics)
	Passive aerodynamics		Passive aerodynamics
Operational Characteristics	**Drivability**	*General Drivability*	General drivability
		Handling	General handling
			Steering feel/controllability/responsiveness
			Cornering ability/grip/balance/body control
		Acceleration	General acceleration
			Acceleration feel/smoothness/responsiveness
			Acceleration capability/power/torque
		Braking	General braking
			Brake feel/responsiveness
			Stopping ability
	Noise		Tire/road
			Wind
			Interior
			Powertrain
			General noise
	Vibration		Chassis
			Powertrain
			General vibration
	Ride comfort		Ride comfort
	Fuel economy		Fuel economy
	Range		Range
	Charging		Charging

At the onset of the coding operation, 40 auto reviews coded by each coder were verified by the adjudicator. This achieved a 100% verification of 80 auto reviews that facilitated early detection of problems.

- Coder #1 assigned 912 codes, of which 21 codes and 13 sentiments were flagged for correction and discussion by the adjudicator.
- Coder #2 assigned 532 codes, of which 19 codes and 8 sentiments were flagged for correction and discussion by the adjudicator.

After the 100% verification of those 80 auto reviews, the adjudicator randomly selected about 10% of coded reviews to be verified each week. The coders and the adjudicator also met weekly to resolve coding issues. By the end of the coding period, we achieved an overall 10% of the 1,253 coded reviews being verified using the measures discussed in this section.

3. RESULTS

A total of 1,253 auto reviews for MY2015 vehicles from seven Websites, representing 37 manufacturers and 19 official vehicle Class categories (using EPA Size Class definitions[6]) were coded. In terms of publication dates, 711 of the auto reviews were published before 2015, with the remainder (461) being published in 2015. Eighty-one reviews had no dates recorded.[7]

3.1 Database Structure

The coding results are reported in an Excel-based database. The database was maintained in Excel to allow easy access and manipulation of the data by EPA. Two separate tabs were generated to display data at the sampling unit and recording unit levels. At the sampling unit level, each row represents one sampling unit, with columns representing variables shown in Table 3-1. A separate tab displays the recording units and their Positive, Negative, and Neutral codes.

Data recorded for the engine, transmission, drive, and class variables were determined by matching specification information from auto review to corresponding data in the 2015MY EPA Fuel Economy database[8], a public data source that contains vehicle specifications and fuel economy data for manufacturers subject to EPA's greenhouse gas standards. Information provided in the auto reviews, when available, was used to discern the specific model and trim information. Trim information was also checked against the 2015MY EPA Fuel Economy database for accuracy.

[6] See https://www.fueleconomy.gov/feg/epadata/15data.zip
[7] MY2015 vehicles could have been available for test drive by professional auto reviewers prior to 2015. In addition, we could not locate publication date in the auto reviews from Consumer Reports.
[8] See https://www.fueleconomy.gov/feg/epadata/15data.zip

Table 3-1. List of Variables for Each Auto Review

- Sample ID
- Index ID[9]
- Chain ID[10]
- EPA Dataset ID[11]
- Auto Review File name
- Website name
- Website URL
- Date review was published
- Date review was accessed
- Vehicle make
- Vehicle model
- Vehicle class
- Vehicle Trim (when available)
- Engine Cylinders
- Engine Displacement
- Transmission type
- Drive
- Overall assessment of the auto review: Positive, Negative, or Neutral
- All efficiency technology types and their Positive, Negative, or Neutral evaluations
- All operational characteristics and their Positive, Negative, or Neutral evaluations

3.2 Summary Statistics

Table 3-2 below shows the number of auto reviews coded by Website. Auto reviews from Autotrader.com (n=339), Motortrend.com (n=289), and Caranddriver.com (n=207) combine to make up approximately 67% of the coded auto reviews, followed by Automobilemag.com (n=140), Edmunds.com (n=108), Cars.com (n=90), and Consumerreports.org (n=80).

Table 3-2. Auto Reviews by Website

Website	Counts
Autotrader.com	339
Motortrend.com	289
Caranddriver.com	207
Automobilemag.com	140
Edmunds.com	108
Cars.com	90
Consumerreports.org	80
Total	**1,253**

Thirty-seven makes were represented in the coded auto reviews, as summarized in **Table 3-3**. The difference in the number of auto reviews by makes reflects the range of models

[9] Unique identifier for reviews at the website level, assigned by the EPA
[10] Unique identifier used for linking auto reviews, see Section 2.1 Unitizing.
[11] EPA Fuel Economy Label, see https://www.fueleconomy.gov/feg/epadata/15data.zip

and trims that were available for each make, as well as the professional reviewer's and Website's decision to provide substantive reviews for a vehicle.

Table 3-3. Auto Reviews by Manufacturers

Make	Count	Make	Count	Make	Count
Chevrolet	101	Kia	44	Bentley	16
Mercedes	84	Dodge	41	Jeep	15
Ford	79	Volvo	36	Mazda	15
BMW	77	Honda	30	Buick	11
Toyota	75	Chrysler	28	Mitsubishi	10
Hyundai	64	Infiniti	23	MINI	9
Volkswagen	62	Acura	22	Ram	8
Audi	60	Jaguar	22	Scion	8
Subaru	59	Lincoln	22	Lamborghini	5
Lexus	54	Cadillac	21	Fiat	4
Nissan	54	GMC	21	Rolls-Royce	4
Porsche	47	Land Rover	17	Tesla	4
				Maserati	1

Nineteen vehicle classes, as defined by the 2015MY Fuel Economy Dataset described in the previous section, were represented in the auto reviews. As shown in **Table 3-4**, most reviews fell under the Compact (278), Midsize Cars (n=151), Small SUV 4WD (n=121), Large Cars (n=120), and Subcompact (n=116) classes. Two classes had few auto reviews represented: Special Purpose Vehicle 2WD (n=3) and Vans, Passenger Type (n=1).

Table 3-4. Auto Reviews by Class

Class	Count
Subcompact Cars	116
Minicompact Cars	13
Compact Cars	278
Two Seater	75
Midsize Cars	151
Midsize Station Wagon	21
Vans, Passenger Type	1
Small Station Wagon	56
Small Pickup Truck 2WD	13
Small Pickup Truck 4WD	14

Small SUV 2WD	91
Small SUV 4WD	121
Special Purpose Vehicle 2WD	3
Special Purpose Vehicle, minivan 2WD	28
Standard SUV 2WD	44
Standard SUV 4WD	80
Large Cars	120
Standard Pickup Truck 2WD	12
Standard Pickup Truck 4WD	16
Total	**1,253**

The publication date for each auto review is also included in the database. Because publication dates of the reviews varied widely (from 4/1/2013 to 8/14/2015),[12] we categorized them into three groups: "before calendar year 2014" (2% or n=20), "calendar year 2014" (55% or n=691), and "calendar year 2015" (37% or n=461). Note that 6% (n=81) of auto reviews did not have dates, including 80 from Consumerreports.org and 1 from Autotrader.com.

3.2 Summary Tables of Content Analysis Output

Table 3-5 provides the unique number of auto reviews that had Positive, Negative, or Neutral evaluations of efficiency technologies. For example, when *low rolling resistance tires* received positive evaluations multiple times in an auto review, we report that auto review only once under *Positive-low rolling resistance tires*. If the technology receives positive and negative evaluations of a specific efficiency technology in the same auto review, we report that auto review once for Positive and once for Negative for that code. In comparison, **Table 3-6** provides the *total* number of Positive, Negative, or Neutral evaluations of efficiency technology based on individual codes.

Table 3-7 provides the unique number of auto reviews that had Positive, Negative, or Neutral evaluations of operational characteristics. For example, when *Steering feel/controllability/responsiveness* receives positive evaluations multiple times in an auto review, we report that auto review only once under *Positive-Steering feel/controllability/responsiveness*. If the operational characteristic receives both positive and negative evaluations in the same auto review, we report that auto review once for Positive and once for the Negative evaluations for that code. In comparison, **Table 3-8** provides the *total* number of Positive, Negative, or Neutral evaluations of operational characteristics.

[12] Some auto reviews of MY2015 vehicles were published as early as 4/1/2013, most likely because those models were available for test drive at that time.

Table 3-5. Efficiency Technology's Positive, Negative, or Neutral Evaluations by Auto Reviews

Efficiency Technology Categories		Coding Level	Negative	Neutral	Positive	Total[a]
Active air dam		Active air dam (active aerodynamics)	0	0	0	0
Active grill shutters		Active grill shutters (active aerodynamics)	1	0	8	9
Active ride height		Active ride height (active aerodynamics)	0	0	0	0
Low rolling resistance tires		Low rolling resistance tires	4	1	8	13
Electronic power steering		Electronic power steering	22	20	118	160
Powertrain	*Engine*	Turbocharged	43	36	270	349
		GDI	4	6	55	65
		Cylinder deactivation	4	3	18	25
		Diesel	8	3	27	38
		Hybrid	10	5	32	47
		Plug-in hybrid electric	4	3	11	18
		Fuel Cell	0	0	1	1
		Full electric	0	3	17	20
		Stop-start	15	9	24	48
		General engine	117	84	513	714
	Transmission	High speed automatic	97	77	313	487
		CVT	38	14	75	127
		DCT	18	10	83	111
		General transmission	51	24	80	155
	General Powertrain	General powertrain	27	13	84	124
Electric assist or low drag brakes		Electric assist or low drag brakes	0	0	2	2
Lighting-LED		Lighting-LED	0	1	28	29
Mass reduction		Mass reduction	3	2	43	48
Passive aerodynamics		Passive aerodynamics	2	0	18	20
		Total	468	314	1,828	2,610

[a] The Total column slightly overstates the number of reviews that mentioned the technology, because one review could mention the same technology more than once. For example, if the technology receives positive and negative evaluations in the same auto review, we report that auto review once for Positive and once for Negative evaluations. That renders "2" for that row in the total column. (But if the same technology receives positive [or negative] evaluations more than once, we report that auto review only once as having received positive [or negative] evaluations.)

Table 3-6. Efficiency Technology's Total Number of Positive, Negative, or Neutral Evaluations

Efficiency Technology Categories		Coding Level	Negative	Neutral	Positive	Total
Active air dam		Active air dam (active aerodynamics)	0	0	0	0
Active grill shutters		Active grill shutters (active aerodynamics)	1	0	8	9
Active ride height		Active ride height (active aerodynamics)	0	0	0	0
Low rolling resistance tires		Low rolling resistance tires	5	1	8	14
Electronic power steering		Electronic power steering	25	20	121	166
Powertrain	*Engine*	Turbocharged	48	37	392	477
		GDI	4	6	61	71
		Cylinder deactivation	4	3	18	25
		Diesel	9	3	71	83
		Hybrid	12	9	64	85
		Plug-in hybrid electric	5	3	25	33
		Full electric	0	4	29	33
		Fuel Cell	0	0	2	2
		Stop-start	17	9	25	51
		General engine	158	89	886	1,133
	Transmission	High speed automatic	129	82	408	619
		CVT	51	15	123	189
		DCT	24	11	110	145
		General transmission	66	25	107	198
	General Powertrain	General powertrain	31	13	89	133
Electric assist or low drag brakes		Electric assist or low drag brakes	0	0	2	2
Lighting-LED		Lighting-LED	0	1	30	31
Mass reduction		Mass reduction	3	2	53	58
Passive aerodynamics		Passive aerodynamics	2	0	18	20
		Total	594	333	2,650	3,577

Table 3-7. Operational Characteristics: Positive, Negative, or Neutral Evaluations by Auto Reviews

Parent Hierarchy		Coding Level (Child codes)	Negative	Neutral	Positive	Total[a]
Drivability	*Handling*	Steering feel/controllability/ responsiveness	174	122	526	822
		Cornering ability/grip/balance/body control	138	133	503	774
		General drivability	174	133	632	939
		General handling	142	118	581	841
	Acceleration	Acceleration feel/smoothness/ responsiveness	161	48	414	623
		Acceleration capability/power/ torque	260	237	754	1,251
		General acceleration	47	39	174	260
	Braking	Brake feel/responsiveness	99	47	230	376
		Stopping ability	49	73	232	354
		General braking	17	16	72	105
Noise		Tire/road	115	48	175	338
		Wind	50	36	151	237
		Interior	21	4	27	52
		Powertrain	151	68	406	625
		General noise	62	24	335	421
Vibration		Chassis	2	0	1	3
		Powertrain	10	2	6	18
		General vibration	15	2	18	35
Ride Comfort		Ride comfort	204	137	592	933
Fuel Economy		Fuel economy	240	163	489	892
Range		Range	7	8	23	38
Charging		Charging	2	2	10	14
		Total	2,140	1,460	6,351	9,951

[a] The Total column slightly overstates the number of reviews that mentioned the operational characteristics, because one review could mention the same operational characteristic more than once. For example, if the operational characteristic receives positive and negative evaluations in the same auto review, we report that auto review once for Positive and once for Negative evaluations. That renders "2" for that row in the total column. (But if the same operational characteristic receives positive [or negative] evaluations more than once, we report that auto review only once as having received positive [or negative] evaluations.)

Table 3-8. Operational Characteristics: Total Number of Positive, Negative, or Neutral Evaluations

Parent Hierarchy		Coding Level (Child Codes)	Negative	Neutral	Positive	Total
Drivability	*Handling*	Steering feel/controllability/ responsiveness	205	125	629	959
		Cornering ability/ grip/balance/body control	164	150	695	1,009
		General drivability	222	147	1,127	1,496
		General handling	179	134	845	1,158
	Acceleration	Acceleration feel/smoothness/ responsiveness	218	53	554	825
		Acceleration capability/power/ torque	377	270	1,418	2,065
		General acceleration	58	43	207	308
	Braking	Brake feel/responsiveness	118	51	260	429
		Stopping ability	51	73	255	379
		General braking	18	16	73	107
Noise		Tire/road	125	48	180	353
		Wind	56	36	152	244
		Interior	23	4	28	55
		Powertrain	191	79	524	794
		General noise	76	25	441	542
Vibration		Chassis	2	0	1	3
		Powertrain	11	2	6	19
		General vibration	16	2	18	36
Ride Comfort		Ride comfort	303	152	864	1,319
Fuel Economy		Fuel economy	324	179	793	1,296
Range		Range	13	9	50	72
Charging		Charging	2	2	19	23
		Total	2,752	1,600	9,139	13,491

4. LIMITATIONS

There are two major sources of uncertainty:

1. The inherent variability between human coders, which was minimized by conducting comprehensive training on coding, evaluating inter-coder reliability, and regular quality checks by the adjudicator. This is a limitation faced by all content analysis studies using human coders (Gottschalk 1995, Krippendorff 2013); and
2. Inconsistencies in how vehicle details are reported in the auto reviews (e.g., BMW 3-series is reviewed as a whole or more than one model is covered in one review). Such inconsistencies are beyond analyst control and are not atypical in content analysis. To address this limitation, we discussed these occurrences with staff at EPA who had greater insight into the details. In some instances, the review comments did not meet the inclusion criteria for "substantive" reviews and therefore were excluded from coding.

References

Berg, B. L., & Lune, H. (2012) Qualitative research methods for the social sciences (8th ed.). Boston: Pearson.

Carney, T. F. (1972). Content analysis: A technique for systematic inference from communications. Winnipeg, Canada: University of Manitoba Press.

Cohen, Jacob (1960). "A coefficient of agreement for nominal scales". Educational and Psychological Measurement 20 (1): 37–46. doi:10.1177/001316446002000104

Gottschalk, L. A. (1995). Content analysis of verbal behavior: New findings and clinical applications. Hillside, NJ: Lawrence Erlbaum Associates, Inc.

Krippendorff, K. (2013). Content Analysis: An Introduction to Its Methodology, SAGE Publications, Inc.

Moeller, L. G. (1963). An introduction to content analysis--including annotated bibliography. Iowa City: University of Iowa Press.

Sha, M. and Beach, R. (2015). Content Analysis of Professional Automotive Reviews. Final report prepared for U.S. Environmental Protection Agency.

Weber, R. P. (1990). Basic content analysis, second edition. Newbury Park, CA: Sage Publications.

Appendix A:
Glossary and Coding Guidelines

Table A-1. Efficiency Technology

Parent Hierarchy	Child Code	Definition of Code	Example
Low rolling resistance tires	Low rolling resistance tires(acronym LRR)	Tires designed with less rolling resistance to improve vehicle fuel efficiency.	"Low-rolling-resistance tires do sacrifice some grip, but the hybrid's 184-foot 70-to-zero stopping distance was only four feet longer than that of the last no hybrid Accord we tested."[a] (Neutral)
Electronic power steering	Electronic power steering	Power steering that relies on computer controlled electric motor to assist steering. This is in contrast to less efficient hydraulic systems that have been almost universally used until recently. (synonyms: EPS. Note that Steer-by-Wire is just one type of EPS system, in which there is no mechanical connection to the steering wheel).	"The steer-by-wire system has been divisive so far, with senior features editor Jonny Lieberman calling bits of it somewhat "disconcerting…"[b] (Negative)
Powertrain	NA	Defined as the engine and transmission combination.	NA
Engine	Turbocharged (Turbo, Eco-boost, Ecotec)	Device that increases engine combustion efficiency (in terms of power per fuel consumption).	"…the Regal GS boasted its own tune for the 2.0-liter turbo four that provided cushions of 50 horsepower and 35 lb-ft of torque over the same engine in the mid-grade Regal Turbo." (Positive)[c]
	GDI	Gasoline Direct Injection (GDI) is a fuel-delivery technology that allows gasoline engines to burn fuel more efficiently. synonyms: direct injection, direct-injection engine, petrol direct injection (PDI), direct petrol injection (DPI), spark ignited direct injection (SIDI), fuel stratified injection (FSI), turbo fuel stratified injection (TFSI), smart charge injection SCi), direct-injection-spark-ignition (DISI), Ecotec (LAF, LCV, or LTG), LT1) Note: Port fuel injection (PFI/SPFI/MPFI) is not a type of GDI system)	Example not yet available

(continued)

Table A-1. Efficiency Technology (continued)

Parent Hierarchy	Child Code	Definition of Code	Example
	Cylinder deactivation	Technology used on bigger engines to help improve fuel economy that shuts down one or more the engine's cylinders under low demand situations. (synonyms: Variable displacement, engine deactivation, engine displacement change, variable cylinder management, active fuel management, multi-displacement system, active cylinder control system, active cylinder control)	Example not yet available
	Diesel	Diesel internal combustion engine (synonyms: Compression-ignition engine)	"Engine noise is subdued, and clues that it's a diesel are remarkably few."[d] (Positive)
	Hybrid (HEV)	A Hybrid Electric Vehicle (HEV) uses one or more electric machines (motor/generator) to help propel the vehicle and recapture braking energy, but only gasoline or diesel is used to fuel the vehicle (no plug-in to recharge battery)	"Compared with its arch rival, the Camry hybrid, Honda's planet-saver doesn't sacrifice the driving experience on the altar of eco frugality." (Positive)
	Plug-in hybrid electric (PHEV)	Same as HEV, except that rechargeable batteries can be restored by plugging into an electrical source (synonyms: Range Extended Electric Vehicle (REEV), Extended Range Electric Vehicle (EREV))	"Crucial to the Fusion Energi's appeal, the Ford's EPA-rated 21-mile EV range before the gas engine turns on is far less than the 2013-2014 Volt (38 miles), but more than the Prius (11 miles) and Accord Hybrid (13 miles)." (Neutral)
	Full electric (EV)	Vehicles that run on rechargeable electric battery packs only (synonyms: Battery Electric Vehicle (BEV))	"Although we found electrification dulls one of our favorite Hondas, the reverse seems true of the Chevy: It makes a boring car intriguing." (Positive)
	Fuel Cell	Fuel cells create electricity to power an electric motor, generally using oxygen from the air and compressed hydrogen.	Example not yet available

(continued)

Table A-1. Efficiency Technology (continued)

Parent Hierarchy	Child Code	Definition of Code	Example
	Stop-start	Engine shuts down while idling to reduce fuel consumption/emission. Not applicable to HEV's and PHEV's. (synonym: i-Stop)	"The EPA rates the TDI versions of the A6 and A7 at 24/38 mpg city/highway, and after back-road stints through Virginia and Maryland, the in-car trip computers reported seriously impressive fuel sipping: 35 mpg in the A6 and 34 mpg in the A7. Both cars are helped by a standard engine stop-start system that can be alternately discreet and abrupt."
	General Engine	Engine technologies not specifically defined by another category	"Elantra's 4-cylinder engine becomes thrashy when accelerating hard." (Negative)
Transmission	High speed automatic	Automatic transmission with a torque converter that is 6 speeds or higher (4 and 5-speeds are not fuel saving technologies and should not be coded. If just "transmission" is referenced without speed specification code as general transmission.) Not applicable to DCT's and CVT's which also change ratios automatically.	"The 6-speed automatic is ultra-smooth..." (Positive)
	CVT	Continuously Variable Transmissions change through an infinite number of effective gear ratios. This contrasts with other mechanical transmissions that offer a fixed number of gear ratios. A vehicle with CVT is like driving an automatic without the feel of "gear changes." (Note: Some recent manufacturers have designed CVTs to mimic the feel of gear changes.)	"We like the way the CVT paddle shifters help the 2.5-liter make the most of its power." (Positive)
	DCT (Porsche may refer to it as PDK).	Dual-clutch transmission shifts automatically using clutches, allowing greater efficiency and acceleration performance than the typical automatic transmission with a torque converter.	"Happily, you can't miss with either transmission. The PDK is clever enough that you can leave it in auto even on the track" (Positive) "Helping the Focus is a quick-shifting 6-speed dual-clutch PowerShift transmission with launch control" (Positive)

(continued)

Table A-1. Efficiency Technology (continued)

Parent Hierarchy	Child Code	Definition of Code	Example
	General Transmission	Transmission technologies not specifically defined by another category or when specific transmission type is not specified.	"…the transmission's seeming inability to find and hold a gear." (Negative)
General Powertrain	General Powertrain	Powertrain technologies (i.e. a combination of engine and transmission) not specifically defined by another category.	"…the engine and transmission live in relative harmony." (Positive)
Electric assist or low drag brakes	Electric assist or low drag brakes	Electric brake boosters that increase breaking pressure in emergency/quick braking situations, which allows a greater distance to be maintained between the brake pads and rotors during normal driving for reduced drag). (synonyms: Electric servo brake system)	"The same goes for the Accord hybrid's new electrically assisted brakes: While totally reengineered to use mostly regenerative braking, they give crisp top-of-pedal response that's easy to modulate." (Positive)
Lighting-LED	Lighting-LED	Evaluations of LED headlights	"Standard low beam LEDs on all Corollas not only allow versatile styling but provide some of the best visibility we've ever tested. These LEDs also have excellent levels of light intensity." (Positive)
Mass reduction	Mass reduction	Reducing weight of vehicle through the use of alternative and lighter weight materials.	Example not yet available
Active ride height (Active aerodynamics)	Active ride height	The vehicle automatically adjusts suspension/height of vehicle to reduce drag, increasing fuel efficiency (e.g. if vehicle lowers to the ground when at higher speeds there is less drag on the vehicle).	Example not yet available
Active grill shutters (Active aerodynamics)	Active grill shutters	Grille shutters which open and close automatically, controlling airflow to engine bay to reduce drag on vehicle	Example not yet available
Active air dam (Active aerodynamics)	Active air dam	Air dams which open and close automatically to optimize aerodynamics.	Fully extended, the clever air dam sits lower than the GT3's nose, but, at low speeds, it's flush against the bottom of the bumper, so drivers don't have to worry about scraping against driveways
Passive aerodynamics	Passive aerodynamics	Static characteristics of the vehicle's body design and/or added components that work to reduce vehicle drag. (e.g. specific body shapes, spoilers, underbody covers etc.)	The "air curtain" directs air through the corners of the lower front fascia, around the front wheels, and out the front fender scallops, thus making them functional.

[a] 2014_Honda Accord Hybrid Car and Driver, 012
[b] 2014_Infiniti_Q50S_Compact_1ab_Motortrend, 001
[c] 2014_Buick_Regal-Turbo-AWD-GS-AWD_Midsize_1_CarandDriver

Table A-2. Operational Characteristics

Parent Hierarchy	Child Code	Definition	Example
Drivability	NA	The degree to which a vehicle's lateral and longitudinal movements follow a desired path and speed on the road, and are controlled easily and predictably by the driver.	NA
General Drivability	General Drivability	Drivability characteristics that do not fall under other child codes (handling, acceleration, braking) (Keyword examples: drive, drivability, driving)	"There's nothing particularly fun about driving the Elantra." (Negative)
Handling Refers to the vehicle's lateral movements (i.e. turning movements controlled through steering) and the degree to which they follow a desired path and speed on the road, and are controlled easily and predictably by turning the wheel . Better handling means a car can turn at higher speeds with reduced risk of losing control. A car that doesn't handle well will be quicker to lose grip, or lose control. Do not code evaluations of parking maneuverability and turning radius.)	General handling	Handling characteristics that do not fall under other child codes (steering feel…, cornering ability…) Refers to the degree to which a vehicle's lateral movements (i.e. turning movements controlled through steering) follow a desired path and speed on the road, and are controlled easily and predictably	"On the track, the Corolla was secure and forgiving." (Positive) [a]
	Steering feel/Controllability/Responsiveness (Driver experience)	Driver perception of steering via steering wheel feel/Driver perception of how well the vehicle responds to steering inputs by driver/ Drivers perception of how well vehicle can be controlled via steering inputs. (e.g. When the driver turns the wheel does it react the way they want it to?) Keyword examples: Sharp, crisp, (pos) vague, disconnected (neg).	"By no means does the DAS interfere with driving, but you end up doing so by other tactile feel… and muscle memory. In other words, your hands really don't feel connected to the road, despite the artificial feedback."

(continued)

Table A-2. Operational Characteristics

Parent Hierarchy	Child Code	Definition	Example
	Cornering ability/Grip/Balance/Body Control (Performance expectations)	Refers the cars ability to safely and quickly handle corners. (i.e. How in control is the driver of the car going around corners at accelerated speeds? Does the car have the ability to go through around the corners quickly? How well does the car/tires grip the road when going around corners? Do tires slide out (balance), or does the car understeer (steers less than the amount commanded by driver) or over-steer (steers more than the amount commanded by driver) around the corner?) Note: this code refers to the actual performance of the vehicle, not how it "feels" to the driver while maneuvering.	"It steers nicely through turns and is totally controllable, although there's limited grip and power available." (Negative)
Acceleration Refers to the rate of increase in vehicle speed (i.e. forward movement controlled through the accelerator pedal) and the degree to which speed increases smoothly and predictably in response to the driver's application of the pedal.	General acceleration	Acceleration characteristics that do not fall under other child codes (acceleration feel…, acceleration capability)	"Performance for our LE with the 132-hp engine and the CVT was adequate. No complaints about acceleration but no one raved, either."[b] (Neutral)
	Acceleration feel/Smoothness/Responsiveness (Driver experience)	How the acceleration of the car feels to driver/Acceleration smoothness (or lack of smooth acceleration)/Responsiveness of pedal (i.e. Does the vehicle respond as expected when the pedal position is changed?.)	"The Elantra's 4-cylinder engine becomes thrashy when accelerating."[c] (Negative) "Quick and precise turn-in with excellent feel through the thick and grippy steering wheel" (positive)
	Acceleration capability/Power/Torque (Performance expectations)	How fast can the car accelerate? Note: power can only be perceived as an operational characteristic through acceleration performance. Be careful not to code evaluations of power as a specification, i.e., when it is not experienced through acceleration while driving. Example:"260 horsepower is low for its class" (do not code – specification only)	"Power is weak at low revs, and its 0-60 mph time of 9.7 sec is slow for the class."[d] (Negative)

(continued)

Table A-2. Operational Characteristics (continued)

Parent Hierarchy	Child Code	Definition	Example
Braking Refers to the slowing and stopping of the vehicle (i.e. forward movement controlled through the brake pedal) and the degree to which the vehicle can be stopped quickly and responds predictably to driver application of the brake pedal.	General braking	Braking characteristics that do not fall under other child codes (brake feel…, stopping ability)	"Overall braking performance was good with relatively short stops on both surfaces. It's not a top performer in its class, but at least on par." (Neutral)
	Brake feel/Responsiveness	Driver perception of braking via feel of pedal/Driver perception of how well the car responds to braking/pressing pedal.	"The Elantra exhibits some initial brake jumpiness when hitting the pedal at higher speeds…"[e] (Neutral)
	(Driver experience)	For hybrid & EV in specific, refers to regenerative braking and transition between friction and regenerative.	"The same goes for the Accord hybrid's new electrically assisted brakes: While totally reengineered to use mostly regenerative braking, they give crisp top-of-pedal response that's easy to modulate. The brakes are neither grabby nor laggy like those in many other brands' hybrids and electrics" (Positive)
	Stopping ability (Performance expectation)	Braking performance (i.e. How well the vehicle can stop/responds to driver braking.) This includes how well the tires grip while braking, and stopping distance.	"…its panic-stop distance of 126 feet from 60 mph is longer than average." (Negative)
Noise (synonyms: Sound, turbulence, boisterousness, boom, clang, clatter, discord, disquiet, drumming, racket, ring, thud, echo; quiet or quietness (antonym)	Tire/Road	Noise generated from tires while car is in motion, based on perceptions of the driver inside the cabin. Also referenced as "road noise."	"Staggered sized UHP run-flat tires do their share in keeping the cabin noisy with plenty of rumble and impact boom reverberating from the rear." (Negative)
	Wind	Noise generated as the vehicle passes through the air, based on perceptions of the driver inside the cabin).	"The Corolla has suppressed levels of wind and road noise." (Positive)
	Interior	Noise generated from vehicle's interior (e.g. squeaky instrument panel) [note different from General noise]	"We did notice one intermittent dash rattle."
	Powertrain	Noise coming from powertrain components (engine/trans), based on perceptions of the driver inside the cabin.	"We were also mildly annoyed by a whirring electric-motor sound at low speeds."[g] (Negative)

(continued)

Table A-2. Operational Characteristics (continued)

Parent Hierarchy	Child Code	Definition	Example
	General noise	References generically to "cabin noise" or "interior noise", without reference to the source of the noise, based on perceptions of the driver inside the cabin.	"Elantra is impressively quiet at highway speeds."[h] (Positive)
Vibration	Chassis	Vibration originating from base/frame of the vehicle	Example not yet available
	Powertrain General vibration	Vibration originating from powertrain components (transmission and engine)	"At idle, vibration transmitted to the cabin is significant -- so significant that senior production director Zach Gale said, "Mitsubishi could almost advertise this car as having a low-intensity massaging seat setting." (Negative)
	General vibration	Vibration not specified by another category	
Ride comfort	Ride comfort	How comfortable the ride of the car is for passengers when there are bumps in the road surface (Note: this does not include reviews of seat cushion comfort or interior decoration)	"…surprisingly harsh over bumps and potholes, feeling unrefined compared to several key rivals."[i] (Negative)
Fuel economy	Fuel economy	The amount of fuel a vehicle uses. Fuel economy can be evaluated through observed fuel efficiency reported from test drive, based on reviewer's thoughts of published descriptions (specifications) of fuel economy, or in comparison with other vehicles.	"Even with our typically heavy collective right foot, we saw observed mileage in the low 40s—compelling for a mid-size car."[j] (Positive)
Range	Range	The distance you can travel on a full charge in an electric vehicle before the battery requires a recharge. Range can be evaluated through observed range reported from test drive or from the reviewers thoughts on a published specification of range.	

(continued)

Table A-2. Operational Characteristics (continued)

Parent Hierarchy	Child Code	Definition	Example
Charging	Charging	Evaluations of observed charging times for electric/hybrid electric vehicles.	

Additional Coding Guidelines

Relative Evaluations

An evaluation relative to another vehicle may be provided in which the positive or negative rating of that other vehicle is not provided. In such cases, the following rules should be followed for coding:

- A positive evaluation relative to another vehicle should be coded as positive. (e.g. "quieter than…")
- A mitigated negative evaluation relative to another vehicle should be coded as neutral.(e.g. "not as noisy as…")
- A mitigated positive evaluation relative to another vehicle should be coded as neutral.(e.g. "not as quiet as…")
- A negative evaluation relative to another vehicle should be coded as negative (e.g. "noisier than …")
- An equivalent evaluation relative to another vehicle where the evaluation of the other vehicle is not described in the article, or relative to another trim level of the same vehicle coded elsewhere in the article should not be coded (e.g. "same noise level as…")
  - Note: if the evaluation of the other vehicle is described in the article or can be inferred from the surrounding text, then code according to that evaluation (e.g. "Overall, the Corolla doesn't ride much worse than the larger Camry." Would be coded as positive, with ride comfort being essentially the same as the "larger" vehicle and its implied ride quality.)

Unobtrusive Technologies

Many efficiency technologies are intended to save fuel while not affecting other operational characteristics of the vehicle. Statements which evaluate a technology as unobtrusive or not noticeable should be coded as positive for that technology. Examples: "you'd never know the Corolla has a CVT". "Testing director Kim Reynolds said if Jonny hadn't told him, he would have guessed it was a normal steering setup"

Synonymous Evaluations of Technologies and Operational Characteristics

Some technologies are perceived through only one relevant operational characteristic. When there is never a distinction between technology and operational characteristics, the evaluation shall be coded in only one category, as defined below:

- Evaluations of engine, transmission, or powertrain noise shall be coded in the operational characteristic category of "Noise: Powertrain", and not under the technology categories of "Engine" or "Transmission"

  "We were also mildly annoyed by a whirring electric-motor sound at low speeds" (Honda Accord)

"And my ears receive a sort of "achievement unlocked" reward, as the engine sounds smooth, tight and athletic – if not race car-raucous – at higher revs." (Infiniti)

- Evaluations of transmission shift quality, smoothness, or frequency shall be coded under the appropriate technology category for that transmission type. Noise may be the only overlapping characteristic.

Specifications

Note text that is coded under the Efficiency Technology node should be coded only when a review generated from observing a specific technology during test drive occurs, not simply when the technology is listed. That is, do not code specifications. Example:

CODE: "We like the way the CVT paddle shifters help the 2.5-liter make the most of its power."

- Coded as CVT: positive

DO NOT CODE: "The 2.5i Premium ($24,090) adds a CVT, 17-in alloy wheels, the Cold Weather Package (heated seats, side mirrors and windshield defrosters), upgraded audio with 4.3-in LCD display, fog lights and a 10-way power driver's seat with power lumbar support."

- While this mentions the CVT, it is only highlighting it as a specification. Do not code specifications

Tip: Ask yourself, is the reviewer evaluating a technology? An operational characteristic? If they aren't evaluating/reviewing an aspect of the car based their experience of driving the vehicle, then it is not a codeable passage.

General Codes

Passages should only be coded under "general" (e.g. acceleration, handling, braking) categories after all other "specific" codes (acceleration capability…steering feel… etc.) for that characteristic have been eliminated. That is, coders should first exhaust all other coding possibilities under more "specific" codes for that category.

Coding Overall Evaluations

In addition to categorizing each individual code as positive, negative or neutral, the overall sentiment of the review must be coded as well. Each review should be assigned a positive, negative or mixed code for the whole review. Review summaries and conclusions can often provide a general idea of the reviewer's attitude about the reviewed vehicle (e.g. reviewer states if they feel consumers should/shouldn't purchase particular car etc.) Example:

"We like diesels. We like the big torque and the excellent real-world fuel economy. But the notion that anyone is buying a $60,000 sedan with a heavy environmental conscience or a pragmatic economic analysis is a stretch. Performance sells cars in this price range. As civilized and torquey as it is, the TDI engine doesn't have the immediacy of the gas-fueled,

supercharged V-6, an engine that sets an industry standard for its instant throttle response, supreme linearity, and excellent power delivery. Paying more money for fewer thrills doesn't make much sense here." (Negative)

"Redesigned for 2014, the new Corolla has landed right on target, and it now ranks among the top models in its class. It combines the practicality and frugal fuel economy that compact-sedan buyers want with more interior room, upgraded amenities, and a sorely needed shot of style. Overall, it's a reasonable alternative to a larger, midsized sedan." (Positive)

Use of Synonyms

Reviews may not necessarily spell out the technology. Sometimes you will need to infer based on the synonyms provided and the context of the passage. For example, "electrically boosted steering" is the same as "electronic power steering."

Creating Spawns

An auto review generates a "spawned" review when the former a) reviews and/or compares multiple trims of the same make/model or b) compares different makes and models.

- Content coded in spawn reviews should focus on one trim, or make/model
- Content coded for spawn reviews that review multiple trims of the same make or model may have overlapping content if reviewer references the make/model more generally.
- EPA Label ID needs to be assigned under source coding for each spawn based on the trim being coded for each spawn created.

Comparison Reviews

The following outlines the scenarios and coding guidelines for comparison reviews.

- Compare MY15 to older MY autos
    - Reference "relative evaluations" coding guidelines and code ONLY the MY15 content
    - Do not create a spawn for the non MY15 review or code any non MY15 content
    - Assign EPA Label ID of MY15 review
- Compare different makes and models
    - Create spawns for each make and model
    - Code content related to only 1 auto per spawn review
    - Assign EPA Label ID accordingly for each make/model a spawn was created.