Review of Car Owner Survey Feedback on Advanced Driver Assistance Systems (ADAS)

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October 8, 2019

Data Summary

- 7636 respondents: Owners of 2018 model year cars across:
    - 34 unique makes
    - 246 unique models
- Respondents provided feedback on up to five ADAS types:
    - Lane Departure Warning
    - Front Collision Avoidance
    - Rear Collision Avoidance
    - Blind Spot Monitor
    - Cruise Control
- Respondents rated and described experiences with ADAS type (where applicable) using:
    - Four-level Likert item for satisfaction level (Very satisfied, Somewhat satisifed, Somewhat dissatisfied, Very dissatisfied)
    - Free text response

Data Preparation

- For simplicity and due to very low combined percentages for either dissatisfaction level, satisfaction/dissatisfaction levels were combined into “Positive” and “Negative” levels

- Respondents reporting “No Experience,” or providing no response for a given ADAS type were not considered

- Respondents who did not specify the variant of an ADAS type also were not considered

- For analysis of specific car make/models:

  - The 15 most frequently reported makes were considered (each of these makes made up at least ~1.8% of respondents)

  - The 25 most frequently reported models were considered (each of these models made up at least ~0.8% of respondents)

Approach

- **Assessment of each ADAS type:**
    - **Assess satisfaction level with each type and its variants**
    - **Examine phrases (2-4 words) associated with both positive and negative satisfaction levels**
        - **Apply Term Frequency-Inverse Document Frequency (TF-IDF) to text responses to determine “intensity” of phrases**
        - **Average TF-IDF over all text responses to determine highest intensity phrases associated with positive/negative feedback**
- Assessment across car make and model:
    - Assess satisfaction level across the most common makes and models
    - Identify models/makes with satisfaction levels which “stand out”

Lane Departure Warning: Satisfaction Levels

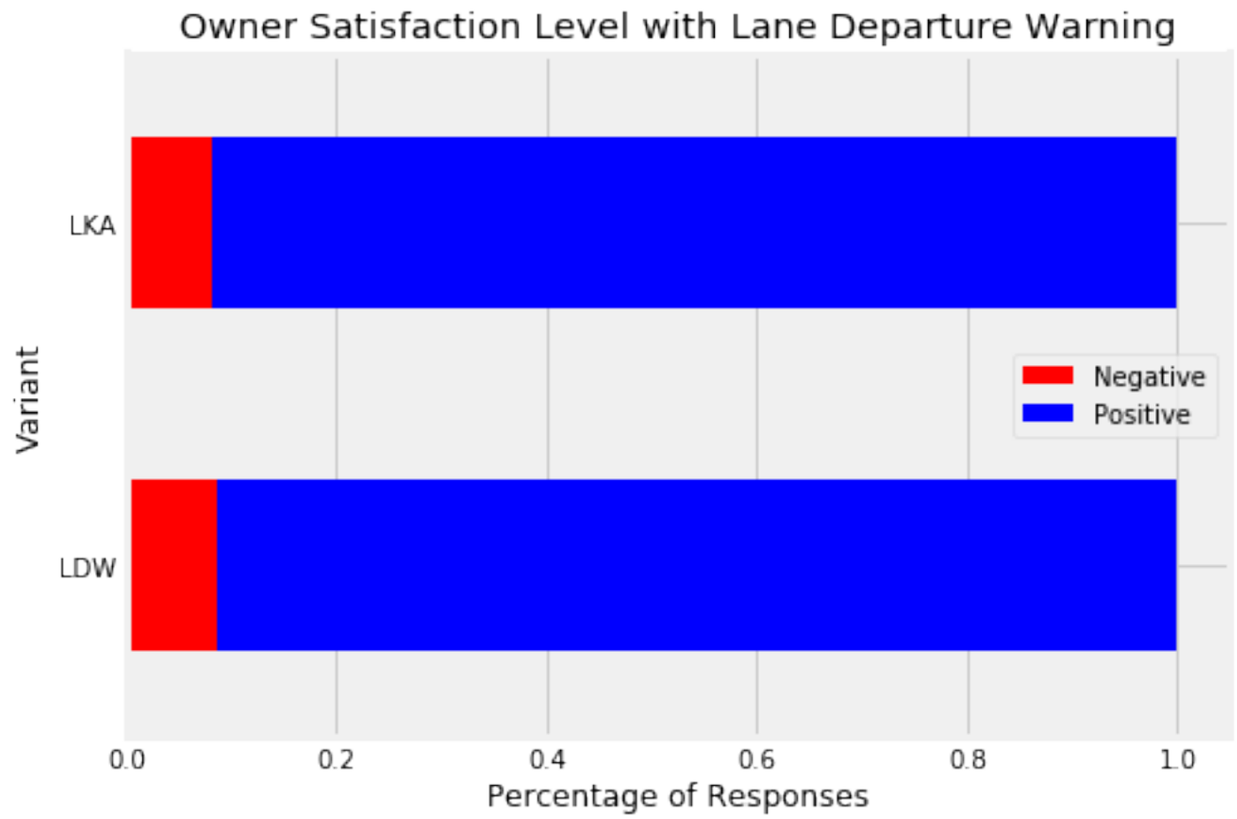
Two Variants:

- Basic Lane Departure Warning (LDW): Alert only
- Lane Keeping Assistance (LKA): Alert + Intervention (under certain conditions)

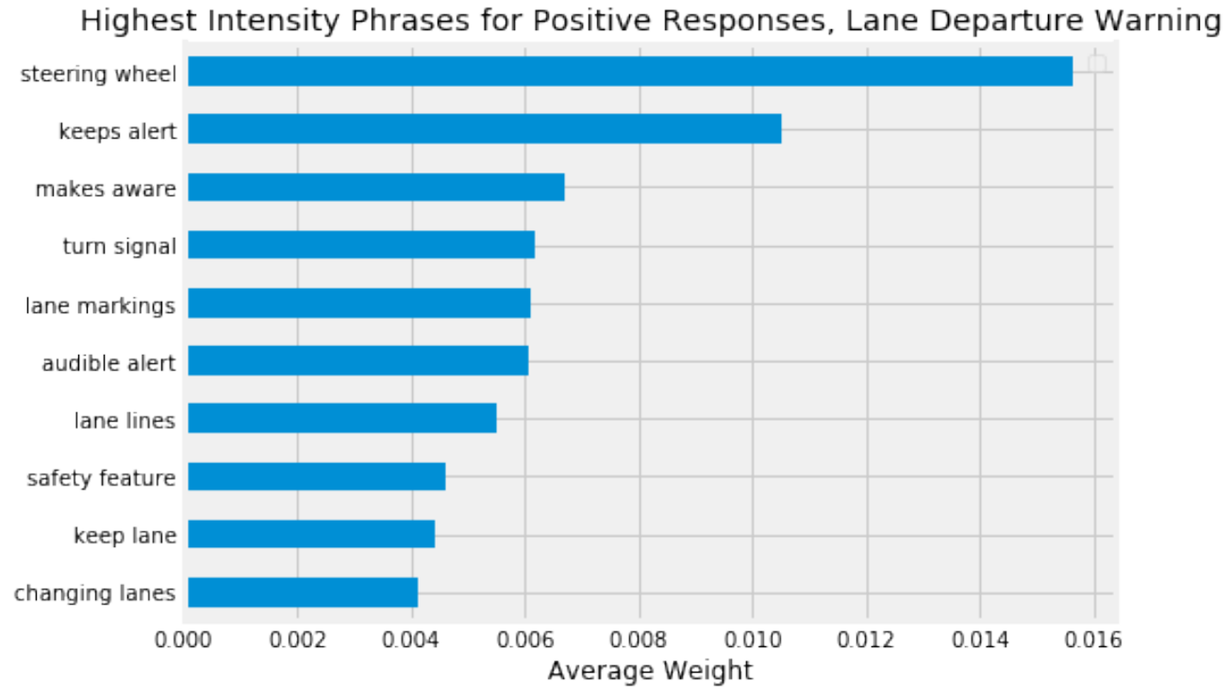
	Positive	Negative
LDW	1634	156
LKA	3506	313

Takeaways:

- Respondents overwhelmingly reported positive experiences across both variants (though less so relative to other ADAS types)



Lane Departure Warning: Positive Text Responses

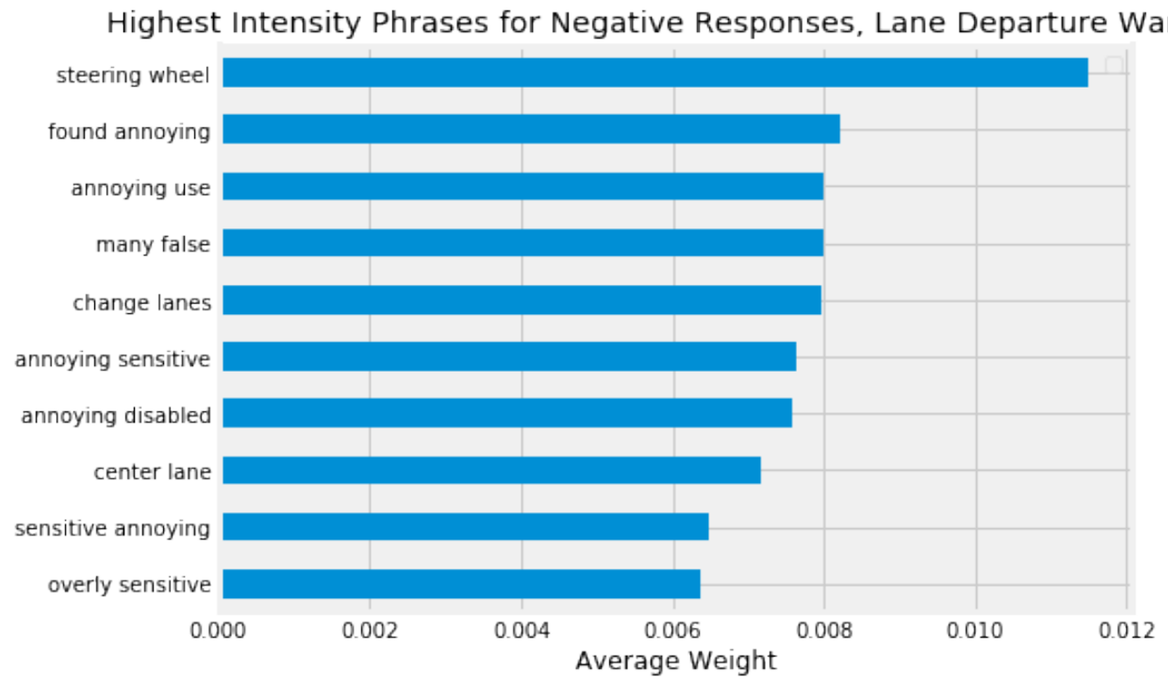


- Tactile (vibrating steering wheel) and/or audible alerts are mentioned often in favorable terms (though not universally)

- Respondents also point out system helps make them more aware/alert regarding their driving, safety practices (e.g., using turn signals) and other traffic

- System's effectiveness is praised under conditions it is designed for (e.g., clear lane markings)

Lane Departure Warning: Negative Text Responses



- Vibration of the steering wheel also discussed intensely, respondents here find it annoying and dislike loss of control

- System is described as too sensitive and frequently triggered by false alarms

- Other primary complaints emphasize that the system is ineffective at keeping the car centered and can make changing lanes difficult

Front Collision Avoidance: Satisfaction Levels

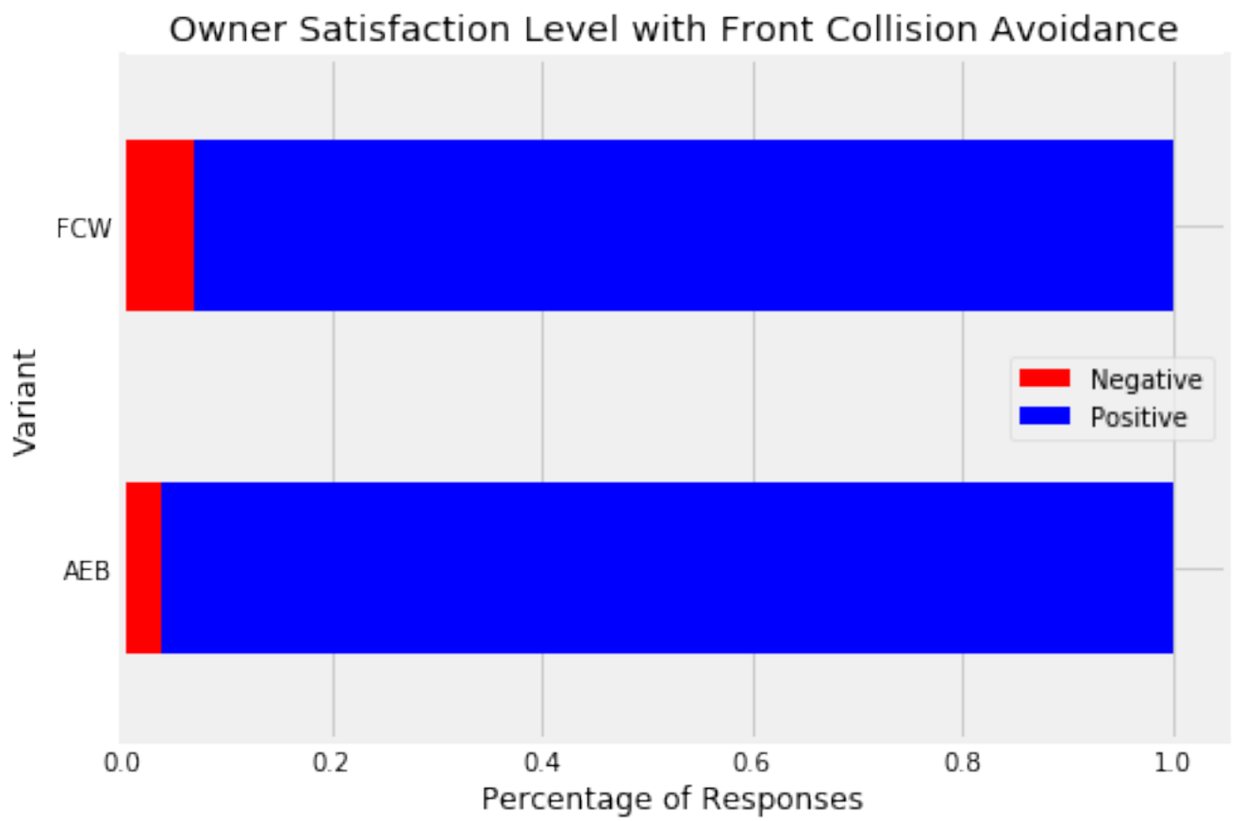
Two Variants:

- Forward Collision Warning (FCW): Alert only
- Autonomous Emergency Braking (AEB): Alert + Intervention (under certain conditions)

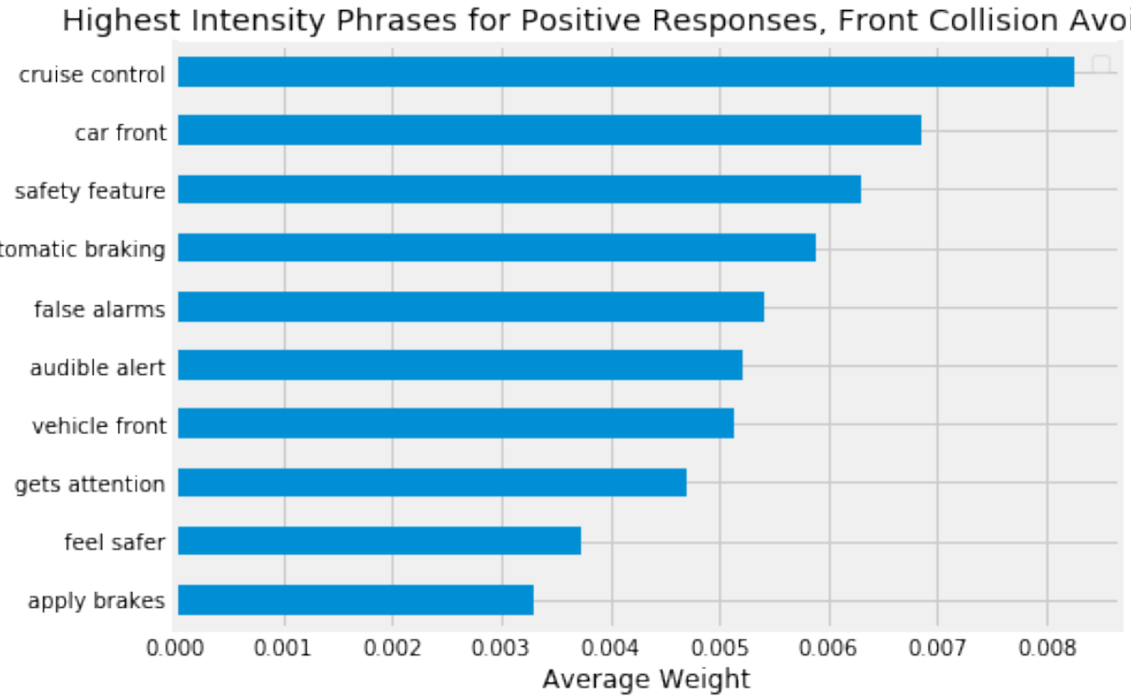
	Positive	Negative
AEB	4369	168
FCW	1015	76

Takeaways:

- Respondents overwhelmingly reported positive experiences across both variants
- More negative feedback regarding the standard FCW variant compared to AEB

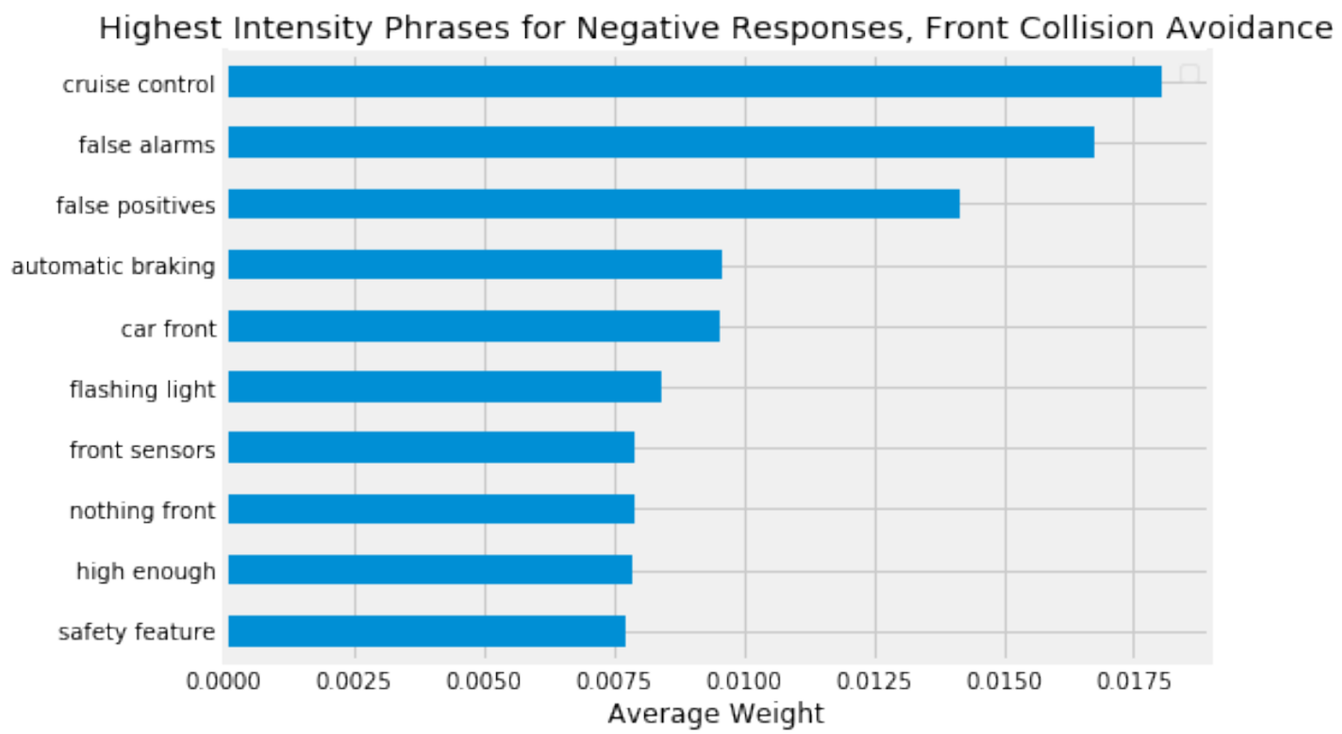


Front Collision Avoidance: Positive Text Responses



- Coupling with cruise control is mentioned frequently but not always that favorably — system is assessed as helpful when cruise is engaged, not as much otherwise
- Many responses point out it is a good safety feature that increases awareness of cars in front through visual and audible alerts
- Automatic braking is not viewed as much of a positive, even from satisfied owners
- Mentions of false alarms is a bit mixed — some have experienced them not at all or rarely, others have under certain conditions though largely do not express irritation with them

Front Collision Avoidance: Negative Text Responses



- Coupling with cruise control is not viewed positively
- System is viewed as too aggressive and sensitive, producing many false alarms and jarring stops

Rear Collision Avoidance: Satisfaction Levels

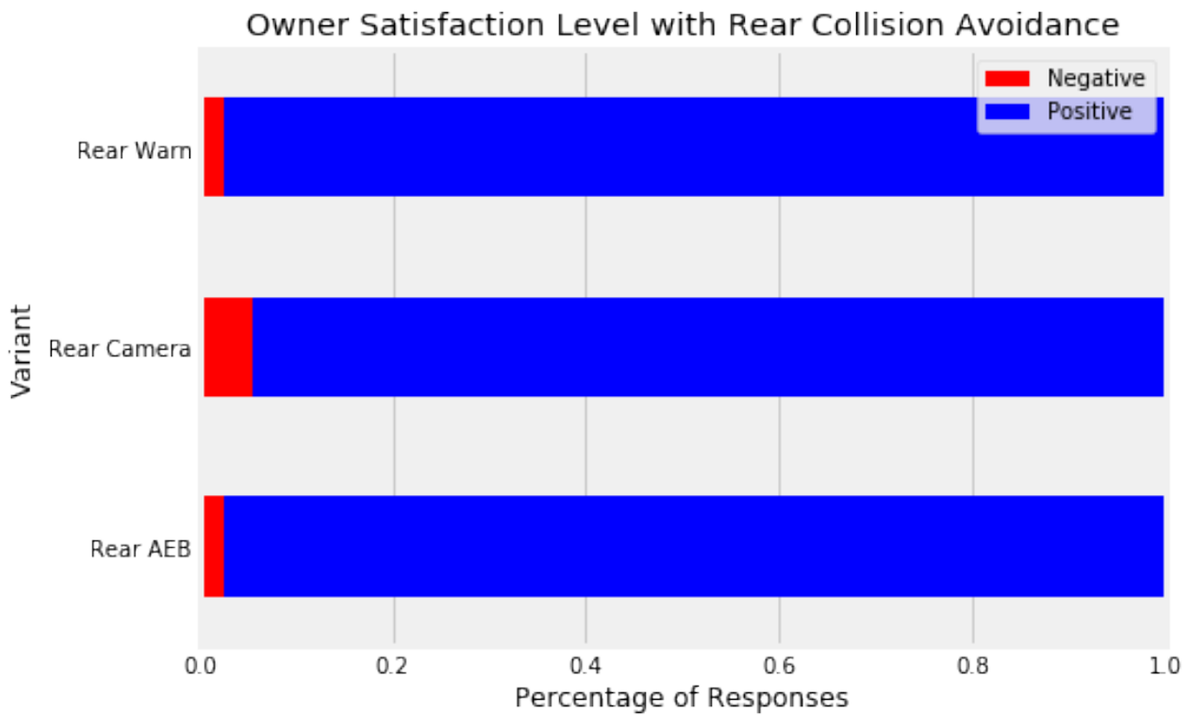
Three Variants:

- Rear Camera: Camera
- Rear Warning (Warn): Camera + Alert
- Rear AEB: Camera + Alert + intervention

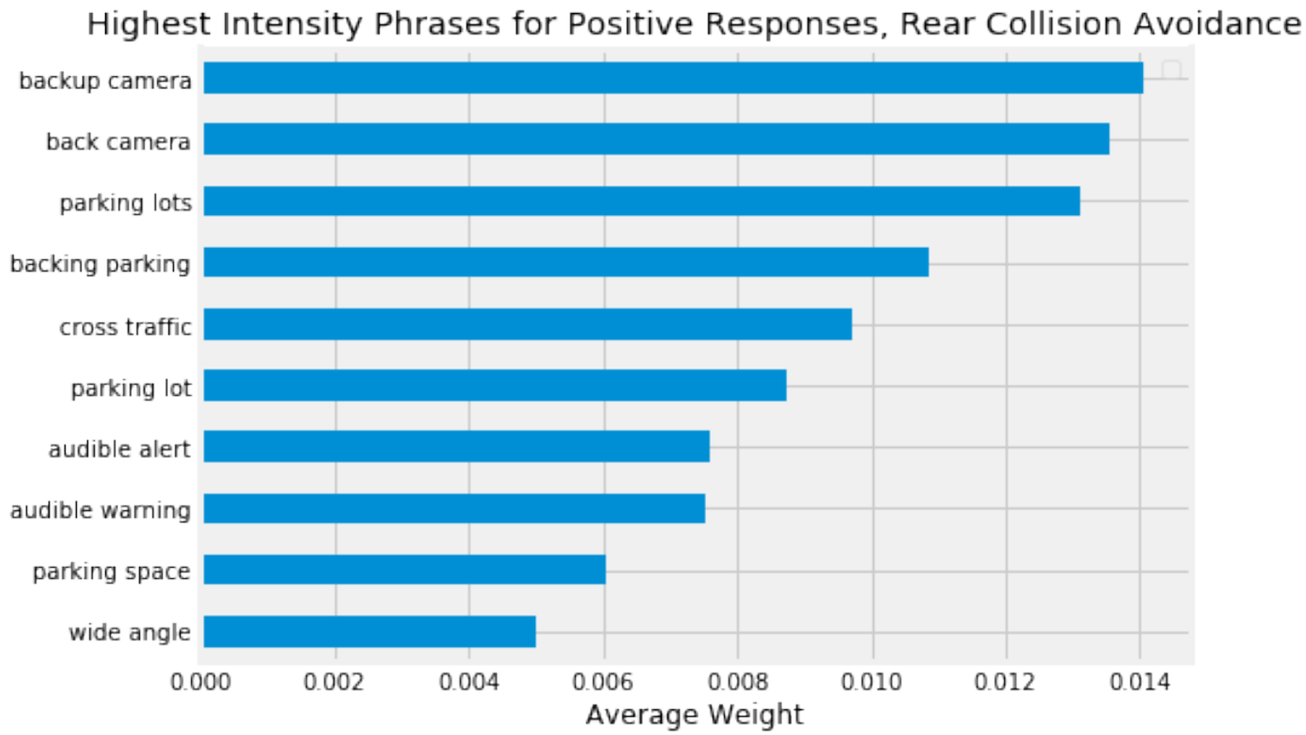
	Positive	Negative
Rear Camera	700	41
Rear Warn	3824	94
Rear AEB	1955	50

Takeaways:

- Respondents overwhelmingly reported positive experiences across all variants
- More negative feedback regarding the Rear Camera compared to others



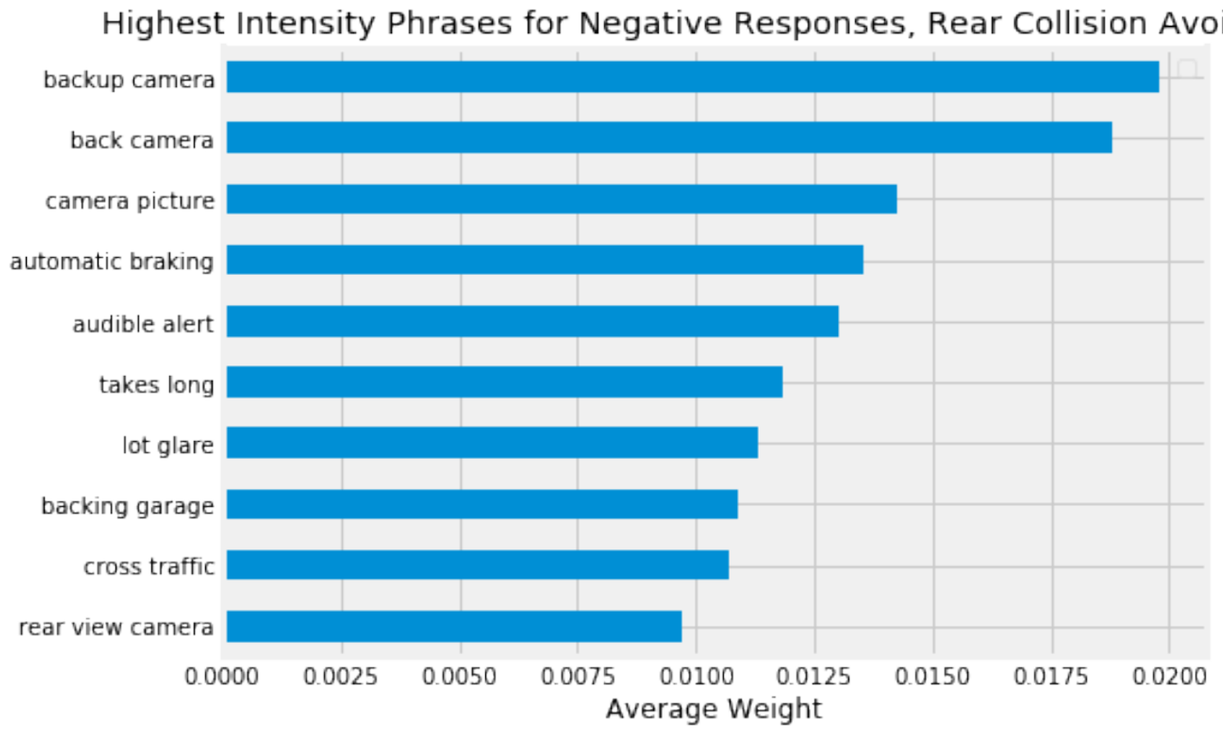
Rear Collision Avoidance: Positive Text Responses



- Camera (especially the wide-angle view provided) is viewed positively, especially in situations where the car needs to be reversed (e.g., parking, backing out a driveway)

- Visual and audible alerts are also praised for supporting driving tasks where backing up a car is required

Rear Collision Avoidance: Negative Text Responses



- Camera is mentioned frequently but is dinged for being unclear, off-center, or not loading up quickly
- Display is also dinged for glare issues
- Automatic braking viewed as too jarring

Cruise Control : Satisfaction Levels

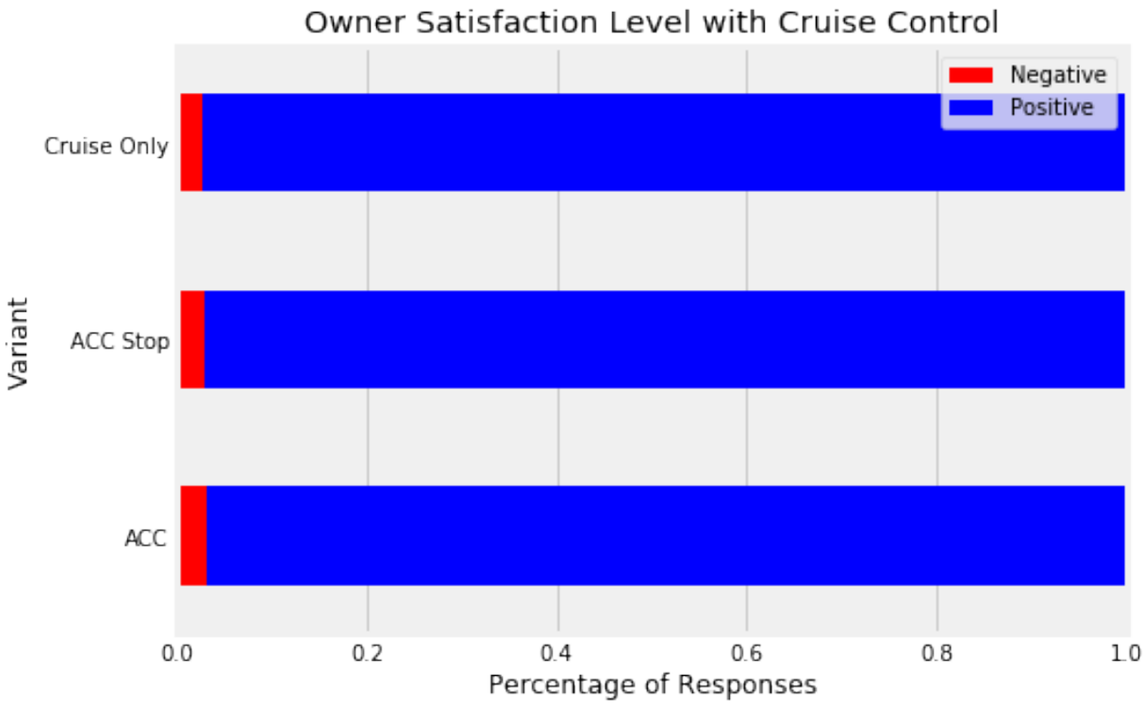
Three Variants:

- Cruise Only: Speed control only
- Adaptive Cruise Control (ACC): Speed control with dynamic adjustment
- ACC Stop: ACC with automated stopping

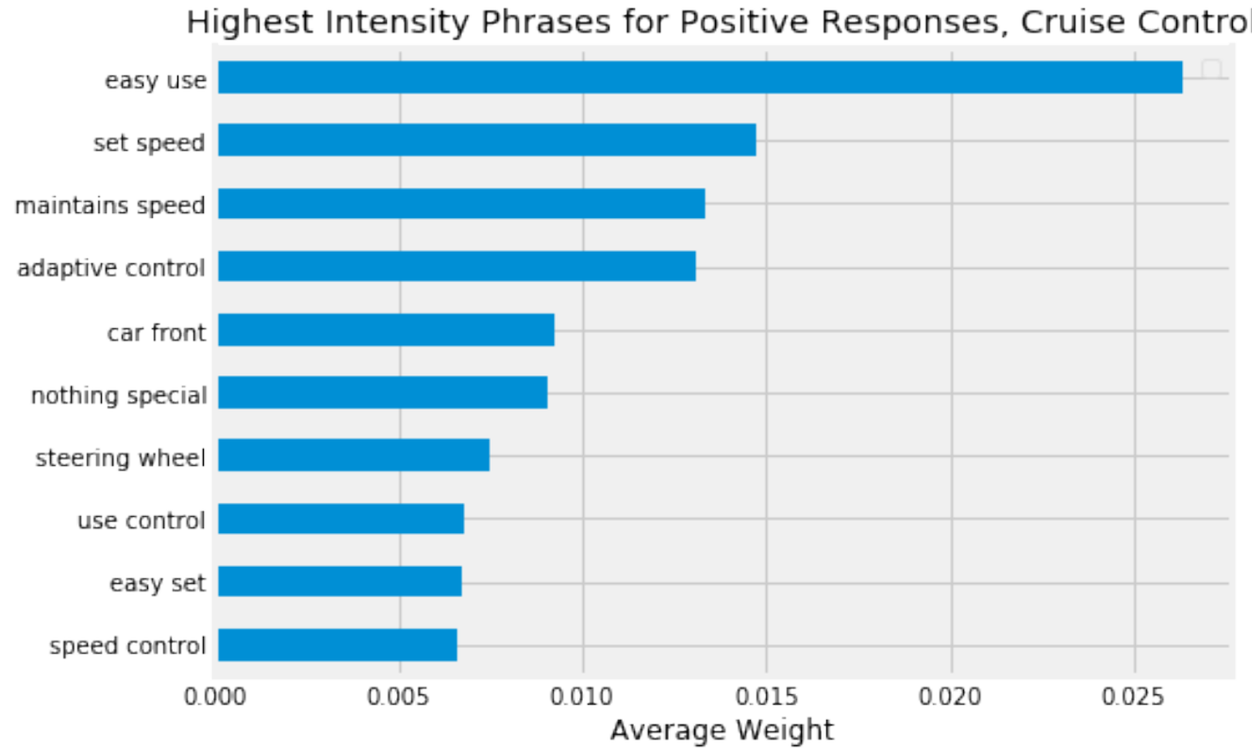
	Positive	Negative
Cruise Only	1623	46
ACC	2376	75
ACC Stop	2635	80

Takeaways:

- Respondents overwhelmingly reported positive experiences across all variants



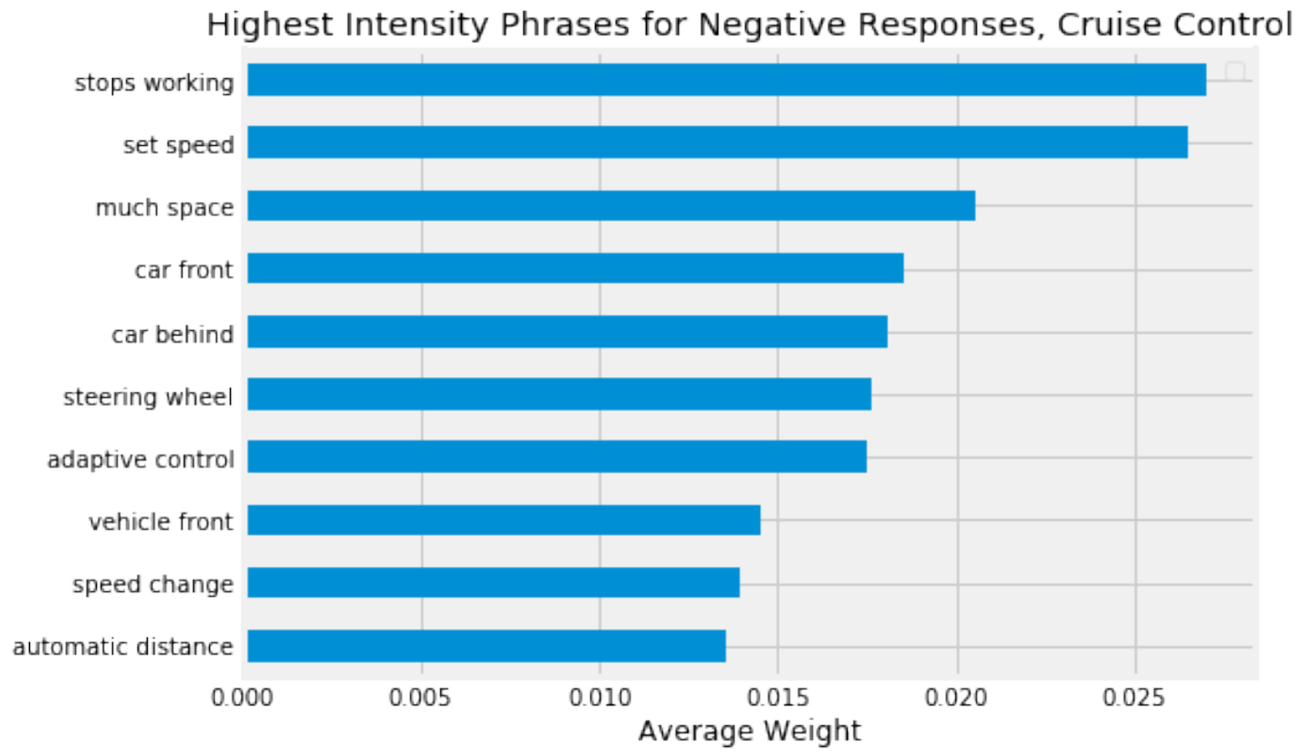
Cruise Control: Positive Text Responses



- Respondents find the system easy to use and essentially does what it is supposed to do (set/maintain speed and adjust if so designed)

- However, the system does not always function correctly in response to cars in front and its coupling with steering wheel is sometimes viewed as awkward

Cruise Control: Negative Text Responses



- Respondents are disappointed with speed and distance controls resulting in extra required adjustments, poor spacing, abrupt changes and/or poor awareness

- Controls on steering wheel are not viewed as user-friendly

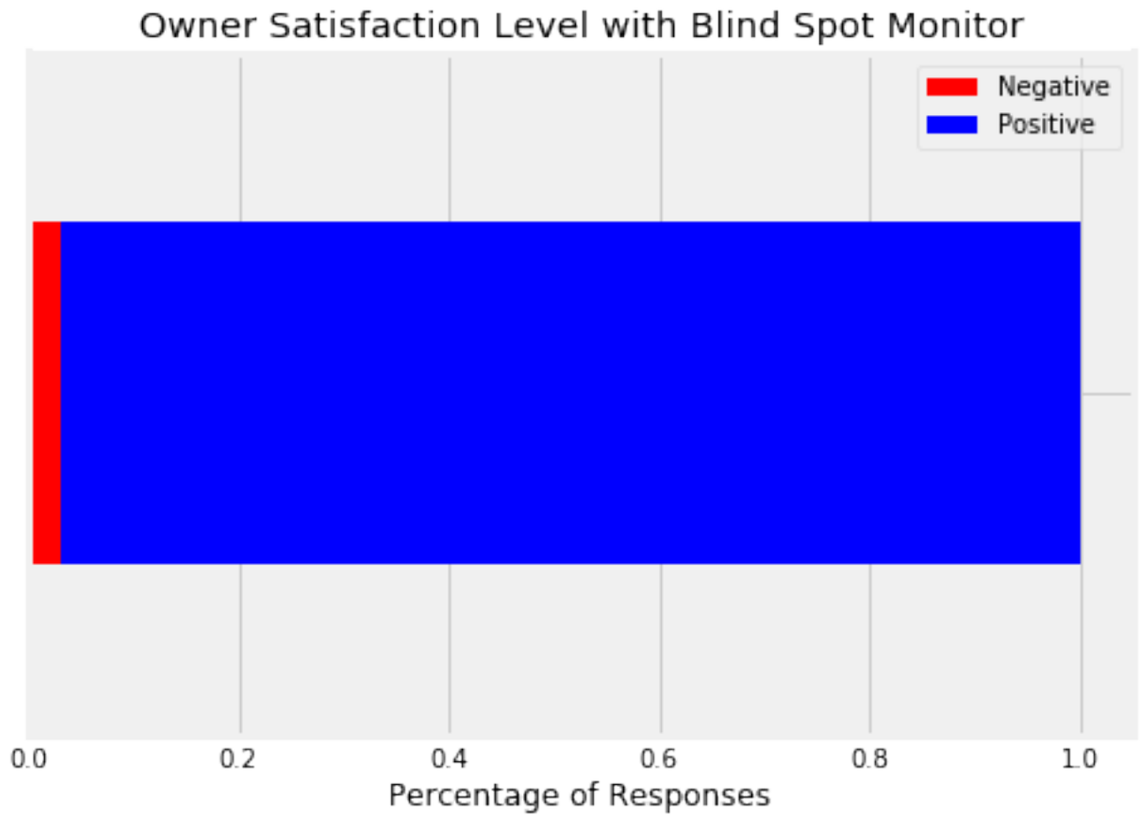
Blind Spot Monitor: Satisfaction Levels

Single variant

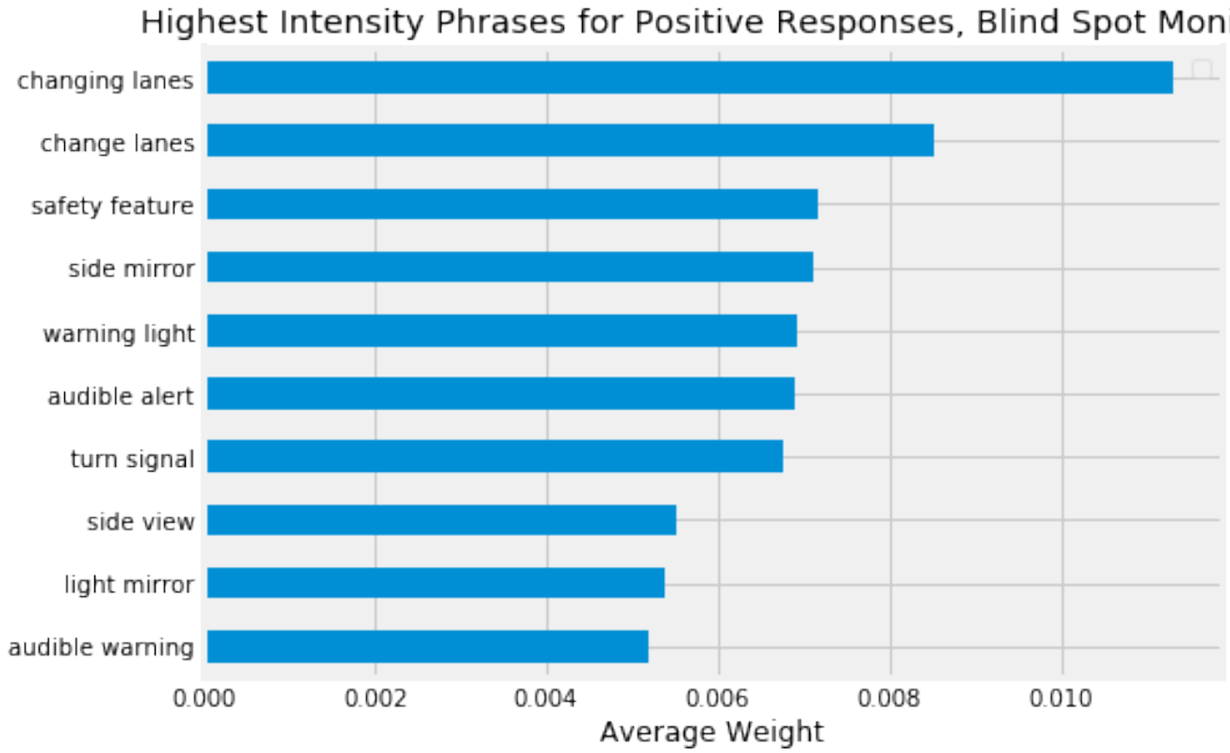
Takeaways:

- Respondents overwhelmingly reported positive experiences with this system

	Positive	Negative
Blind Spot Monitor	6065	193



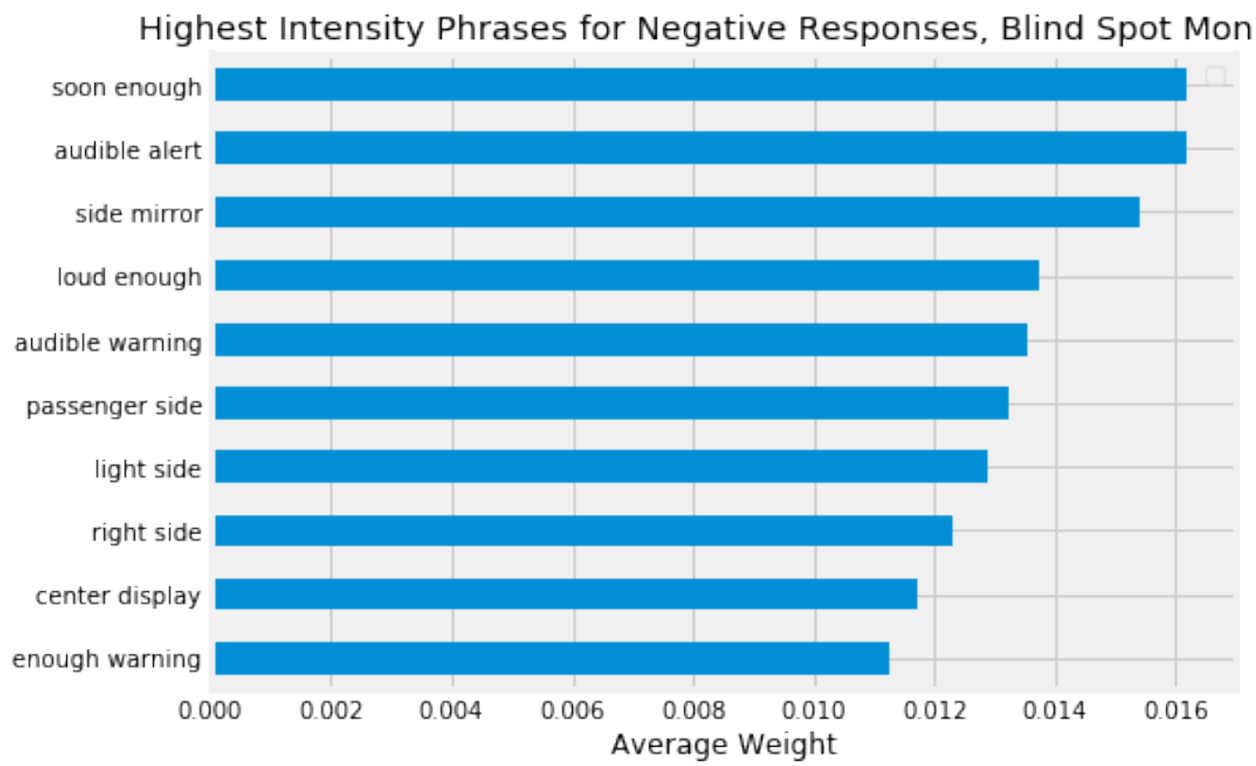
Blind Spot Monitor: Positive Text Response



- Respondents generally view the monitor as valuable decision support when changing lanes

- All features are praised whether the visual alerts in the side mirror, audible alerts (when available, otherwise requested), and coupling with turn signal

Blind Spot Monitor: Negative Text Response



- Respondents emphasize the lack of or weakness of audible alerts
- Contrary to other systems, the insensitivity and slow alerting are viewed negatively
- Visual cues/alerts are deemed insufficient

Approach

- Assessment of each ADAS type:
    - Assess satisfaction level with each type and its variants
    - Examine phrases (2-4 words) associated with both positive and negative satisfaction levels
        - Apply Term Frequency-Inverse Document Frequency (TF-IDF) to text responses to determine “intensity” of phrases
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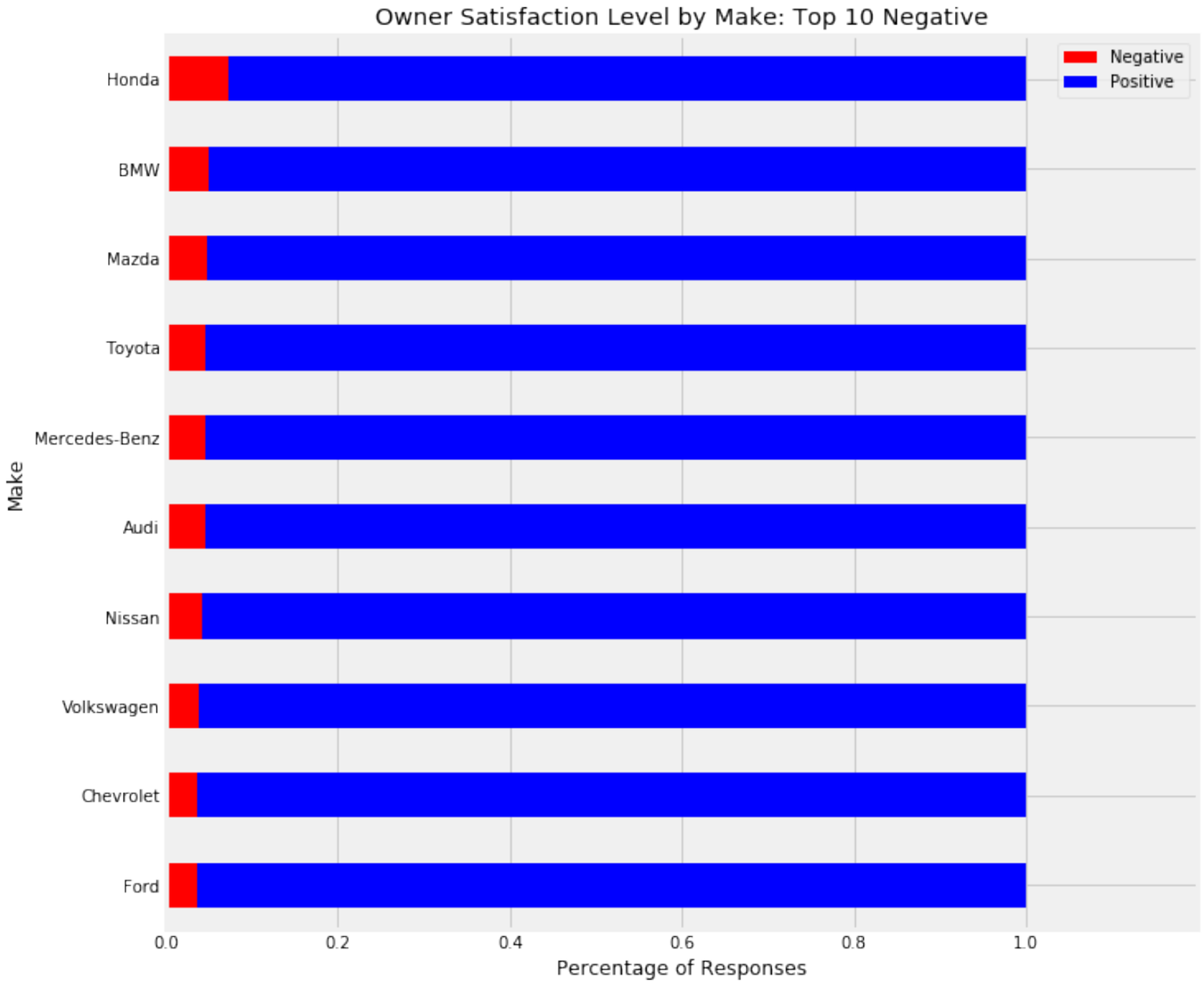
- **Assessment across car make and model:**
    - **Assess satisfaction level across the most common makes and models**
    - **Identify models/makes with satisfaction levels which “stand out”**

Satisfaction Levels by Make

- Aggregating over all ADAS types, **Honda** clearly leads in reported negative experiences, while having the 3rd most respondents in the sample

- Honda has the highest percentage of reported negative experiences (over all makes) with:
    - Lane Departure Warning
    - Front Collision Avoidance
    - Cruise Control
- Honda also has frequently reported negative experiences with:
    - Rear Collision Avoidance (4th highest)
    - Blind Spot Monitor (5th highest)
- No other make appeared in the 5 highest percentages of reported negative experiences with more than 3 ADAS types

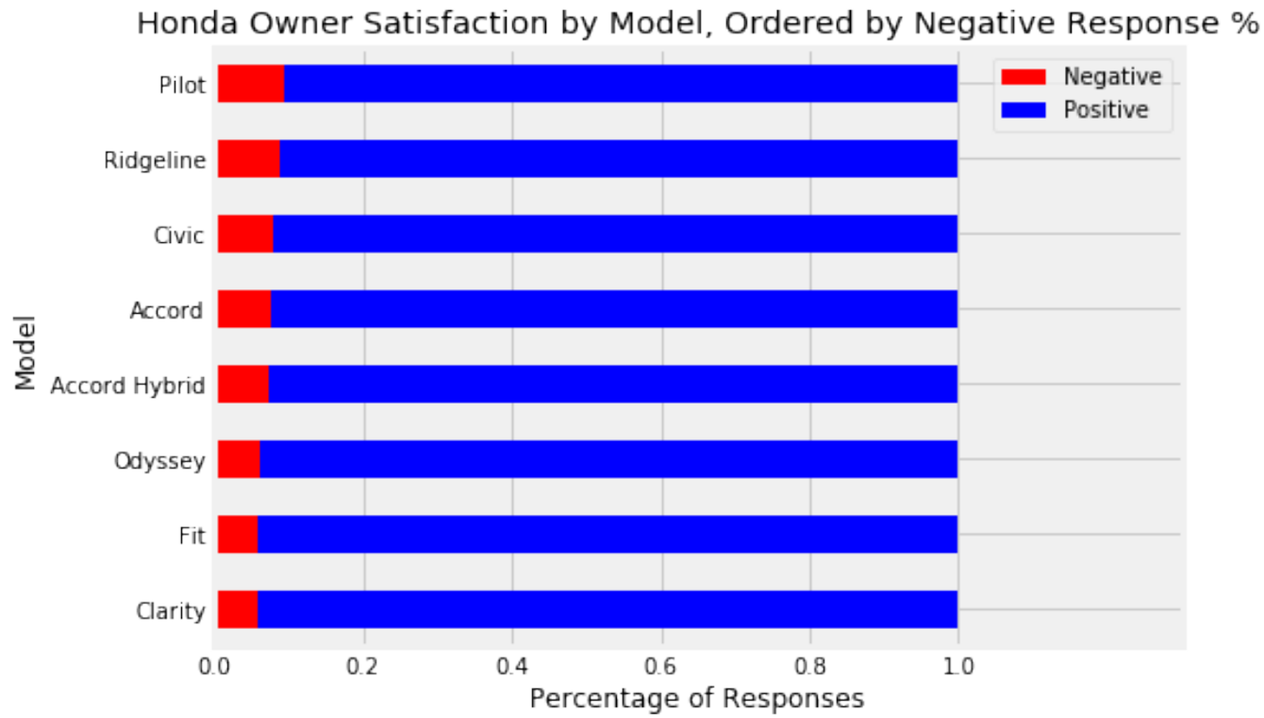


A Deeper Look Into Honda (Part 1)

- Pilot, Ridgeline, Civic, and Accord have the highest percentages of reported negative experiences over all ADAS types

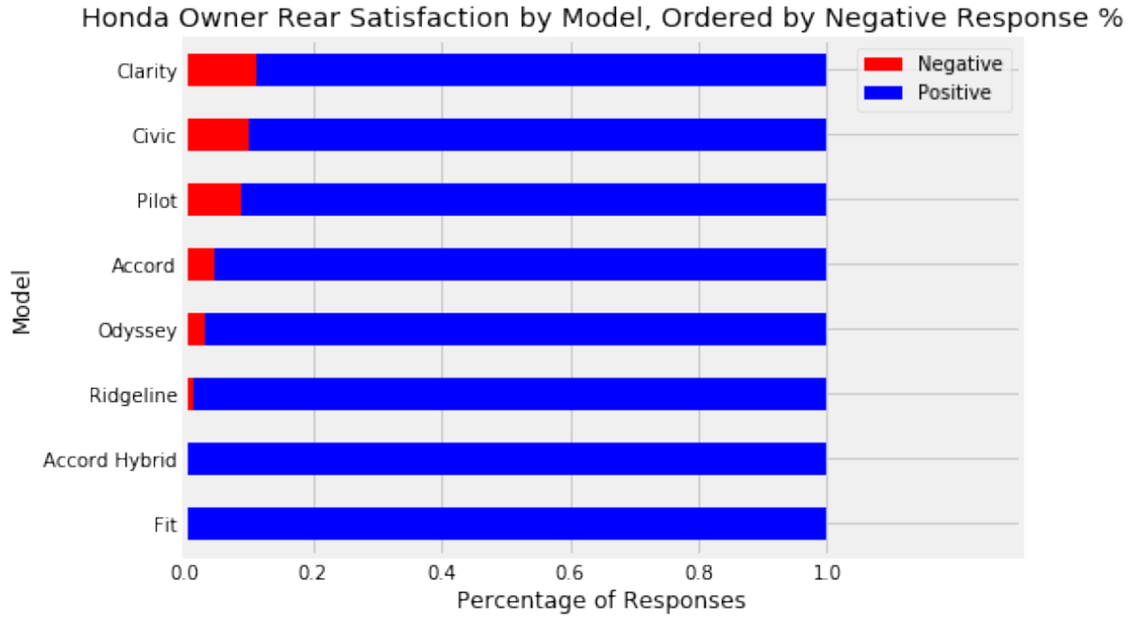
- These four models are also among the five most frequent Honda models

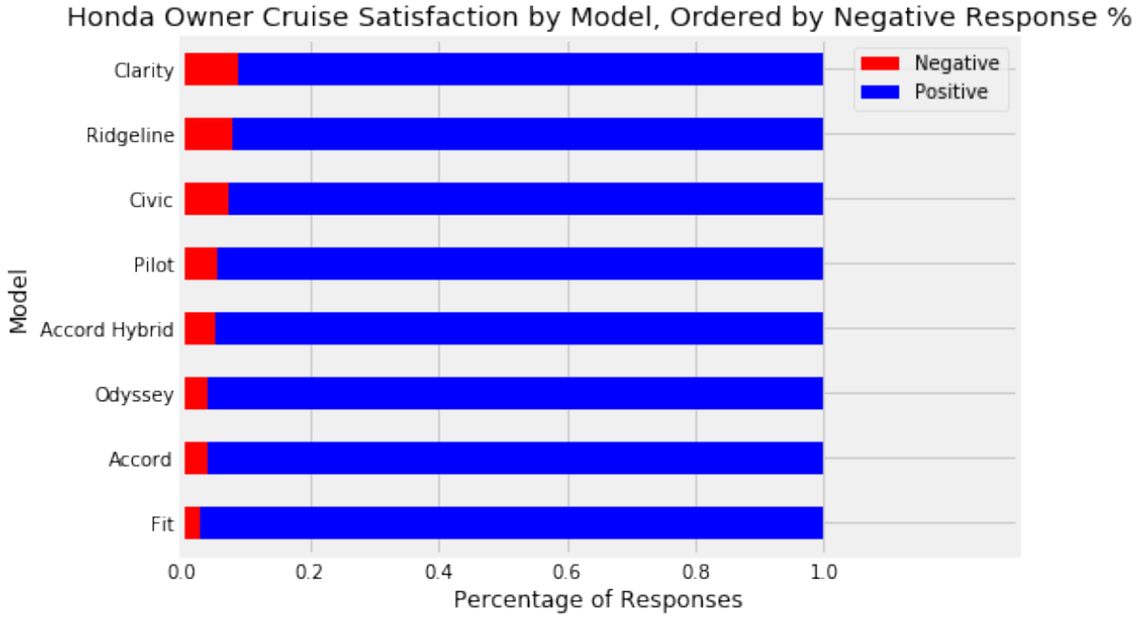
- **Ridgeline** and **Pilot** have at least 15% and 10% reported negative experiences with Lane Departure Warning and Front Collision Avoidance systems, respectively



A Deeper Look Into Honda (Part 2)

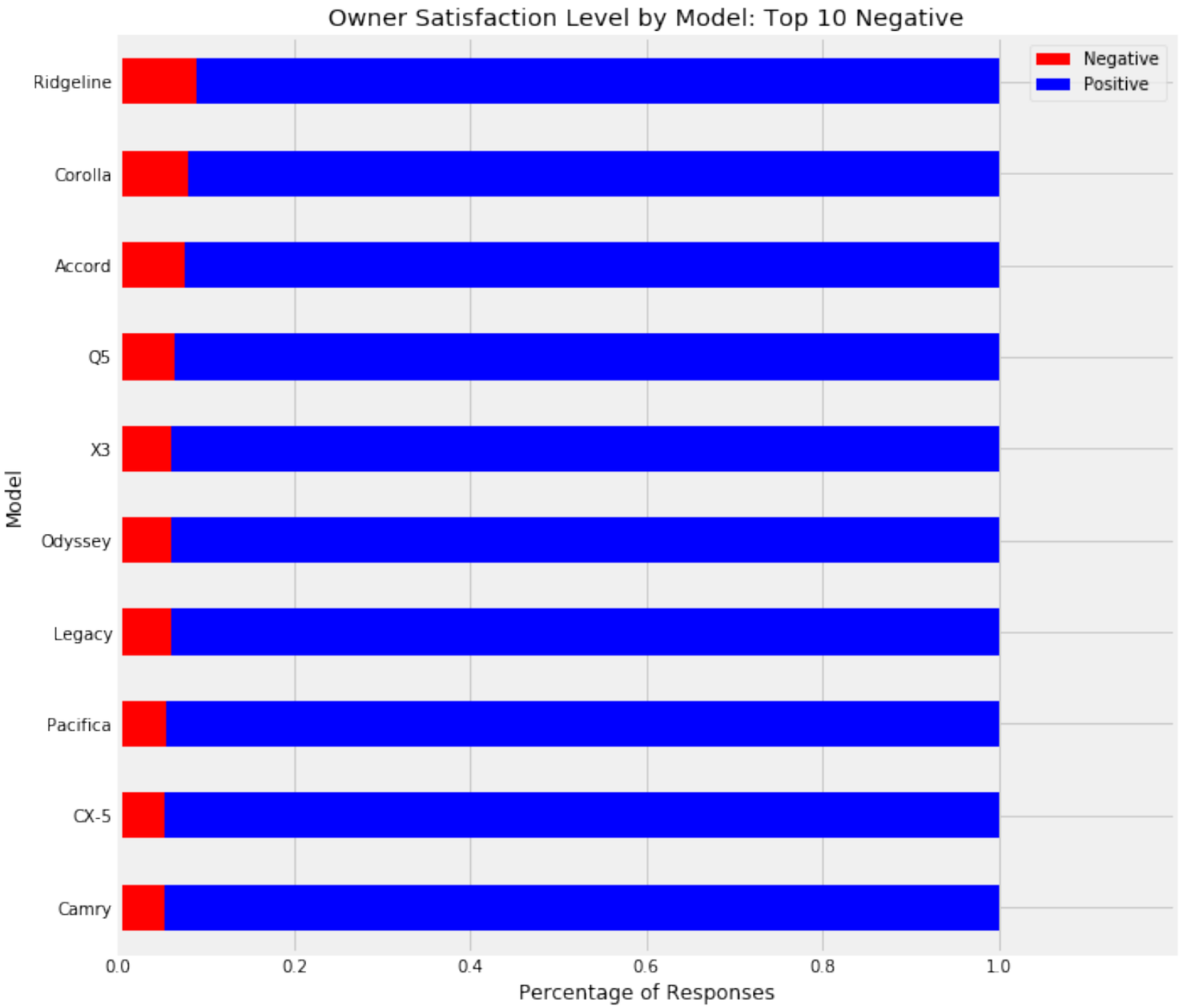
- Clarity and Accord Hybrid also accounted for the highest percentages of reported negative experiences with specific ADAS types
- **Clarity** leads for **3** systems:
  - Rear Collision Avoidance
  - Blind Spot Monitor
  - Cruise Control





Satisfaction Level by Models (Part 1)

- Aggregating over all ADAS types, **Toyota Corolla** clearly leads in reported negative experiences, aside from Honda models
- Corolla has the highest percentages of reported negative experiences (over all models) with:
    - Blind Spot Monitor (33.3% negative)
    - Cruise Control
- Corolla also has frequently reported negative experiences with:
    - Lane Departure Warning (7th highest, 5th aside from Honda models)
    - Rear Collision Avoidance (4th highest, 3rd aside from Honda models)



Satisfaction Level by Models (Part 2)

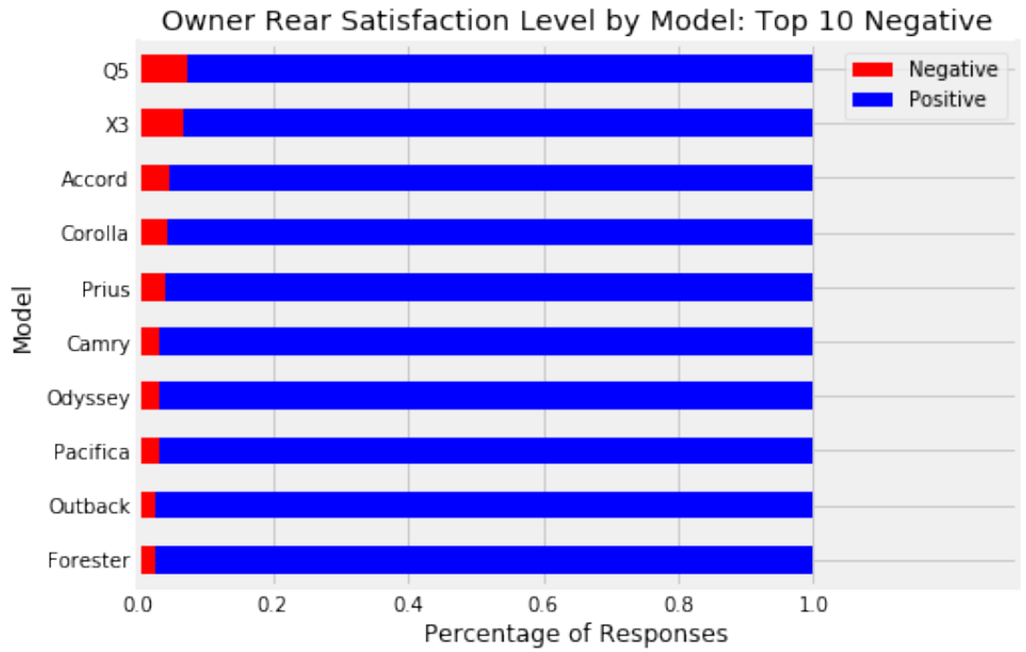
- The 2 non-Honda models following the Toyota Corolla in reported percentage of negative experiences, Audi Q5 and BMW X3, also have among the highest percentages with specific ADAS types

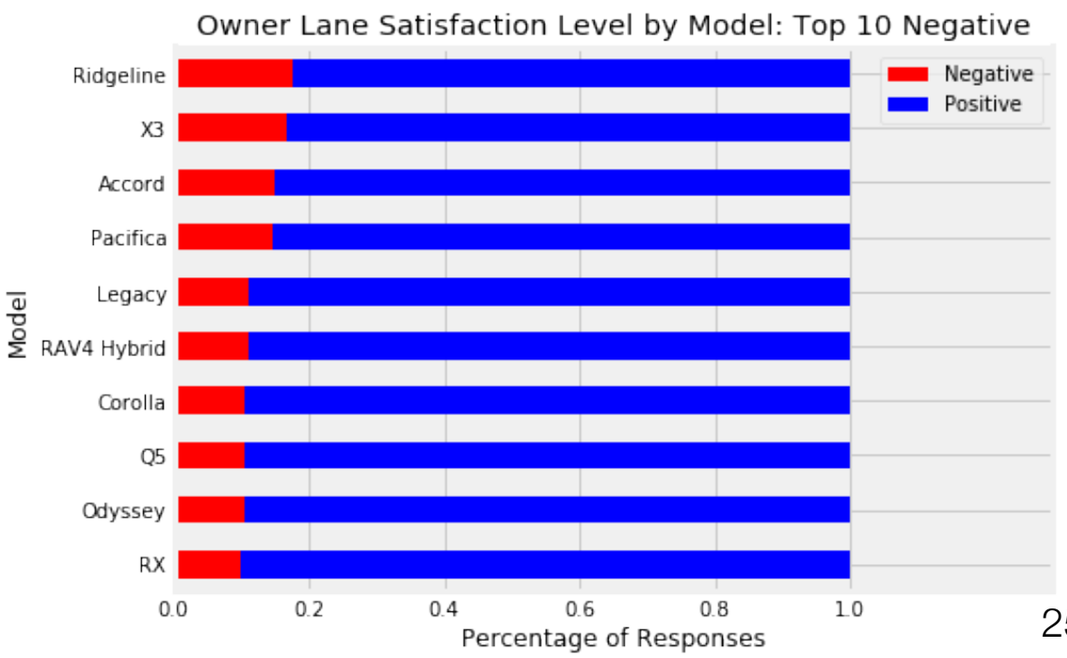
- Q5 and X3 have the two highest reported percentages of negative experiences with Rear Collision Avoidance

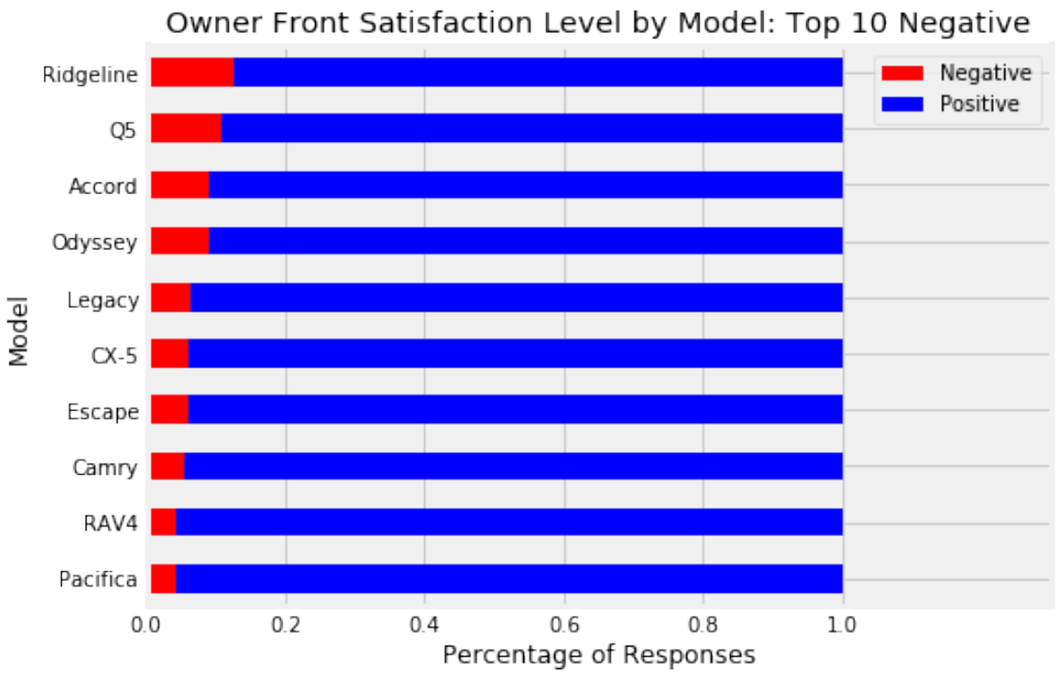
- Besides Honda Ridgeline, the highest reported percentages of negative experiences belong to:

  - X3 for Lane Departure Warning

  - Q5 for Front Collision Avoidance







Summary & Conclusions

- In general, respondents overwhelmingly reported positive experiences with all ADAS types/ variants (Lane Departure Warning with the highest reported negative experiences)

- More negative experiences were reported for system variants with lower levels of automation for Lane Departure Warning, Front Collision Avoidance and Rear Collision Avoidance systems

- Positive feedback emphasized systems' effective alerting through multiple channels (and not just singularly visual or audible, though generally audible > visual), additional situational awareness, and support in common use cases

- Negative feedback emphasized systems' incidence of false alarms, intrusiveness, interference with normal car operation, or limitations in utility

- Among specific car makes, respondents reported more negative experiences with Honda — especially the Ridgeline, Pilot, and Clarity models

- Other models with systems eliciting higher negative feedback include: Toyota Corolla, Audi Q5, BMW X3

Limitations and Next Steps

- Some information may be lost in combining the satisfaction/dissatisfaction levels:
  - No “Neutral” satisfaction level
  - “Somewhat satisfied” and “Somewhat dissatisfied” may be more similar to one another than “Very satisfied” and “Very dissatisfied,” respectively
  - May observe additional patterns in responses to ADAS types and variants
- Could also get more insight looking at all makes and models (as observed when looking deeper into Honda models)
- Potential directions to extend the current analysis with:
  - Similar analysis with original satisfaction levels or just the “Very” levels
  - Conversion of original levels to point scale for more rigorous statistical analyses
  - More involved text and make/model analysis including breaking down text responses according to make, model and ADAS type/variant

Thank You!