



#635



In-car HMI UX Evaluations

In-Car HMI UX Evaluation & Benchmarking

Acura ZDX

In this edition, our UX experts test the 2024 Acura ZDX, the Honda brand's first battery-electric vehicle. It is also the first vehicle by Acura to feature Google built-in, which provides native versions of Google Assistant, Google Maps, and the Google Play store. These apps and more are hosted across the EV's two interior screens - an 11-inch Precision Cockpit Driver Information Cluster, and an 11.3-inch Center Information Screen.

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Scoring

- > **Features and functionality:** evaluating whether the solutions provide features that customers expect, need and solve problems (or provide a wow factor).
- > **Reliability/stability:** evaluating the repeated usability and whether the users can have a similar (positive) experience each time.
- > **Usability:** evaluating whether the features available are easy to learn and use. This considers areas such as ergonomics, legibility, usability characteristics and how the system implements the various features.
- > **Perceived quality:** evaluating the potential perception in quality of the HMI components and how this contributes to the overall customer experience.

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Introduction



Report Introduction

Welcome to the 2024 HMI benchmarking report series. This report has been created to provide a fair, unbiased and objective view of the latest in-vehicle HMI solutions in the US, European, and Chinese markets. Evaluations are carried out by SBD usability experts with a deep understanding of CASE domains such as the Connected Car and ADAS & autonomy domains.

SBD supports clients throughout the development of new HMI and products from a relatively simple companion app to a more complex multi-domain infotainment solution. The methodologies used in these reports take into account many years of experience with consumer testing and custom client projects to provide a fair and, as much as possible, objective methodology.

All viewpoints and analysis within the report are aimed defining areas of concern through a data driven approach. This report aims to benchmark and score solutions whilst also being able to provide actionable recommendations to design and development teams.

Please note that due to the ever-evolving automotive technology market, SBD updates it's methodology each year, but does not update scores from the previous years. Therefore, please assume a slight drop in scores for both user experience (UX) and functionality from the previous year.



Intuitive



Supportive



Flexibility



Consistency



Brevity



Depth



Presentation

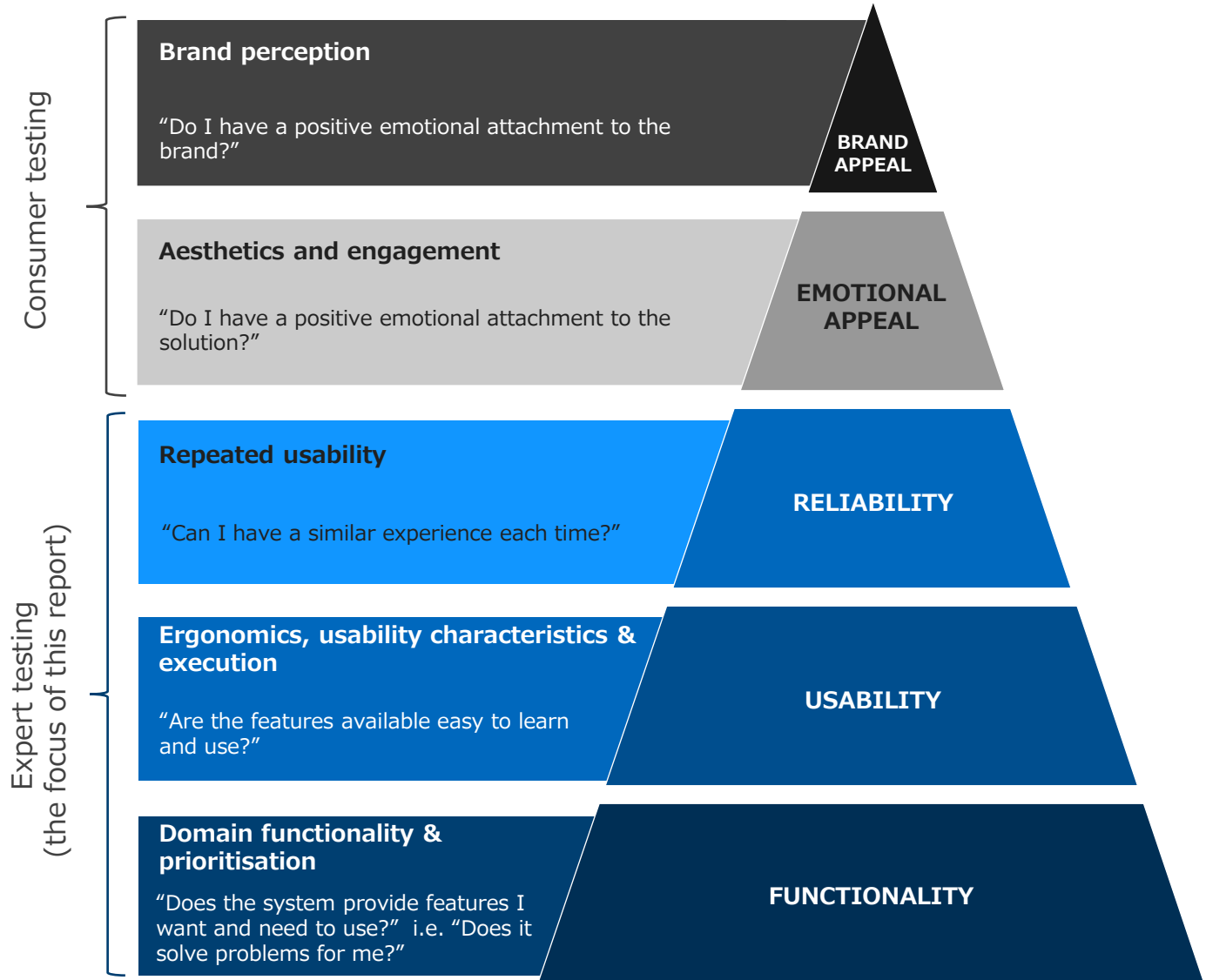
Section	Content
Birds Eye View	An overview of the key findings from SBD's various CX related and adjacent reports.
Executive Summary	Presents key highlights and conclusions from the report.
The Basics	What do you need to know about SBD's CX evaluation methodology?
Analysis	Analysis of report findings by SBD experts.
Features and functionality	Overview of key features and functionality by domain.
Execution	Assess success of implementation and overall execution of various system elements.
Perceived quality	Scoring and analysis of interior perceived quality levels.
ADAS domain	Highlight and analysis of key positive and negative points within the ADAS domain.
Infotainment domain	Highlight and analysis of key positive and negative points within the infotainment domain.
Navigation domain	Highlight and analysis of key positive and negative points within the navigation domain.
Voice recognition domain	Summary and scoring of various aspects of the voice recognition system.
Convenience domain	Summary of various convenience focussed features.
Future Outlook	Seven UX principles are considered against drivers and barriers into the future of this reports test vehicle.
Next Steps	Can SBD help you with any unanswered questions?



Aim of this report

One of the core goals of these studies is to provide a true indication of what the final customer experience of each solution could be. To do this evaluations are focused on providing scoring and analysis in the following areas:

- **Features and functionality:** evaluating whether the solutions provide features that customers expect & need, and solve problems (or provide a wow factor)
- **Usability:** evaluating whether the features available are easy to learn and use. This considers areas such as ergonomics, legibility, usability characteristics and how the system implements the various features
- **Reliability/stability:** evaluating the repeated usability and whether the users can have a similar (positive) experience each time
- **Perceived quality:** evaluating the potential perception in quality of the HMI components and how this contributes to the overall customer experience



SBD's view on the hierarchy of needs for CX benchmarking



Scope of report: focus on in-car HMI evaluations

The scope of evaluations in this report are constrained to the in-car HMI experience, in both static and dynamic conditions. One notable element is driver distraction which SBD covers at only a high level in this study as carrying out a full driver distraction evaluation requires biometrics test equipment to ensure the collected data is unbiased and objective.



A full evaluation of the end-to-end customer experience is not within scope of this report, but it is something which SBD has many years experience in from both a consumer and expert perspective. Other areas such as the companion app, online portal and in-home smart devices are not in scope as they are defined as “out of car” experiences.

Within the vehicle, any HMI element the user interacts with is evaluated including steering wheel controls, touch screen displays, voice control, HUDs and digital keys. The features and services on offer have been broadly grouped into the following domains (or test areas):

- ADAS domain
- Infotainment domain
- Navigation domain
- Voice recognition domain
- Convenience domain





2024 vehicle list

SBD has chosen nine cars to evaluate in 2024, based on two selection categories. New/interesting UX focuses on systems with to never-seen-before features or functionality, or the implementation of a solution that has previously been a challenge or pain-point for end-users. New mass-market UX includes vehicles in segments that are sold in high numbers and are entering a new generation of UI for that vehicle. While we make best efforts to adhere to the chosen cars and schedule, the last two years have seen release dates slipping significantly, so it may be necessary to make substitutions.

Group A

Cars tested



BMW X1

- First BMW to be released with iDrive9
- Android based system
- US market test



Mercedes-Benz E-Class

- All-new MBUX Superscreen
- Unique features, apps and games
- German market test



Lincoln Nautilus

- BlueCruise hands free
- Digital Experience
- All-new infotainment system
- US market test



Hyundai KONA Electric

- 12.3-inch cluster and central display
- New Bluelink+ services
- US market test

Priority target vehicles



Polestar 4

- New IVI
- SEA Platform
- Absence of rear window
- EU market test

Group B

Cars tested



Xiaomi SU7

- Xiaomi's first vehicle offering
- New vehicle from CE company
- Xiaomi Pilot MAX
- Chinese market test



Acura ZDX

- Google Built-in
- AcuraWatch 360+ with hands free cruise
- US market test

Other vehicles being considered for 2024



Audi Q6 e-tron

- All-new "Digital Stage" infotainment system
- AR HUD integration
- EU market test



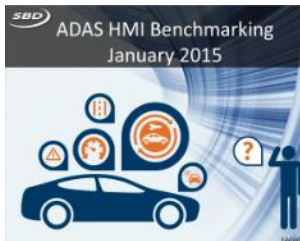
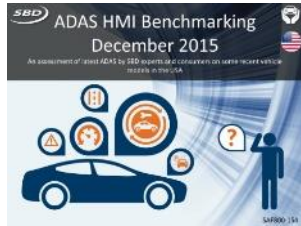
Avatr 12

- Harmony 4.0 OS
- Huawei ADS 2.0 (ADAS)
- Innovative displays
- Chinese market test



SBD experience through years of testing in-car solutions

Over the last ten years SBD has evaluated over 100 solutions from a Connected Car or ADAS perspective for our public report series (many more for private client evaluations). This current report series is an evolution of both test methodologies to provide a holistic view of in-car HMI. Furthermore, custom evaluations methodologies used across the globe for SBD clients have been included where applicable to enhance to overall approach.





One page methodology overview

One of SBD's core goals of this report is to be as objective, fair and as transparent as possible. To achieve this, various methodologies are used throughout the testing to evaluate different areas of the solution in various conditions.

These methodologies are a mix of different types of tests:

- **Objective tests:** where the value provided is not influenced by a tester's viewpoint e.g. response time
- **Subjective tests:** the test score is based on the expert testers' viewpoints e.g. task ease of use
- **Task-based:** evaluations carried out based on a predefined task list e.g. navigate to a pizza restaurant near location X
- **Freeform:** random free testing by the tester with no clear pre-defined task list. This allows the testers flexibility to dig deeper into various parts of a solution when needed
- **Scoring range:** ranges and definitions of how to score a test element e.g. poor depth and accuracy score = the results provided are not in line with what is reasonably expected by the user
- **Static:** tests are carried out when the vehicle is not moving
- **Dynamic:** tests are carried out when the vehicle is moving in various road conditions and locations e.g. motorways/highways, cities, villages, country roads etc.
- **Misuse/failures:** carried out to evaluate the stability of the solution in unusual conditions e.g. repeatedly pressing the voice command button

This document does not provide a detailed description of the methodology and this page serves to provide an overview of the approach.

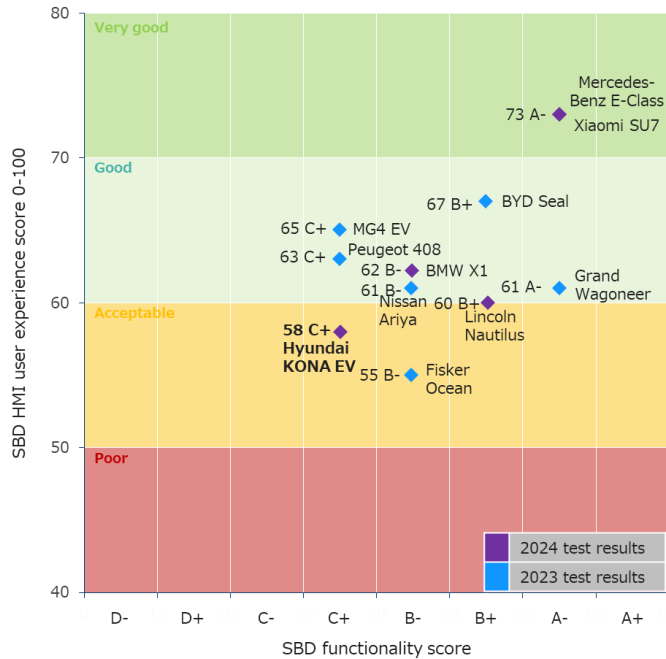
For a detailed discussion and presentation of SBD's methodology please [contact us](#).

Test area	Type of tests							
	Objective	Subjective	Task based	Freeform	Scoring range	Static	Dynamic	Misuse/failures
First impressions		✓		✓		✓	✓	
Static tasks	✓	✓	✓		✓	✓		
Dynamic tasks	✓	✓	✓		✓		✓	
Random free	✓	✓		✓		✓	✓	✓
Navigation specific tests	✓	✓	✓		✓		✓	✓
Voice recognition	✓	✓	✓	✓	✓	✓	✓	✓
Performance & response	✓		✓			✓	✓	✓
System Usability Scale (SUS)		✓			✓			
Final SBD UX score	✓	✓			✓			
ADAS	✓	✓	✓		✓	✓	✓	
UX heuristics	✓		✓			✓	✓	
Execution		✓			✓			
Ergonomics	✓	✓	✓			✓	✓	
Legibility & readability	✓		✓			✓	✓	
Perceived Quality (PQ)	✓	✓	✓	✓	✓	✓	✓	



Report structure and how to interpret certain data sets

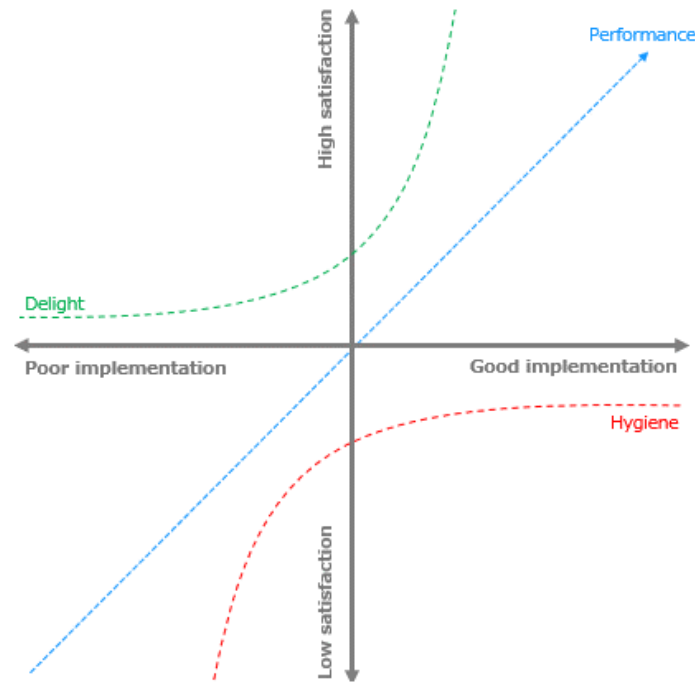
Throughout the testing and evaluation process SBD uses multiple methodologies to align to the situation and test area. Outputs from these evaluations can be broadly grouped into the following three types of report outputs - SBD's goal with these options is to ensure understanding of the results are as clear and fair as possible.



UX & functionality score

Final usability scored based on a 100-point scale with solutions scoring less than 40 defined as "not fit for purpose" with major user complaints expected and score above 80 defined as "exceptional".

Functionality score based on eight core feature set areas: delight features, performance features, hygiene features, navigation feature, ADAS, IoT integration, music, entertainment and info features.

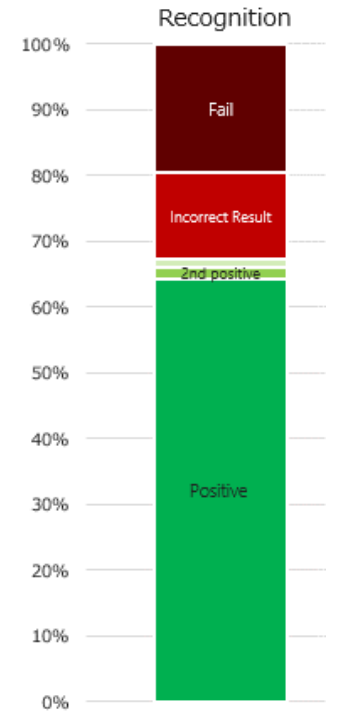


Modified Kano feature analysis

Features plotted against three lines based on their implementation and satisfaction levels:

- **Delight** features: "wow" features likely to provide high satisfaction even with poor implementation
- **Performance** features: as the level of implementation increases so does the customer satisfaction
- **Hygiene** features: poor implementation provides low satisfaction, but good implementation may not provide positive satisfaction as it can be considered as expected functionality

UX heuristic	Score
Cockpit clutter	Good
GUI clutter	OK
Display quality/size	Good
Map aesthetics	Very good
Map layout	OK
Navigation routing	OK
Instrument cluster	Good
General system HMI	OK



Subjective & objective scores

Scoring across multiple areas through subjective scoring with pre-defined ranges, definitions, and comparison to past results.

Objective scoring generally based on a pass/fail criteria or time-based considerations. SBD attempts to minimize subjectivity as much as possible with results aimed at being fair and reasonable with a minimal level of bias.



Example slides from the report

This block represents an example slide from a report. It features a dark-themed photograph of a car's interior, showing the steering wheel with the Acura logo, the dashboard, and the center console. Below the image is a dark blue banner containing the SBD logo on the left and the text 'In-Car HMI UX Evaluation & Benchmarking Acura ZDX' on the right. At the bottom of the slide is a prominent blue button with the text 'Request price' and a white right-pointing chevron symbol.



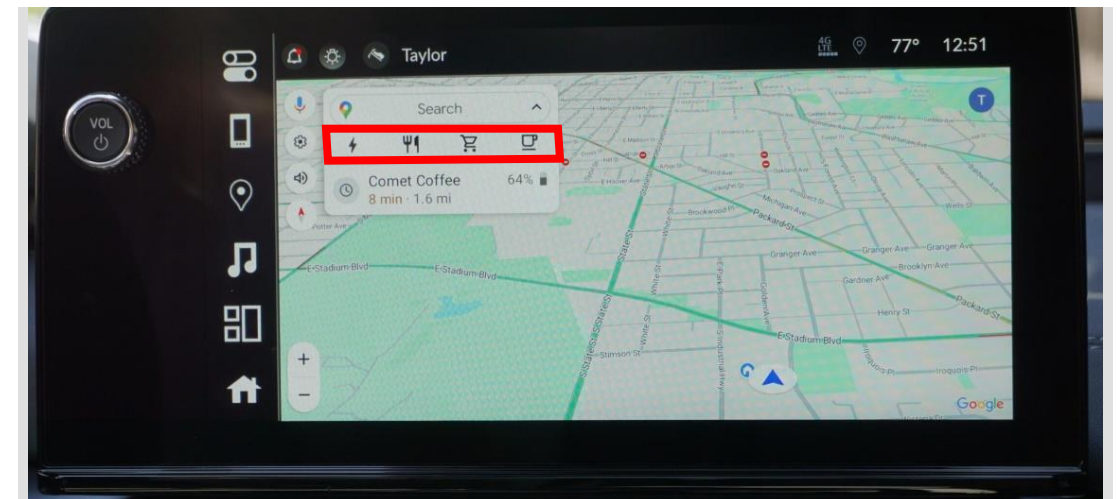
Google Built-in UX similarities across OEMs

Google's control over many aspects of the overall UX

- Now that more systems with Google Built-in have been released into the market and evaluated, some similarities, both good and bad, across OEMs have surfaced.
- Similarities include:
 - Positives:
 - Ability to expand features and functionality with the Google Play Store
 - Good search logic for Google Maps
 - Very familiar UX to CE world for most users
 - Level of depth for POIs in Google Maps, to offer contextual notifications
 - Negatives
 - Frequent stability/bug issues experience with Google Assistant
 - Minimal POI categories offered by Google Maps
 - Google Assistant doesn't always recognize other input methods
 - Google Maps saved/favorited destinations categories is implemented poorly and confusing/unintuitive
- As more systems with Google Built-in are released and evaluated, and these similarities continue, it shows and confirms how much power Google holds in the overall user experience of the vehicles system. Therefore, the important thing for OEMs with Google Built-in in their vehicles to do is find ways outside of the Google features to stand out, like ADAS, radio and phone implementation.

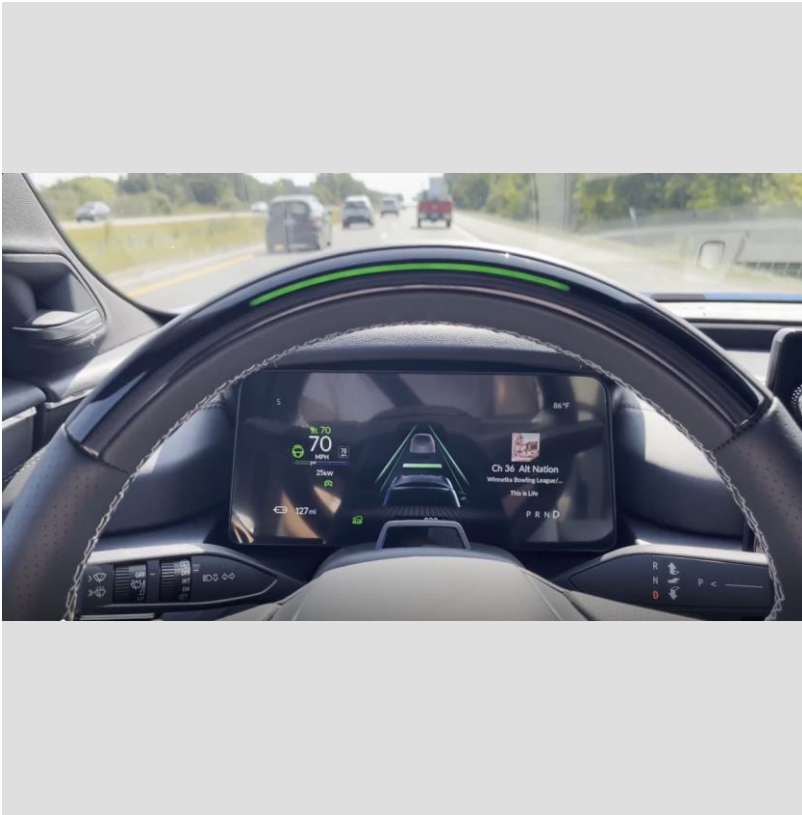


Google Play Store with familiar UX as the CE world and ability to expand system content



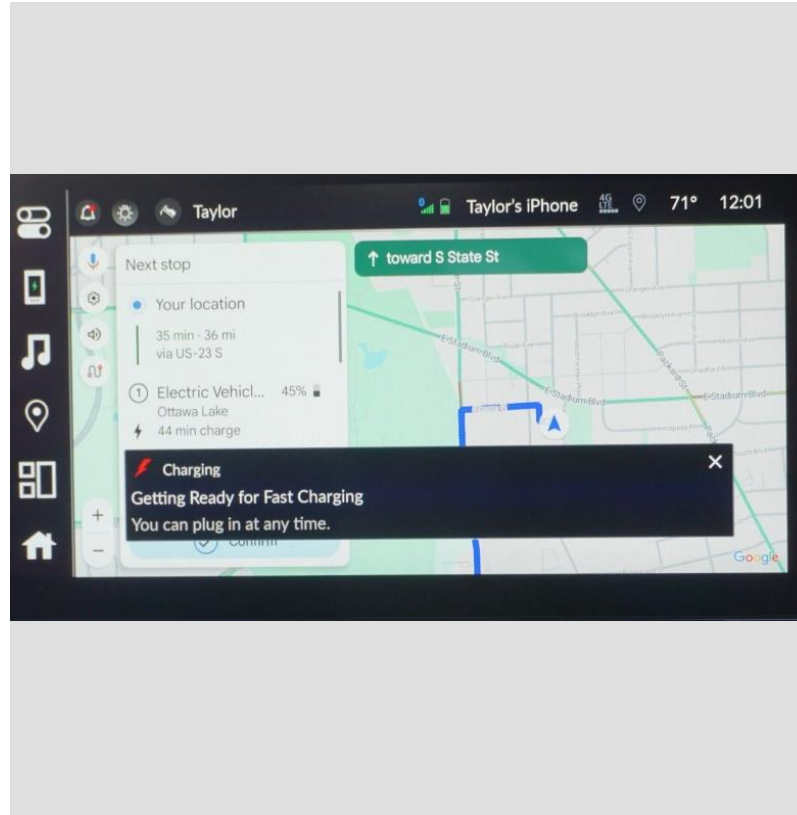
Limited POI categories offered without the ability to customize

Comprehensive ADAS and EV features with a familiar user experience



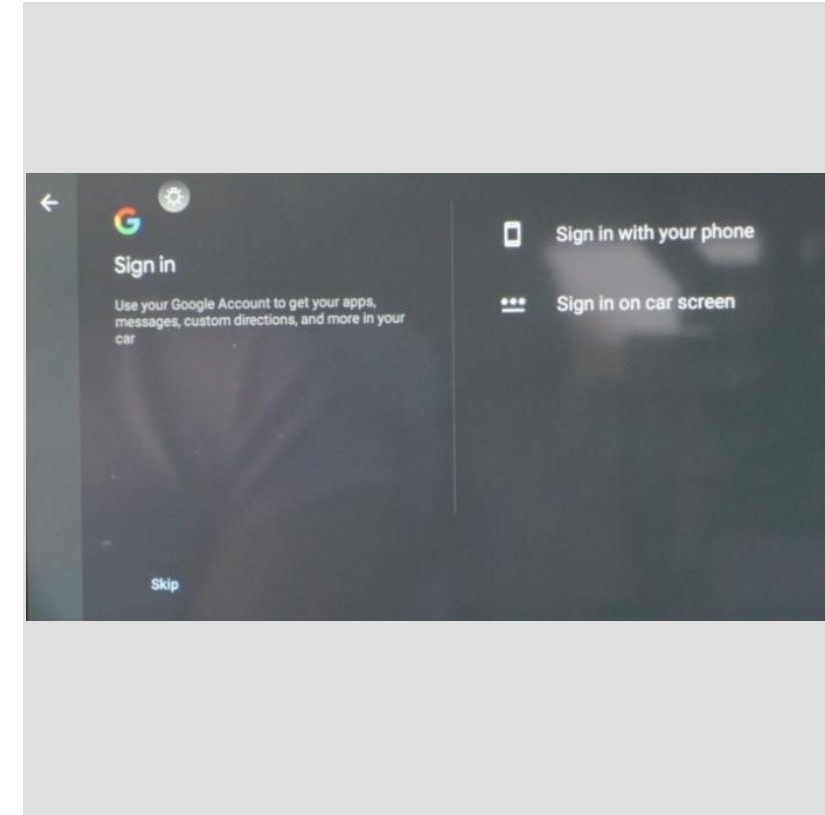
Rich ADAS feature offering

Hands-off piloted driving benefits from an integrated light bar that clearly communicates system status, along with a smooth hand-over routine for when the driver needs to regain control. The implementation of haptics enhances feedbacks across many systems, improving overall responsiveness. The RCTA is capable of distinguishing between vehicles and pedestrians, providing tailored warnings to enhance safety during reversing.



Supportive EV features

The 2024 Acura ZDX features EV-specific navigation tools like Charge Assist and route planning. When navigating to an EV charger, the system automatically preconditions the battery for fast charging and monitors the route to anticipate preconditioning needs, providing a notification when ready to plug in. The route planning also includes charging stops for destinations beyond the current range, factoring charging time into the total travel duration.



Google offers familiar user experience

Incorporating the Google ecosystem into the vehicle provides users with an experience they are already familiar with. Users can bring in their Google Account which can be used in tandem with Google Maps to carry over saved/favorited locations, recent destinations and account settings. Google Maps also offer a very similar experience in the vehicle as it does on a mobile device.



Limited delight features, voice recognition has room for improvement

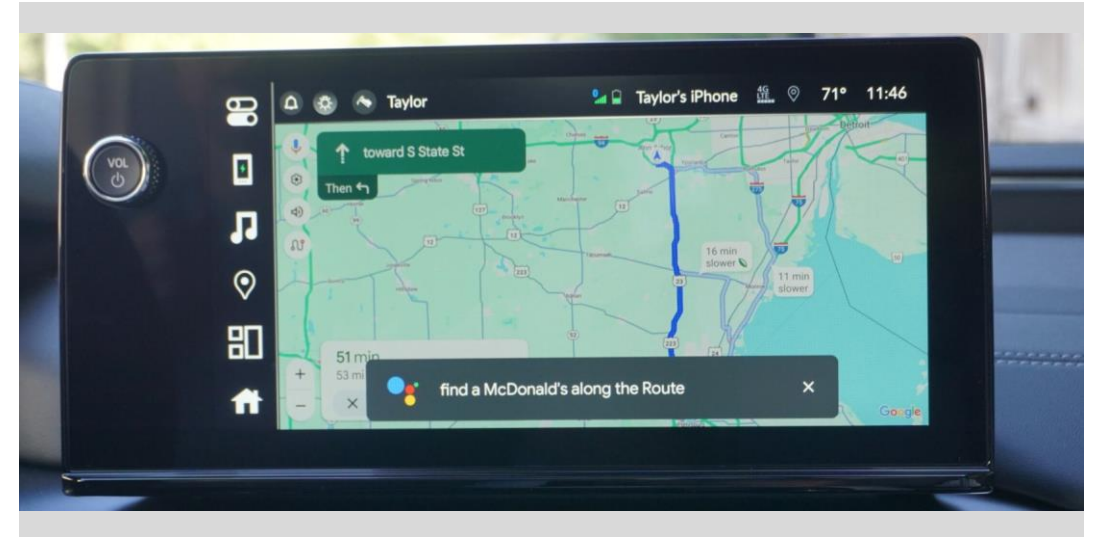
- Users are able to view current air quality inside the cabin and compare against a scale. This is offered as part of the HVAC menu in the central display.
- Users are given on-board access to the Google Play Store via the central display. From here, numerous apps and features can be downloaded and added to the vehicles system.



Google Play Store expands feature offering

By allowing access to an on-board app store via the central display as extensive as the Google Play Store, users are given the chance to expand the feature set of the vehicle in-line with their needs and expectations. It may also contribute to extending the amount of time that a vehicle appears fresh and new to a user thanks to the ability to download and remove apps, creating an ever-changing source of excitement and intrigue.

- The voice recognition system, while capable, also suffers from several issues including support and consistency related problems.
- Multiple inaccuracies are noted within the navigation system.
- Radio and media related information is missing from the head-up display.



Issues with voice recognition

Several issues are highlighted within the voice recognition system, especially relating to some UX principles used to assess the feature. It is occasionally unclear what the system is doing or if it has accepted an input or not, leaving the user confused and unsure on the next action to take. Additionally, the UI switched between two different formats throughout SBD's five days of testing. It changed on a daily basis with no clear reason as to why.

Lack of communication between VPA and other input methods

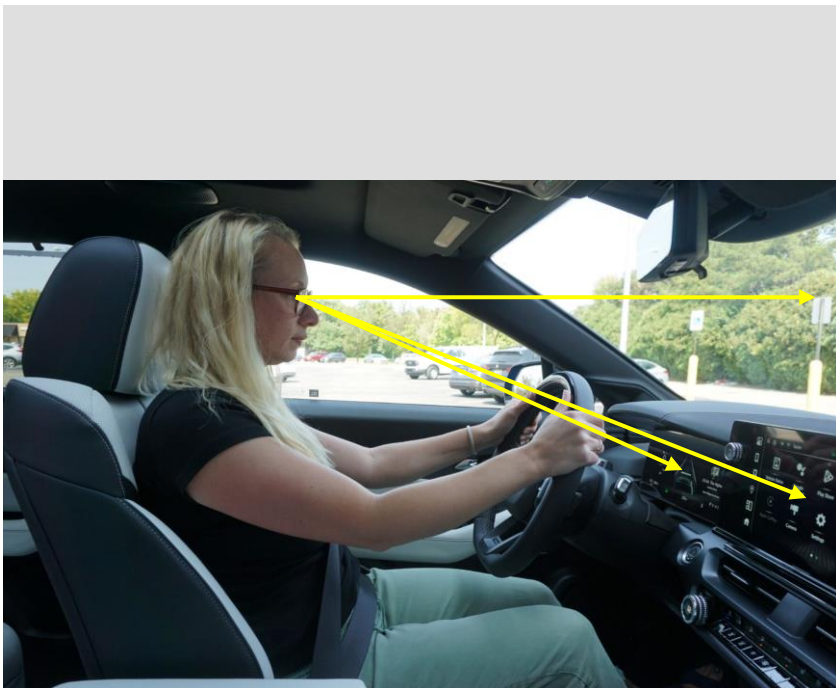
2. Voice Recognition

A list of points of interest (POIs) was provided, and the driver used the touch screen to select one of the options from this list. However, this action did not cancel the voice recognition function, as the voice command did not communicate effectively with the touch screen input.

Frequency	Low	Medium	High
Severity	Minor	Major	Critical



Readability: Display viewing angle



Both displays show some risk

Only minor issues for both displays

Central display is positioned marginally higher than the cluster

The instrument cluster is separate to the central display and is positioned lower down. The central display is positioned marginally higher at further forward into the cabin.

Both displays fall into the "Emerging risk" category. The central display is measured at 21° while the cluster is measured at 24°. Both displays score an acceptability rating of 'Concerns'.

Display	Glance-down angle	Final Rating
Central display	21°	Emerging risk
Instrument cluster	24°	Emerging risk

Display	Severity / Driver distraction Rating	Acceptability Rating
Central display	Emerging risk	Concerns
Instrument cluster	Emerging risk	Concerns



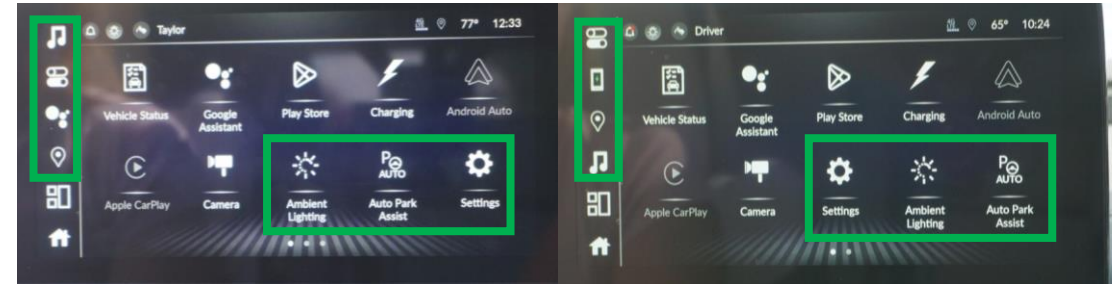
Good level of customization offered throughout

SBD viewpoint

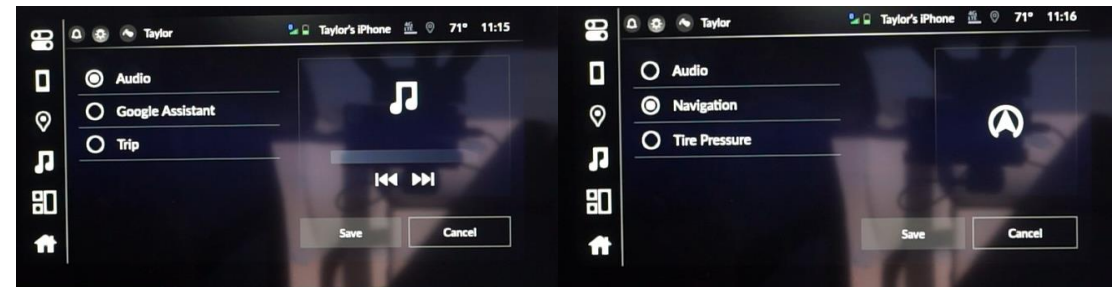
Many aspects of the system allow for customization to enable more use and support from the system individual to the user.

- Outside of the 'Home' and 'Split Screen' options, the other four options on the shortcuts bar on the driver's side of the screen can all be customized.
- The main home screens can all also be customized. The user just has to press, hold and drag on any of the icons in order to move them wherever they like, for both the home screens and the shortcuts bar.
- The split screen view can also be customized. The two tiles can be edited and there are three options to choose from for each tile.
- The instrument cluster also has three different formats to choose from, a more traditional info view, a map view, and an in-depth ADAS view, with a hard button on the steering wheel to easily switch between the different views.
- Other minor settings that can be customized include the heads-up display (HUD) and ambient lighting settings.

Many of these customizations are attached to user profiles which enables a more personal, relevant and overall positive user experience for the driver.



The marked section on the shortcut bar and all of the main screen apps offer customization.



The contents of the split screen can be customized



Positive destination arrival experience

When arriving at a destination, a pop-up will allow the user to restart the route guidance or provide feedback on the navigation.

- Once arrived at the destination, the route guidance automatically ends. In the pop-up box, a button will allow for the route guidance to be activated again with the same destination input. This is helpful if the user passes the destination without realizing it or any other reason the user needs to navigate back to the destination quickly.
- For most destinations, a street view image of the POI is shown on arrival to help indicate to the user that they've made it to the right place.
- Feedback can be provided once the route is complete. Feedback can be provided in the form of a 5-point scale measured with happiness emojis.

Offering supportive visuals of the destination and quick and useful options in an easily accessible way are a positive aspect. These options after the navigation are ended are useful because it allows the user to prevent or correct any errors made while navigating.

SBD viewpoint

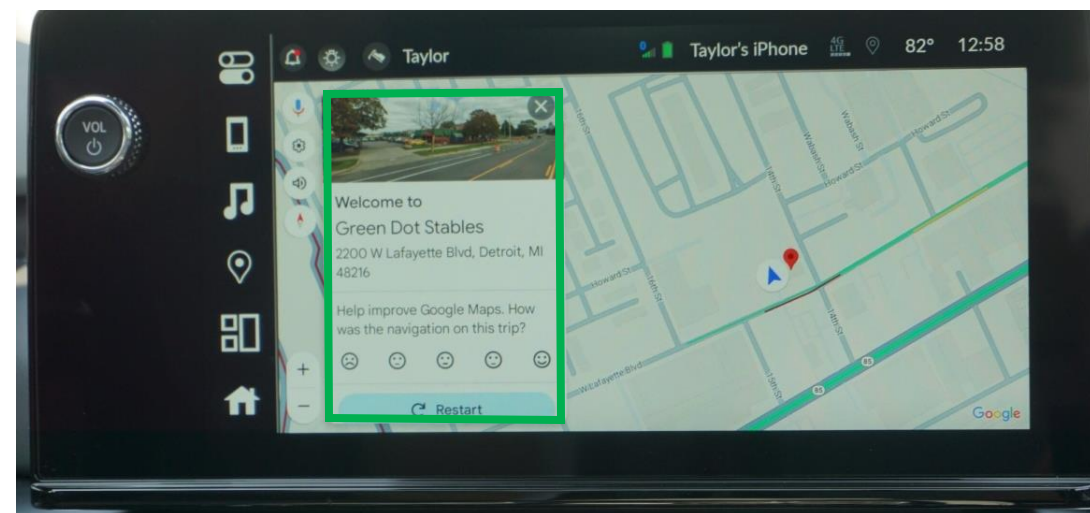
UX impact

Major negative

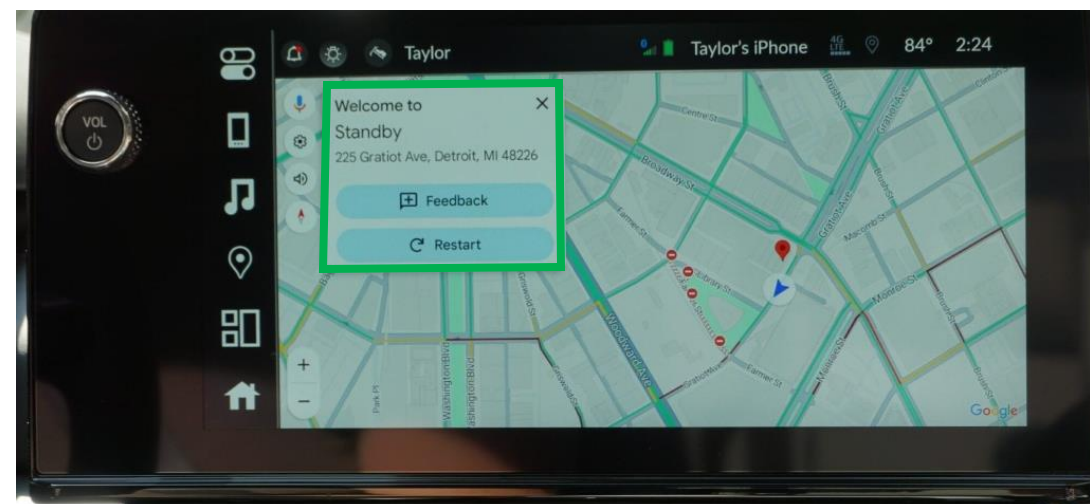
Minor negative

Minor positive

Major positive



Arrival-time notification based on the POI operating hours



Feedback and restart options are provided after navigation ends



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the full report



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