SBD

In-Car HMI UX Evaluation & Benchmarking
Lucid Air

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#635

UX
EVALUATION

In-car HMI UX
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In-Car HMI UX Evaluation & Benchmarking

Lucid Air

In this edition, the UX Team is testing the Lucid Air. As a newcomer OEM, standing out from the established incumbents is a necessary achievement. It would certainly appear initially that for Lucid's first attempt, there is very little to separate the level of effort and execution from some of the industry heavy hitters, with a very convincing impression of brand language and modern style from an OEM with no tangible established brand impressions (yet).

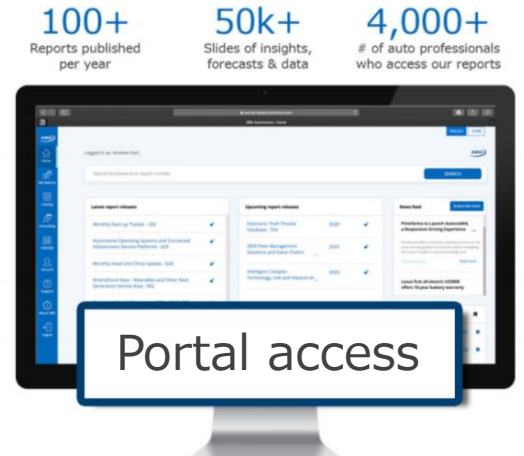| COVERAGE				FREQUENCY			PUBLICATION FORMAT				PAGES	
GLOBAL	NA	CHINA	EUROPE	ANNUALLY	QUARTERLY	6 CARS PER YEAR	PDF	POWERPOINT	EXCEL	ONLINE	170+	Request price

Scoring

> **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.

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In-Car HMI UX Evaluation & Benchmarking
Lucid Air

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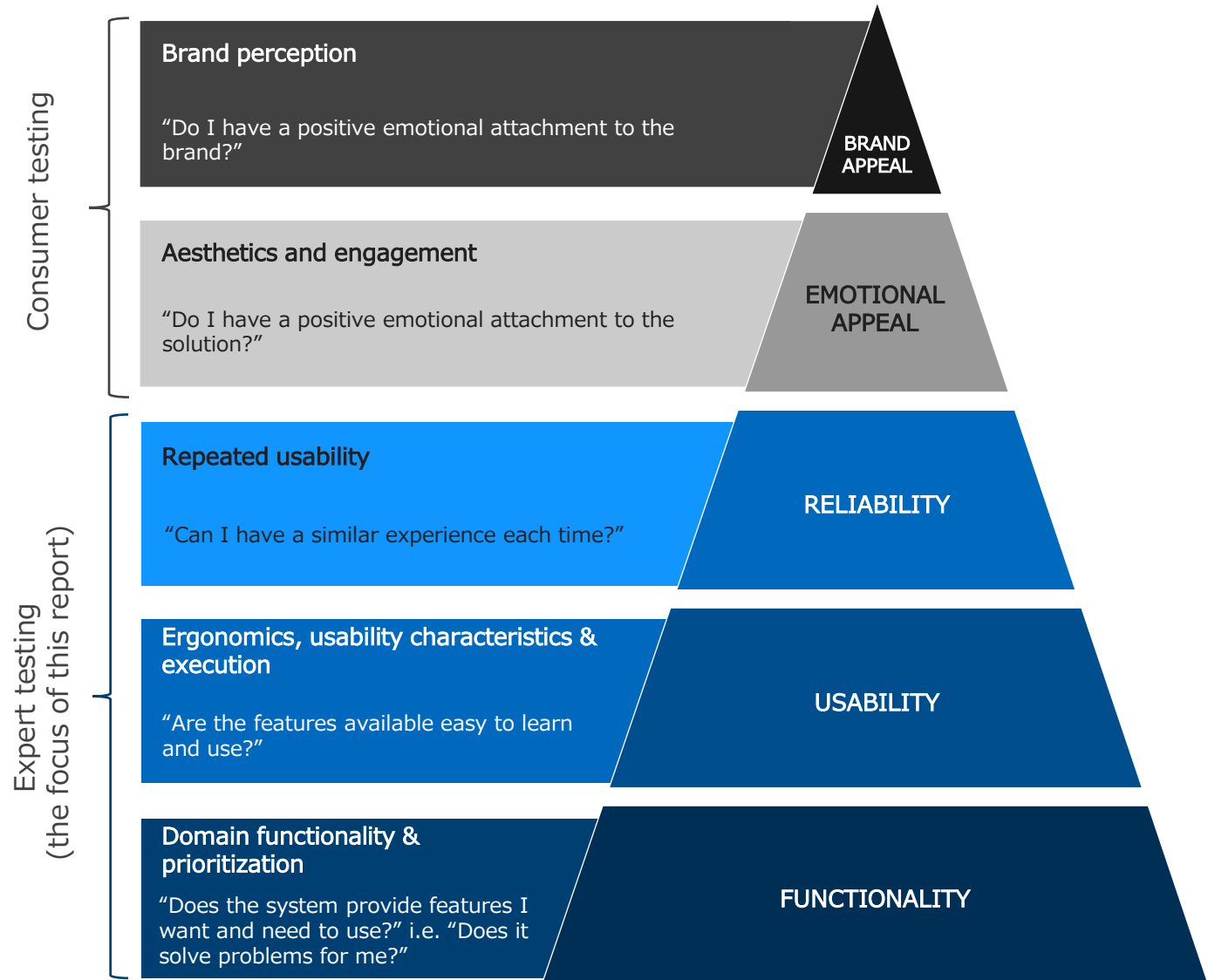Introduction

Aim of this report

Welcome to the 2021 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 European, US and Japanese 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.

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 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 while also being able to provide actionable recommendations to design and development teams.

Consumer testing

Brand perception

"Do I have a positive emotional attachment to the brand?"

BRAND APPEAL

Aesthetics and engagement

"Do I have a positive emotional attachment to the solution?"

EMOTIONAL APPEAL

Expert testing (the focus of this report)

Repeated usability

"Can I have a similar experience each time?"

RELIABILITY

Ergonomics, usability characteristics & execution

"Are the features available easy to learn and use?"

USABILITY

Domain functionality & prioritization

"Does the system provide features I want and need to use?" i.e. "Does it solve problems for me?"

FUNCTIONALITY

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.

Pre-purchase — Purchase — Activation — In-car HMI — Driver distraction — IoT
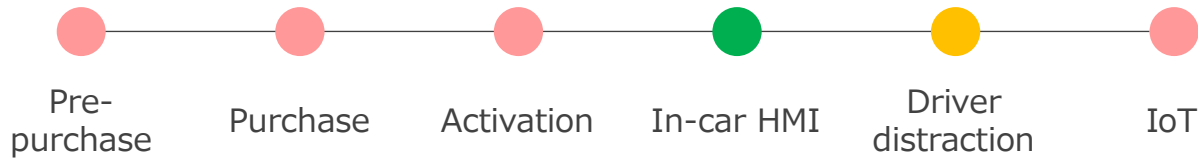
A full evaluation of the end-to-end customer experience is not within scope of this report, but it is something which SBD has may years experience in from both a consumer and expert perspective. Other areas such as the companion app, online portal and in-home smart devices are not in scope as they are 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

- Connected services domain

- Convenience domain

2022 vehicle list

SBD has chosen six cars to evaluate in 2022, 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 year has seen release dates slipping significantly, so it may be necessary to make substitutions.

Cars tested	Awaiting test				
Lucid Air	**Rivian R1T**	**Renault Megane E-Tech**	**Xpeng P5**	**GMC Hummer EV**	**Lexus NX**
• Potential disruptor • Multiple displays • US market test	• New disruptor • Appears to have an innovative approach to HMI • US market test	• LG's new Android Automotive IVI • French market test	• High level of ADAS • Advanced voice recognition • Configurable avatar • China market test	• GM's new Android OS system • Unreal Engine graphics • US market test	• New Lexus system • Cloud-based navi • New voice recognition • German market car, UK test

SBD experience through years of testing in-car solutions

Over the last nine years SBD has evaluated 94 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.
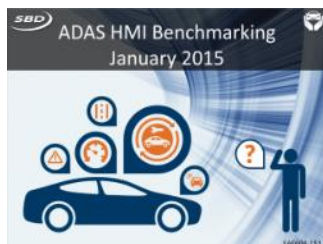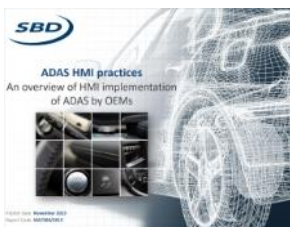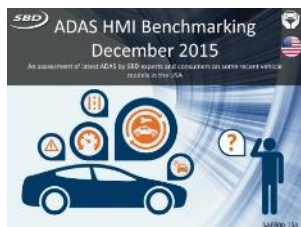
One page methodology overview

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)	✓	✓	✓	✓	✓	✓	✓	

Example slides from the full 170+ page report

In-Car HMI UX Evaluation & Benchmarking
Lucid Air

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ADAS delight features meet expectation, performance leaves room for improvement

Delight feature considerations:

- Of the Lucid Air's delight features, all were considered to be good implementations to varying success. This meant that all are expected to be noticed by users as a point of satisfaction in the overall user experience.

- Fully automatic parking assist was found to be the most satisfying of the delight features, with clear graphics displaying the current status of the maneuver and the ability to easily and directly choose between parallel and perpendicular parking.

- The stow-away Center Screen Control Panel was another delight feature that is likely to provide user satisfaction due to its versatility and offering an extended area of interaction with the system in addition to the Infotainment Display.
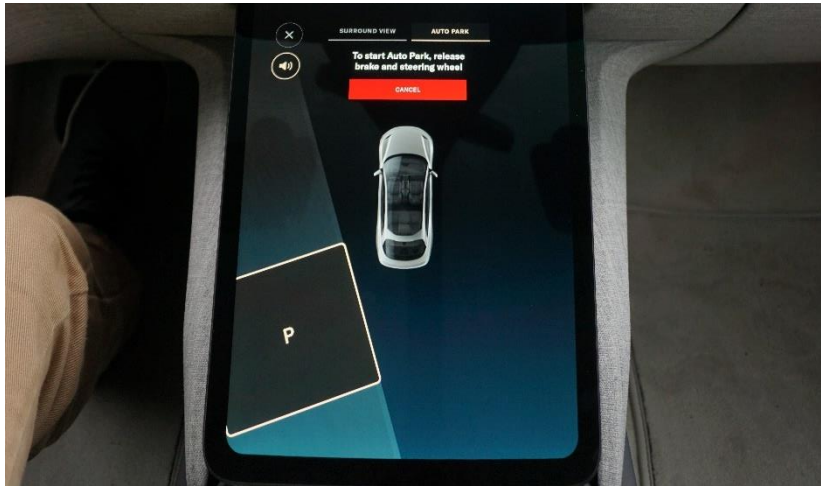

"Auto Park"

The above image shows just one example of the clear graphical representation shown while a maneuver is in progress. The feature also allows direct selection of either parallel or perpendicular orientation, providing the user with the necessary flexibility to park in their chosen alignment. This can be especially useful compared to other solutions which use parking gap size to try to determine what the orientation is, and not letting the user choose.

Performance feature considerations:

- Final destination arrival points in the navigation domain found to be lacking in detail and sometimes inaccurate in comparison to where the actual final destination is located.

- The ability to further refine POI searches by additional criteria isn't possible, mainly due to the system lacking the necessary external content (e.g. user ratings, amenities) to refine what is shown. However, users also cannot make simple refinements, such as narrowing down results in the "Food and Drink" category into popular choices like Italian Food or Coffee Shops.

- On the positive side, users do have the ability to refine where results they are searching for are found: around their current location, along a route or near their set destination. This is fairly common to find, but is nice to have available.
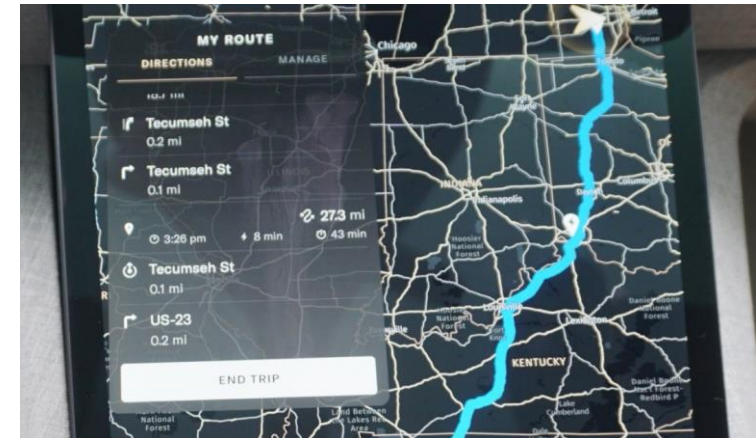
Automatic charging stop calculation

When setting a destination that is beyond the remaining range of the Lucid Air, the navigation system will automatically calculate recommended charging stops at rapid chargers along that route.

The system also includes a suggested time duration for charging at each recommended stop to optimize charging speed and provide the shortest wait times.

Alexa caused a system crash, then suffered a major outage

1. Voice recognition

Asking Alexa to play "Tidal" resulted in a system reboot (both screens went black). Once the system had fully restarted, the home page showed but no media was playing. Asking Alexa different questions repeatedly gave the response "Sorry, something went wrong". This continued for over 10 minutes until the system began working again.

Frequency	Low	Medium	High
Severity	Minor	Major	Critical

Key lowlights

Reaching the Infotainment Display requires an outstretched arm

Infotainment display reach

Users must lean forward out of their seat to operate a number of features

The infotainment display features an aspect ratio that is reasonably wide for a landscape orientation and is located floating just above the instrument panel.

While this works well for the visual appeal, it unfortunately presented reach issues in operation for SBD's testers. Important features like the core feature shortcuts are placed on the furthest part of the display away from the driver, meaning an outstretched arm with some leaning out of the seat was needed.

This naturally also applies to all of the other functions positioned on this side of the display, with content on the left-side faring marginally better for reach.

Updating the UI to make frequently accessed content available closer to the driver is one possible improvement, although this will still have a limited impact on rectifying this issue.

Perceived Quality: Tactile

| Level 1	Tactile
SBD viewpoint	**Stiffness & looseness:** Tolerances of the switchgear were considered a little looser than expected and didn't provide a remarkably high-quality feel. There was also a slight imbalance between the looseness of the steering wheel toggle rotational controls and those in the two-directional rocker type switches in the center console used for HVAC control. **Force feedback:** Overall it is fair to say that most of the feedback experienced matches the user's expectations, with only the difference in feedback strength across interfaces as potential room for improvement. **Material quality:** The tactile finish of the materials used is generally very good, but may leave users wanting for a little more if they have experience of other luxury brands. It would be fair to pitch this vehicle against a Mercedes S-Class where it is likely that the user would notice a small quality difference on some of the touchpoints like the leather used on the steering wheel. **Material harmony:** Material selection for the touchpoints is highly consistent across the vehicle interior. Taking the appearance of the satin aluminum effect switches across the interior, from the center console to the steering wheel and on to the door panel these finishes provide little-to-no perceptible difference. **Geometric & Positioning:** The physical shape and placement of the interior HMI was mostly as expected for this vehicle, with the exception of specific areas that could be improved like the placement of the main feature shortcuts on the infotainment display.

Movement tolerance was higher than expected for this vehicle

Satin aluminum finish across the interior space is highly consistent

Placement of main feature shortcuts is an opportunity for improvement related to Positioning

Level 2 scoring				
Stiffness & looseness	Force feedback	Material quality	Material harmony	Geometric & positioning
Fair	Good	Good	Excellent	Good
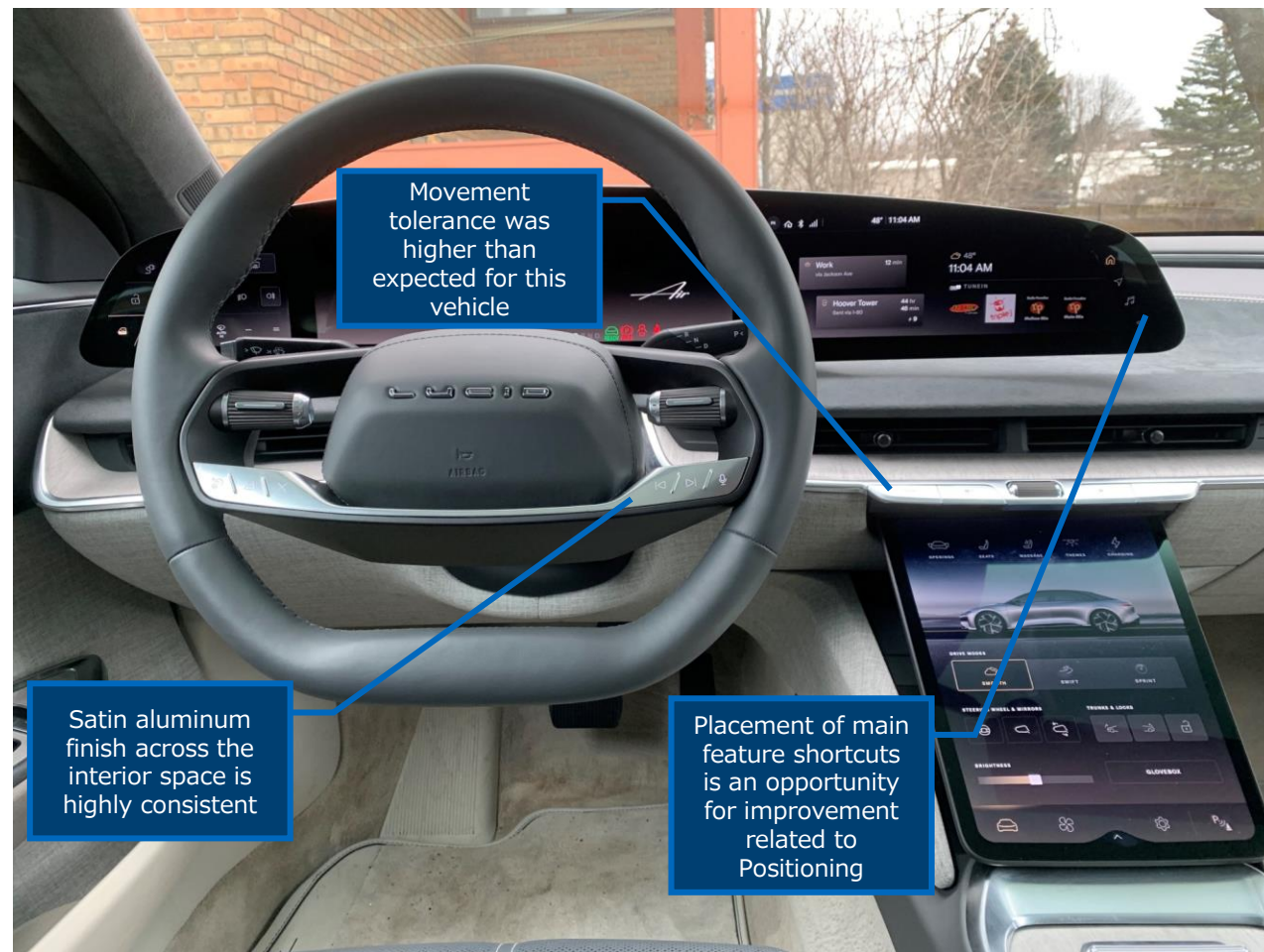
SAE Level 0 ADAS: System usage (1/2)

System usage: LKA

Visual warning during lane deviation when ACC OFF (video)

System usage: BSM

Directional warning in instrument cluster in red

System usage: RCTA

Directional visual warning in infotainment

System usage: LKA

Visual warning during lane deviation when ACC OFF in instrument cluster

System usage: Blind Spot Display

Icon flashes warning in amber when turn signal active, a different color than in instrument cluster
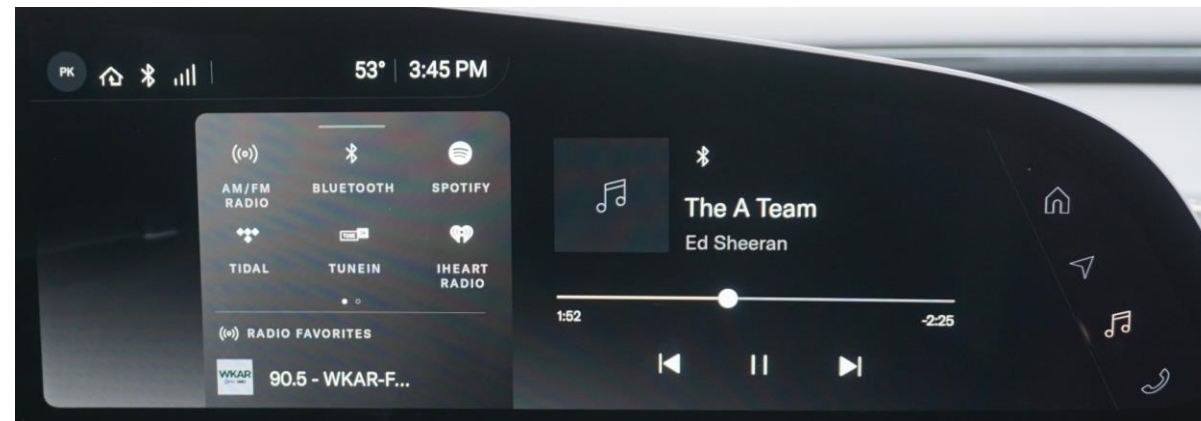

System usage: RCTA
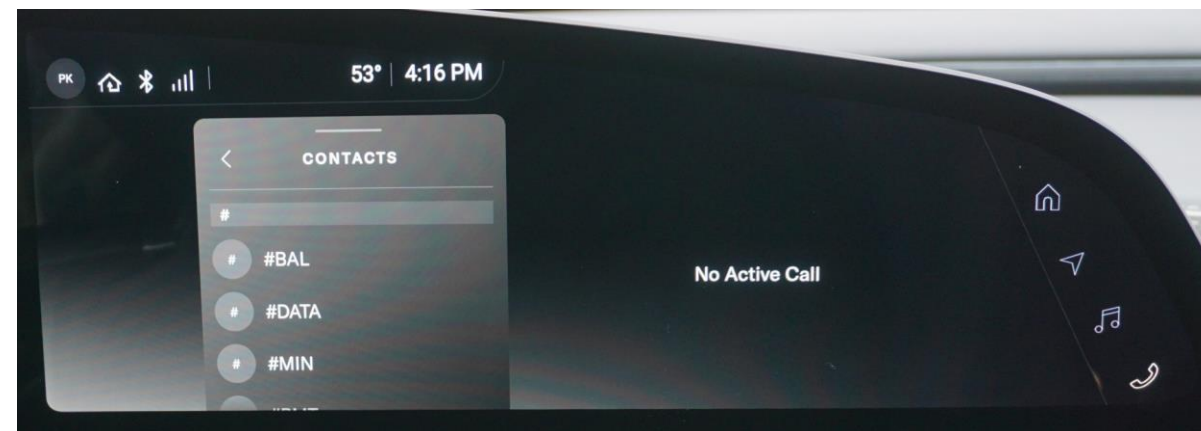
Directional visual warning in infotainment

Limited functionality in infotainment display

Category	Infotainment Display
Description	Media & phone functionality limited if reliant on infotainment display
SBD viewpoint	The infotainment display works effectively most of the time for the majority of infotainment tasks, except notably does not offer a keyboard for typed inputs. • Where search inputs are needed, the keyboard is presented on the center screen control panel. If the center screen control panel is currently in stow-away position, the panel will automatically slide out. • Using the center screen control panel can potentially increase distraction significantly due to its positioning. • The infotainment display by itself offers most media functionality that the center screen control panel offers, except for certain tasks such as typing in searches or setting up profiles. With the center screen control panel available, this is less of a concern as users will simply use this input method. However, during testing, SBD encountered a problem where the center screen control panel stowage mechanism stopped working. If the screen became stuck in the stow-away position, this would cause significant issues.

Control tab required significant scolling

Upon selecting search bar, keyboard displays in center screen control panel below

UX impact	Major negative	Minor negative	No impact	Minor positive	Major positive

Steering wheel radio controls behave unexpectantly

Category	Infotainment
Description	Radio/media steering wheel control operation is unexpected
SBD viewpoint	The steering wheel controls for radio/media do not follow expected performance criteria. • Using the control functions only permit the user to change between next available station and not switch between presets. • A short press vs a long press of the controls does not alter the functionality as with some other systems e.g. for seek functionality. Overall, the system to control the radio functionality through the steering wheel could be made clearer and more comprehensive. Although essential basic functionality is provided, there is a chance that a user may be let down if coming from a previous system that offers more functionality.

Steering wheel media controls behaved in unexpected ways

UX impact	Major negative	Minor negative	No impact	Minor positive	Major positive

18

Intuitive and clear infotainment display

Category	Infotainment
Description	Intuitive home menu structure on infotainment display
SBD viewpoint	Several aspects of the media home menu page are well executed with intuitive design for effective functionality. • The home menu offers a clean and functionally minimalistic layout that is intuitive to understand at a quick glance. • Conveniently placed "Home" and "Work" POIs for easy navigation selection. • Current media being played and source (Spotify, Tidal, radio etc.) • Minimal weather information showing current outdoor temperature and an icon indicating current cloud conditions (the temperature is redundant as it is shown in two locations simultaneously on the screen). • The ability to select driver profiles, open and close a garage door and current connectivity source (Wi-Fi vs LTE). These home page elements provide a modern, attractive and intuitive interface, expected to please most users.

UX impact	Major negative	Minor negative	No impact	Minor positive	Major positive

The infotainment display offers effective design elements

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Lucid Air

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Contact SBD Automotive

Do you have any questions?

If you have any questions or feedback about this research report or SBD Automotive's consulting services, you can email us at info@sbdautomotive.com or discuss with your local account manager below.

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