



SBD June 2023 In-Car HMI UX Evaluation & Benchmarking BYD Seal 635-23(23)

TABLE OF CONTENTS

Executive Summary

Introduction to this Report

Features and Functionality

Execution

Perceived Quality

ADAS Domain

Infotainment Domain

Navigation Domain

Voice Recognition Domain

Connected Features Domain

Convenience Domain

Support Areas

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#635



In-car HMI UX Evaluations

In-Car HMI UX Evaluation & Benchmarking

BYD Seal

In this edition, the UX team is testing the BYD Seal.

Overall, the system achieves a strong score in UX and a reasonable score for functionality. It manages to impress in terms of voice recognition and extensive app offerings, but is prevented from scoring higher by missing functionality and poor integration of some features.

COVERAGE



GLOBAL



NA



CHINA



EUROPE

FREQUENCY



ANNUALLY



QUARTERLY



6 CARS PER YEAR

PUBLICATION FORMAT



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POWERPOINT



EXCEL



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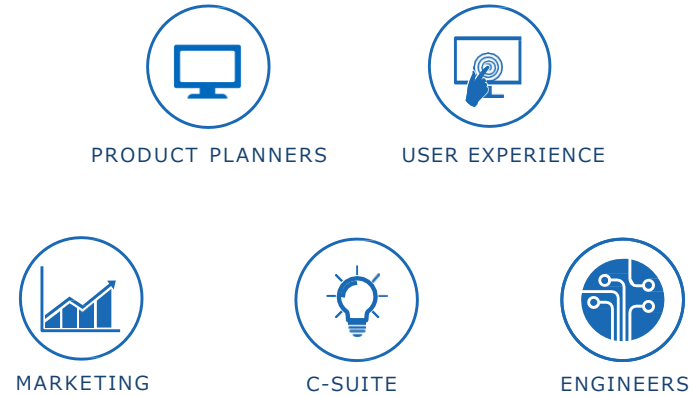
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Scoring

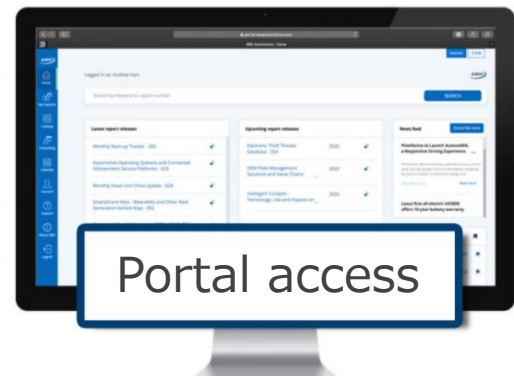
- > **Features and functionality:** evaluating whether the solutions provide features that customers expect, need and solve problems (or provide a wow factor).
- > **Reliability/stability:** evaluating the repeated usability and whether the users can have a similar (positive) experience each time.
- > **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.

This research is useful for



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635-23(23c)

635 - In-Car HMI UX Evaluation & Benchmarking – BYD Seal

<u>Executive Summary»</u>	5	<u>Features and functionality»</u>	22	<u>Perceived quality»</u>	47
<ul style="list-style-type: none">▪ Overall Score▪ SUS score by domain▪ Kano analysis▪ Positive and negative implementations▪ Driver distraction▪ PQ Overview▪ CX recommendations▪ Potential improvements		<ul style="list-style-type: none">▪ Overview▪ Delight and performance features▪ Hygiene and navigation▪ ADAS feature set▪ IoT integration, music, entertainment and information		<ul style="list-style-type: none">▪ Introduction▪ Definitions▪ Evaluation results▪ Highlights	
<u>Introduction to this report»</u>	15	<u>Execution»</u>	28	<u>ADAS domain»</u>	55
<ul style="list-style-type: none">▪ Aim of report▪ Scope of report▪ 2023 vehicles▪ SBD experience▪ Methodology▪ Report structure		<ul style="list-style-type: none">▪ Overview▪ System scoring▪ UX laws▪ System performance▪ Reliability▪ Ergonomics▪ Legibility and readability		<ul style="list-style-type: none">▪ Summary▪ Failure modes▪ Misuse▪ UX Heuristics▪ SAE L0▪ SAE L1&2	
				<u>Infotainment domain»</u>	78
				<ul style="list-style-type: none">▪ Summary▪ UX heuristics▪ Key positive and negative	

635 - In-Car HMI UX Evaluation & Benchmarking – BYD Seal

[Navigation domain»](#)

92

- Summary
- UX heuristics
- Navigation specific scoring
- Key positive and negatives

[Voice recognition domain»](#)

108

- Summary
- Functionality
- Performance
- Stability
- SUS score
- SBD UX principles
- Command structure
- Localization
- Integration
- Amazon Alexa integration

[Connected features domain»](#)

118

- Summary
- Key positive and negatives

[Convenience domain»](#)

125


- UX heuristics
- HVAC summary
- HUD summary
- User profile summary

[Next steps»](#)

132

[Contact us»](#)

141



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SBD June 2023 In-Car HMI UX Evaluation & Benchmarking BYD Seal 635-23(23c)



Introduction



Aim of this report

Welcome to the 2023 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 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.

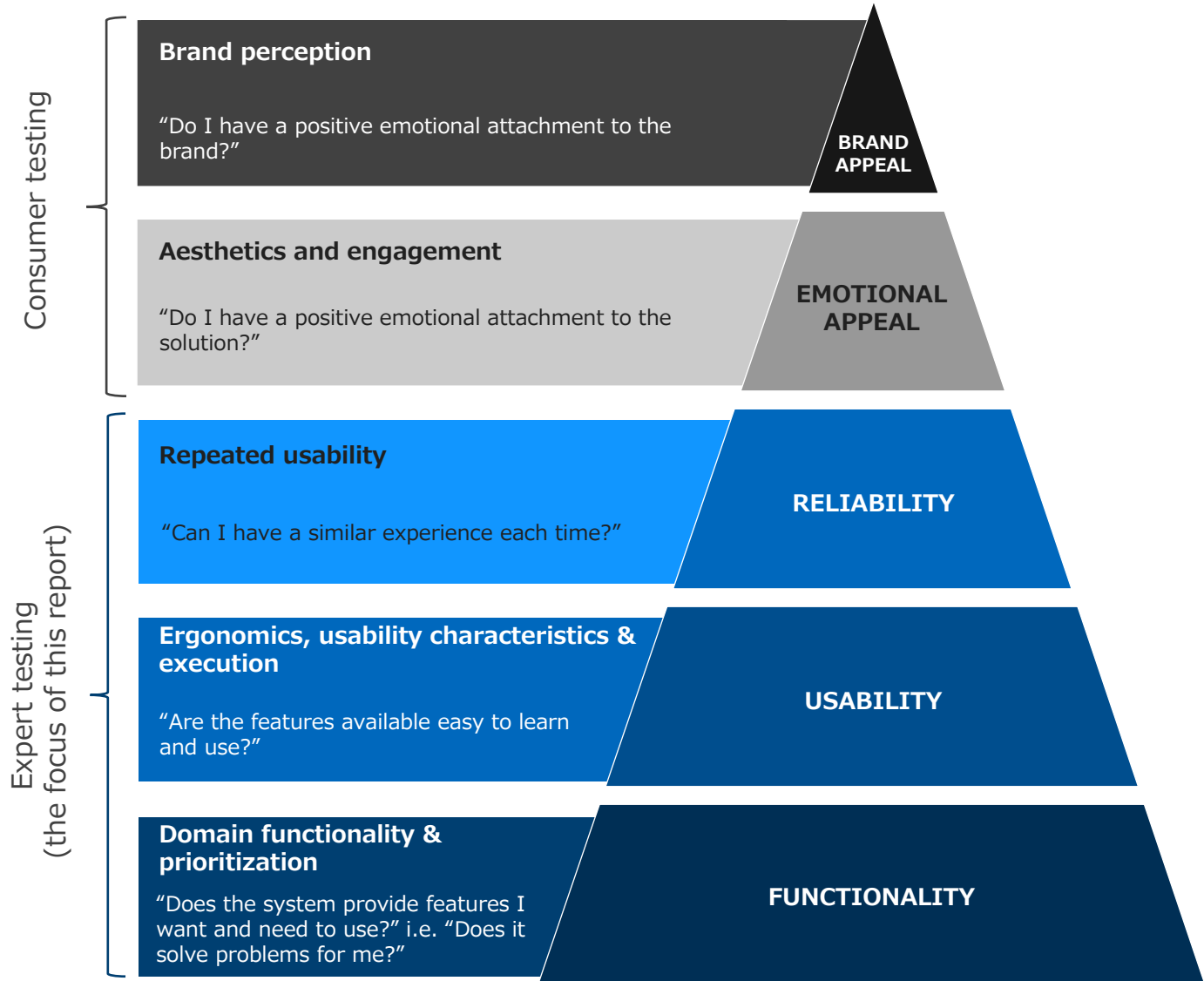
One of the core goals of these studies is to provide a true indication of what the final customer experience of each solution could be. To do this evaluations are focused on providing scoring and analysis in the following areas:

- **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 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.



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
- Connected services domain
- Convenience domain





2023 vehicle list

SBD has chosen six cars to evaluate in 2023, 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.

Cars tested



Jeep Grand Wagoneer

- Passenger display
- Amazon Fire TV
- Active Drive Assist
- US market test



Nissan Ariya

- ProPilot Assist
- Unique HMI and interior
- EV SUV
- German Market Test



BYD Seal

- Unique Home Screen HMI
- EV
- Chinese market test

Planned cars for 2023



Peugeot 408

- Drive Assist 2.0
- 3D instrument cluster
- German market test



Fisker Ocean

- EV SUV
- Sustainable materials
- Large central display
- US market test



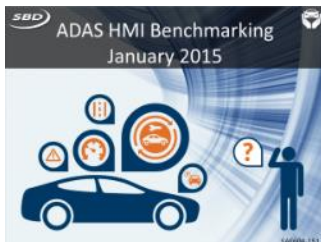
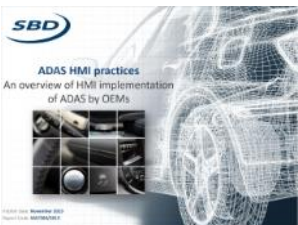
Ford F-150 Lightning

- Android-based OS
- EV Truck
- US 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)	✓	✓	✓	✓	✓	✓	✓	



Example slides from the report

This is an example slide from the report, enclosed in a white border. The top portion of the slide features a photograph of a car's interior, specifically the dashboard and steering wheel area. Below the image is a dark blue banner containing the SBD logo on the left, the text 'June 2023 In-Car HMI UX Evaluation & Benchmarking BYD Seal' in the center, and the reference number '635-23(23c)' 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.



Impressive rotating display, POI search and display poorly integrated

- Delight features are limited to only a small selection of minor features.
- BYD App allows the user to remote control the vehicle backward and forward, and to turn left and right slowly.
- The main delight feature is the rotatable central display from landscape mode to portrait mode.



Rotating central display

The central display can be rotated from a landscape position to a portrait position using the on-screen button or a button located on the steering wheel. When rotated the on-screen display will adjust automatically and change the layout of certain buttons and on-screen elements. Most apps are well integrated regardless of the screen configuration, however some apps are not optimized effectively for both configurations and do not effectively use the screen space in both rotations.

- RCTA lacks the expected level of visual warning by not providing any graphical warning in the central display.
- POI integration is considered poor and not effectively organized or presented to minimize user scrolling and navigating menu steps.



Ineffective POI integration

When adding POIs along the route with route guidance active, the search results are not presented effectively. Only two POIs are shown per page forcing the user to scroll repeatedly. This is not only cumbersome but also potentially distracting if performed while driving. Information on each POI at a top level is also very limited, resulting in the user having to select each POI to view basic information.



Stable performance, lack of commonly used functions

SBD tested five ADAS on the 2023 BYD Seal. These were Rear Cross Traffic Alert (RCTA), Lane Departure Warning/Lane Keeping Assist (LKA/LKA), Blind Spot Monitoring (BSM), Adaptive Cruise Control (ACC) and Piloted Driving (PD).

Overall, most ADAS are well implemented with most system providing important status information at all times, regardless of the display chosen. Warning HMI is good for all system apart from RCTA which lacks any warning the central display. The most negative aspect of the ADAS suite is the absence of SAPA (Semi Automatic Parking Assist) or FAPA (Fully Automatic Parking Assist). This is a feature that most users are likely to expect in this type of vehicle.

RCTA is automatically activated when reverse gear is selected. The system utilizes the BSM warning icons in each side mirror. The system does not provide warning in the central display and system status is difficult to understand.

LKA/LDW provides lane tracking status clearly and is communicated via the cluster and HUD. The repeater icon gives a very good level of detail and shows which side of the lane is being crossed when the main display is not shown. However, there is little distinction between LKA and LDW support.

BSM provides adequate warning in the corresponding side mirror when a vehicle is detected. This warning changes in color and an audible warning is given when indicating into the path of the detected vehicle. A good visual warning is also given in the cluster.

ACC is controlled via buttons located on the steering wheel. A good level of visual feedback is given in the cluster and HUD using correct color logic. A good level of support is given during stop&go traffic. However, information such as headway is only ever shown when adjusted.

Overall PD provides good visual support in the cluster and HUD with clear graphics. The multi lane view in the cluster provides a good sense of the surrounding environment but suffers from some glitches and erratic graphics. Status is clearly communicated at all times. Hands-off warning is clear and robust.

Rear Cross Traffic Alert

Lane Departure Warning/Lane Keeping Assist

Blind Spot Monitoring

Adaptive Cruise Control

Piloted Driving

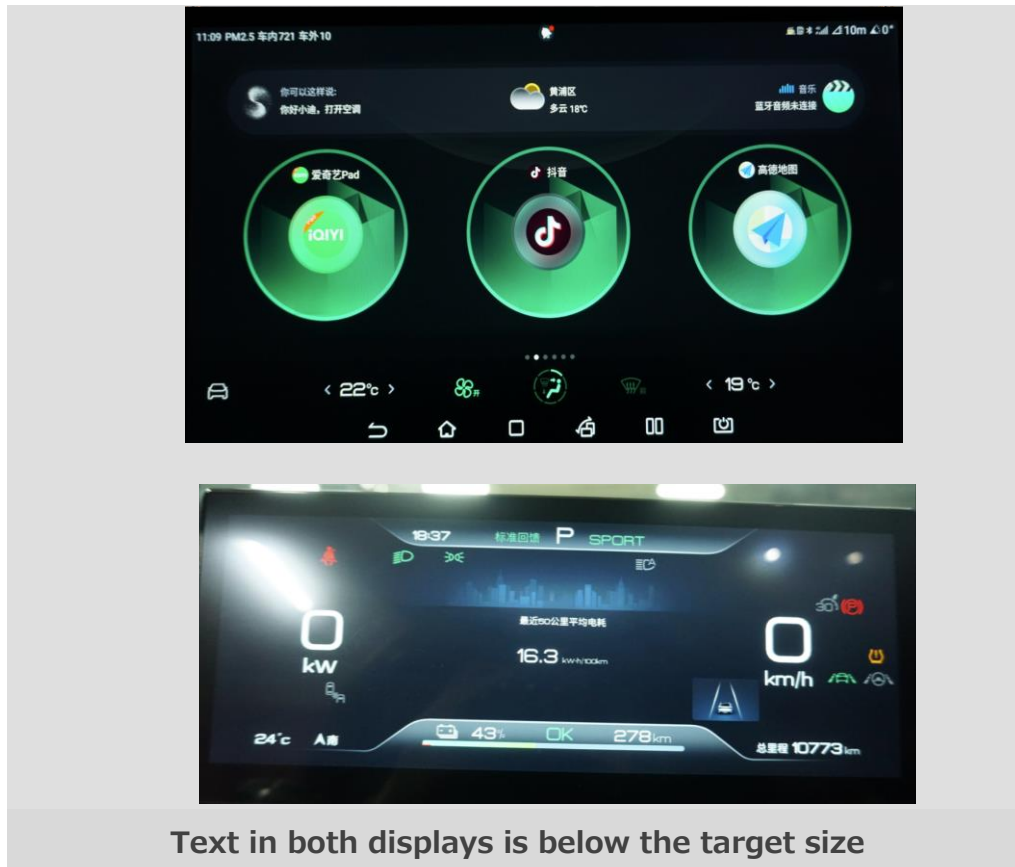
Display reading distance & text size

Smaller text size on both displays

The central display and IC perform very well

In the central display the height of the text “PM2.5” in the top left portion of the screen is 4mm. This is below the target size of 4.5 mm and scores as an “Emerging risk”.

In the instrument cluster, the text size of the unit readout “kW·h/100km” is 3mm. This falls below the recommended text height of 3.5 mm but above the minimum height of 2.8 and is an “Emerging risk”. The two text examples in both displays have an acceptability rating of “concerns” due to the risk they may present while driving.



Text in both displays is below the target size

Display	Reading distance	Text size	Target size	Final Rating
Central display	73cm	4mm	4.5mm	Emerging risk
Instrument cluster	63cm	3mm	4.1mm	Emerging risk

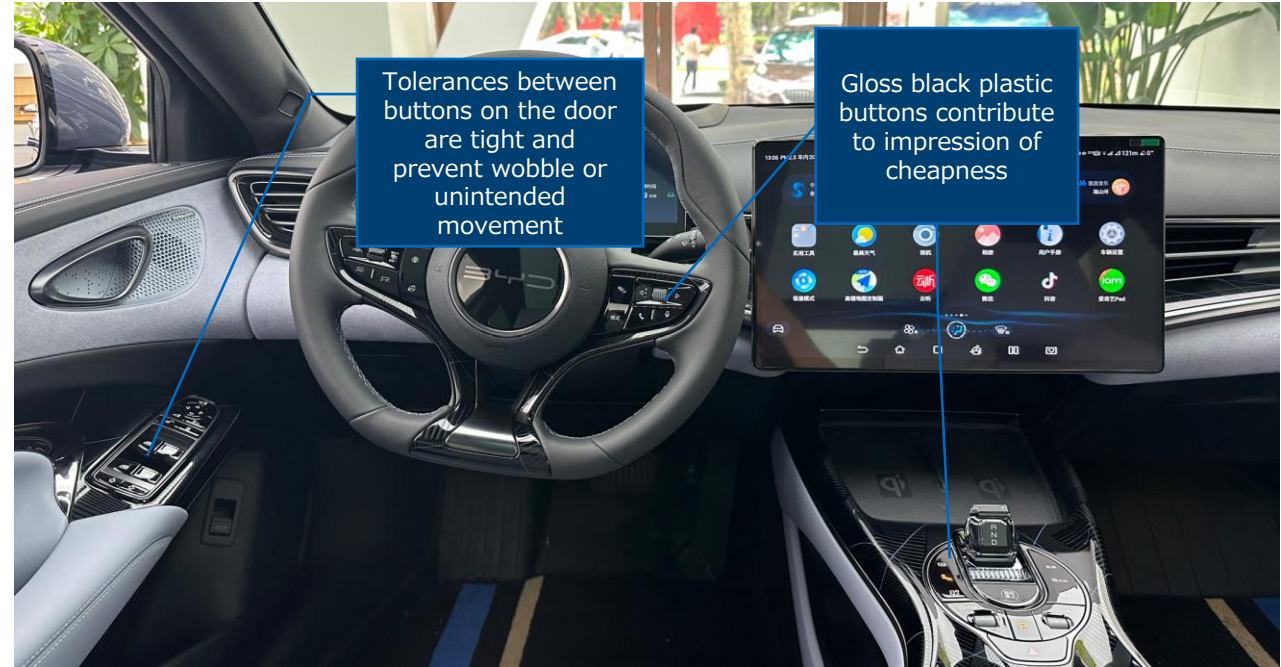
Display	Severity / Driver distraction Rating	Acceptability Rating
Central display	Emerging risk	Concerns
Instrument cluster	Emerging risk	Concerns



Perceived Quality: Tactile

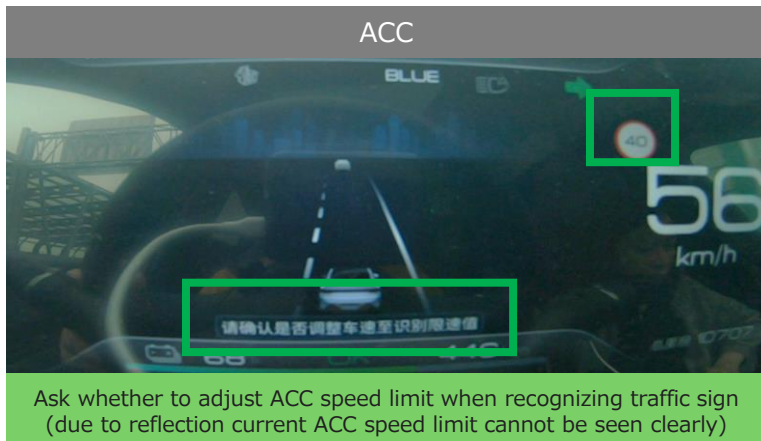
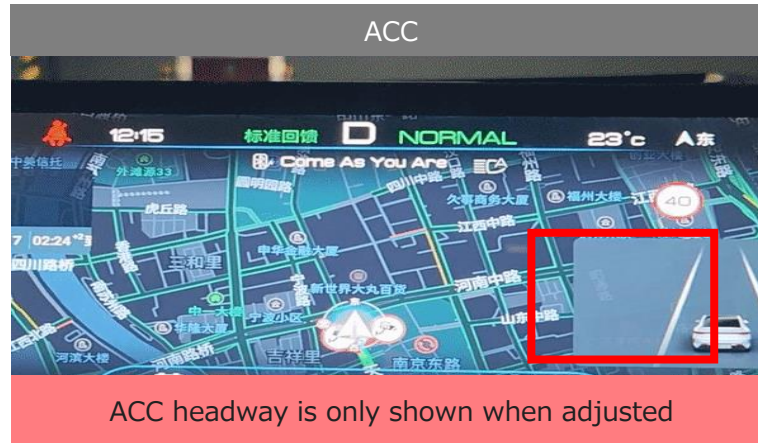
Level 1	Tactile
SBD viewpoint	<p>Stiffness & looseness: Tolerances of most buttons and surfaces are tight and prevent wobble or unintended movement.</p> <p>Force feedback: Most of the feedback from buttons gave the impression of cheapness, partly due to the hard, shiny plastic materials used and the lack of sufficient damping. The volume adjustment rotary feels well damped.</p> <p>Material quality: High gloss and black plastic are used throughout the cabin which contributes to an impression of cheapness for some components and touch points.</p> <p>Material harmony: Steering wheel buttons have the same feeling of quality as other components.</p> <p>Geometric & Positioning: Many of the design elements and surfaces within the cabin have an organic curved appearance.</p>

Level 2 scoring				
Stiffness & looseness	Force feedback	Material quality	Material harmony	Geometric & positioning
Fair	Fair	Fair	Fair	Good





SAE Level 1 & level 2 ADAS - ACC





Multiple aspects of the system are linked to user profiles

SBD
viewpoint

Multiple aspects of the system and settings preferences can be linked to user accounts.

- Elements such as HMI theme settings and ambient lighting preferences (e.g. color, brightness, etc.) can all be tied to a user's profile in the central display. Mainstream 3rd party accounts including Ximalaya FM, Yunting, Kugou Music, Tingban, and Auto Map can also be linked to the user profile.
- When accessing the vehicle using NFC or cloud digital keys, the relevant BYD account will be automatically logged in as well as any linked account.

Multiple HMI-related features and 3rd party account linking to a user account allow users to personalize their own experience and convenience levels while providing an intuitive UX. Convenience levels are greatly enhanced and flexibility is provided if multiple users regular drive the same vehicle.

UX impact

Major negative

Minor negative

Minor positive

Major positive





Lane guidance is clear and precise

SBD viewpoint

When there are multiple lanes on the road (with a set route), the blue lane guidance bar will be displayed on the top of the screen.

- All lanes on the road are shown in the bar with the suggested lane highlighted in white. The lane guidance graphic also clearly indicates which lanes on the road ahead are designated for buses only.
- The lane guidance graphic is presented in a timely manner without obscuring any visual route guidance information on the map.

The visual lane guidance shown in the central display is of a good size and provides drivers with simple and intuitive lane guidance instructions for junctions and intersections. However, when the detailed junction view pop-up is also present, the lane guidance display almost becomes redundant and duplicates information. In these scenarios it could be removed to show more of the map behind.



Clear and precise lane guidance

UX impact	Major negative	Minor negative	Minor positive	Major positive
-----------	----------------	----------------	----------------	----------------



Request price for
the full report

The product card features a photograph of a car's interior dashboard and steering wheel. Below the image is a blue banner with the SBD logo on the left, the text 'June 2023 In-Car HMI UX Evaluation & Benchmarking BYD Seal' in the center, and the reference number '635-23(23c)' on the right. At the bottom of the card is a blue button with the text 'Request price' and a white right-pointing chevron symbol.



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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