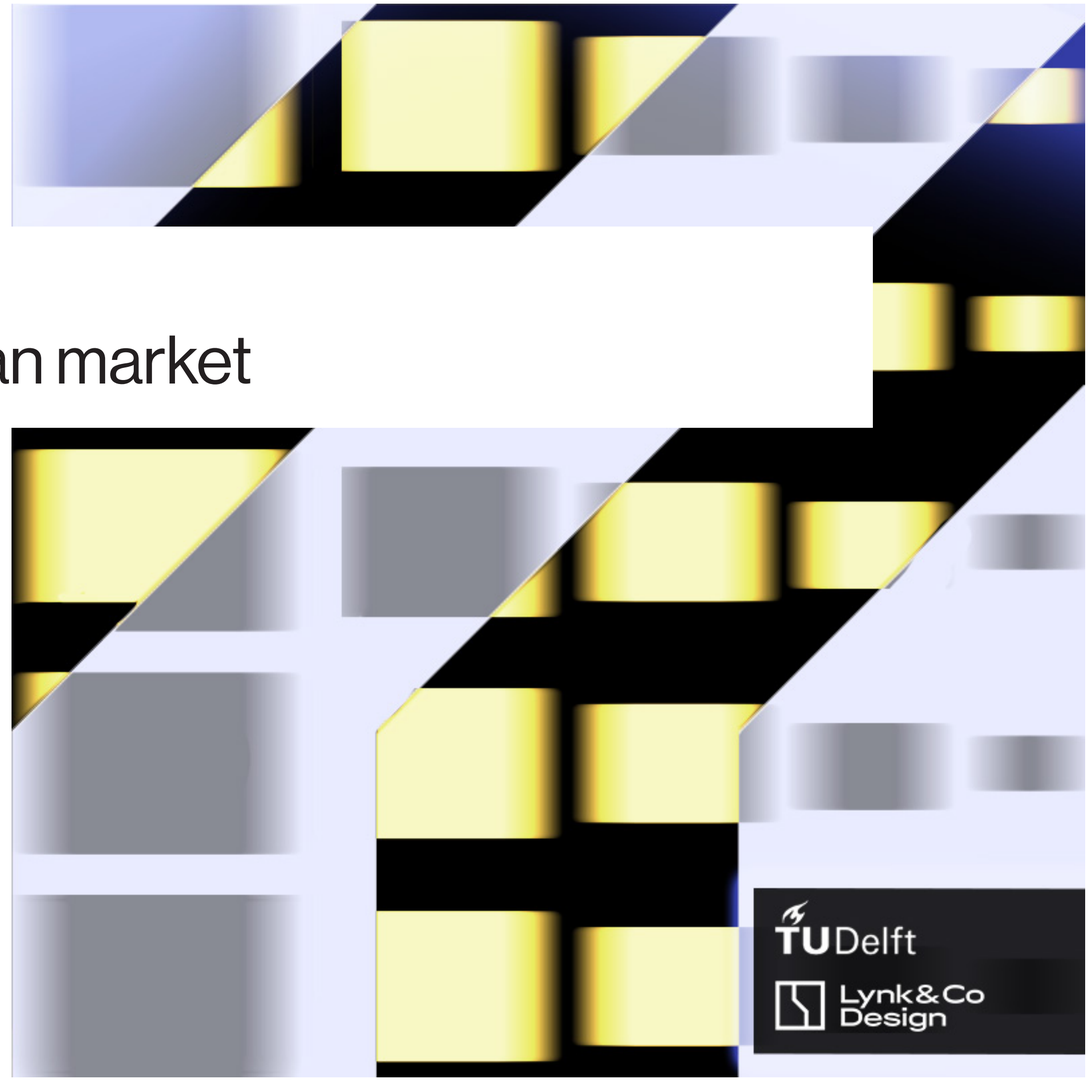
Designing for Lynk&Co's IVA on the European market



Thesis
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Colophon

Guidelines and concept for Lynk&Co's voice asisstant.
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Glossary and Abbreviations

AI
Artificial Intelligence.

CSD
“CSD” stands for “Center Stack Display”. The center stack display refers to the centralized screen or interface located on the center console of a vehicle’s dashboard. It serves as a hub for accessing various infotainment features, navigation systems, climate controls, connectivity options, and other functions within the car.

DIM
“Driver Information Module” in the context of automotive technology.
The car's instrument cluster, generally positioned in front of the driver.

HCI
Human-Computer Interaction. It focuses on designing user-friendly and efficient computer systems and interfaces, taking into account human capabilities and preferences.

HMI
HMI stands for “Human-Machine Interface.” It refers to the technology and design elements that facilitate interaction and communication between humans (users) and machines or devices, such as computers, smartphones, tablets, or automotive systems. The HMI serves as the point of contact through which users can access and control the functionality of the machine or device.
The goal of a well-designed HMI is to enable users to interact with complex systems or devices in a natural and seamless manner, reducing the learning curve and enhancing the overall user experience.

Primary driving task
Primary driving tasks refer to the fundamental actions and responsibilities that a driver must perform to safely operate a vehicle while on the road. These tasks require the driver’s full attention and include activities such as maintaining control of the vehicle, staying within the lane, adjusting speed, braking, accelerating, signaling, and monitoring the surroundings to anticipate and react to potential hazards. Any distractions or impairments that interfere with the driver’s ability to execute these primary tasks can significantly increase the risk of accidents and compromise road safety.

Secondary driving task
Secondary driving tasks refer to activities that are not directly related to the primary operation of the vehicle but are often performed by the driver while driving. These tasks can divert the driver’s attention from the road and may include activities such as adjusting the radio or infotainment system, using a GPS navigation device, interacting with a mobile phone, eating, drinking, or engaging in conversations with passengers. The VA’s interaction is operated as a secondary driving task (Braun et al., 2019).

UI
UI stands for “User Interface.” In the context of software and digital products, the user interface refers to the visual elements and interactive components through which users interact with the application or system. It serves as the bridge between the user and the underlying functionalities of the product.
A good UI design enhances the user experience by ensuring that users can easily access and utilize the features of the product without confusion or frustration.

UX
User Experience (UX) refers to the overall experience that a person has when interacting with a product, system, or service, especially in the context of digital technology, websites, and applications. It encompasses all aspects of the user’s interaction, including their perceptions, emotions, and responses while using the product.

VA
VA stands for VA or virtual assistant.

IVA
IVA stands for IVA

Fig 1- Screen names

Executive Summary

Voice Assistants (VAs) have gained traction in cars, promising safer, more convenient driving experiences (Braun et al, 2021). These Intelligent Voice Assistants (IVAs) offer hands-free control over navigation, entertainment, and climate, reducing distractions and enhancing safety. IVAs also provide context-aware interactions, improving personalization.

Voice control combines button convenience with touchscreen versatility, offering direct access without menu navigation. Automakers leverage IVAs to enhance brand perception, loyalty, and revenue streams, as positive experiences drive brand attachment.

However, despite early adoption, user satisfaction lags (CRI, 2019). Notably, Lynk & Co's IVA elicits numerous complaints due to its underwhelming real-world performance within the complex car environment, causing frustration and distraction.

This jeopardizes brand image, as negative IVA experiences taint overall brand perception. Users might underutilize or abandon the technology, squandering potential. Overestimation of capabilities is common (CRI, 2019), often blaming technology while neglecting usability and context.

The crux lies in the socio-technological challenge of user engagement, surpassing technical issues. To address this, the thesis seeks strategies to bridge user-technology gaps, optimizing IVAs. Tackling usability necessitates understanding user-technology misalignment, considering interaction patterns, learning curves, and context. By doing so, IVAs can genuinely enhance driving experiences, ensuring safer, more convenient, and satisfying journeys.

The thesis employs the 'double diamond' design model and 'user-centered design' method, incorporating literature and field research. User analysis identifies trust and control as key needs, while brand identity is synthesized.

Four essential design questions frame requirements:

Functions: What should it offer?
Interaction: How should it occur?
Visuals: What appearance should it have?
Behavior: How should it act?
Combining these requirements with user needs and brand identity defines the design space, creating a tailored concept for the European market.

Beyond visuals, the core concept involves proactive behavior, humanizing the IVA for perceived competence and trust, encouraging technology adoption. It empowers users by proactively showcasing capabilities and actions.

The IVA's position ranges from driver-facing DIM to distant CSD, adapting based on vehicle activity, harmonizing with brand identity.

Balancing concerns like distraction and customization optimally addresses user needs, brand identity, and requirements.

Preface

From a young age, my passion for cars has been undeniable. Simultaneously, I found joy in expressing my creativity through building, engaging in arts and crafts, and sketching.
A quick addition of the two resulted in the dream of becoming an automotive designer: simple as that.

During my studies, I became aware of the shifting mobility paradigm we are in and started to see beyond automobiles as moving sculptures but as integral elements in the larger context of society.
With that came the realization that for a design to be truly relevant it would take more than a good looking exterior. That is where I realized my education as an industrial designer was not a sidetrack from automotive design, but the key to becoming a designer that could leave a mark.

The shifting mobility paradigm means that the concept of mobility is shifting from being a mere asset to becoming a commodity. A world where I artificial recreations increasingly replace genuine connections seems to be on the horizon. Amidst these changes, cars have never stopped reflecting our society. With them increasingly becoming beacons of mindless consumption, I question the significance of the car as we know it today.

I find myself pondering the future of automotive design and its role in redefining mobility and even society. Yet it is my unwavering belief in the profound values that cars used to represent: - personal expression, freedom, beauty in functionality, - and its way of reflecting society that drives my intrigue about their potential in the future. I am determined to infuse purpose and meaning back into our relationship with cars, mobility and society.

But...
The world of automotive design is a very pillared one. For decades, disciplines like exterior, interior, and HMI have been treated as separate entities despite the fact that they ultimately have to come together cohesively to provide a relevant product. With my broadly developed interests and skill set courtesty to my education as an industrial designer combined with my passion for cars I attempted to prepare myself as well as possible to bridge the gaps between different elements of automotive design and be the designer that can bring the change I feel is necessary.

A year or two ago, I found my search for the rare place facilitating the opportunity to bridge the aforementioned pillars pointing towards Geely and Gothenburg.
When the time had come and I came across the offer for a thesis position at the Geely Design Center in Gothenburg, I knew this would be my way in. This report is the result of that.

The last step of a journey I have been pursuing for almost 25 years now.

Table of contents

Lynk&Co

Introduction

Lynk&Co is a Chinese-Swedish automotive brand founded in Gothenburg, Sweden in 2016 and owned by Chinese car manufacturer Geely.
In Europe, the company aims to disrupt the traditional automotive industry by focusing on its offer of a an all-in-one type of offer of mobility (service) rather than an car (asset) with aspects like insurance, road tax, maintenance all included in a set price (with a maximum limit in km's per month).

The vehicle

Lynk&Co offers only one model: the Lynk&Co 01, a compact crossover SUV.
With this thesis project, there was no focus on this, or another specific Lynk&Co vehicle model. The supervisory team on Lynk&Co's side desired the thesis project to include a concept that can be implemented into any vehicle yet to be introduced on the European market within the window of the scope.
On one hand, this offers freedom. On the other hand, a lack of concrete material to work with.

Lynk&Co's offer

The company's offering model features four options: subscribing, leasing, buying and borrowing.
Subscribing and leasing are similar, where the customer pays a set monthly fee for the car with a monthly max amount of kilometers included. Customers pay per extra km over that limit.
The difference between subscribing and leasing is that subscriptions can be cancelled by the month whereas a lease takes place over longer period. The next option is outright buying the car. What's different to most manufacturers here is that if you insure the car through a partner of Lynk&Co, you can rent out your car to users of the next ownership type, borrowing.
Through the Lynk&Co app, borrowers can book cars from owners that make their cars availabe to them. Payment, insurance and taxes all go through the Lynk&Co app. Borrowers only pay when they use the vehicle, offering owners a return on the investment they did by buying a car.
Rather than tending to either people that want mobility or people that want a car, the models allows the company to tend to both.
This approach has proven succesful: after entering the European market in 2021, it's member network has grown by 145%, to 180000 in 2022.
Including the global sales, Lynk&Co has continously broken records for growth among automotive brands. (Automotive World, 2023) with China being the primary market.

Misalignment in culture

From inside the company, I observed that Lynk&Co still feels like a start-up, even after existing for 7 years and having booked the amount of success and growth it has.
This sentiment is shared more broadly and I have attempted to describe the phenomenon and its cause because of its implications for the current voice assistant, the brand identity (discussed in brand identity chapter), data unavailability and other aspects which will be mentioned when occurring.

The brand has Swedish-Chinese roots. The concept of the brand was thought out by Alain Visser, then a Volvo (also owned by Geely) executive. After pitching the idea for the innovative offering model repeatedly to the Geely board in China, they eventually decided to fund the operation and Lynk&Co was born.
The brand operates in two markets which are situated in very different cultures: the European market and the Asian market, with China being the main market overall.

Trying to tend to two diverse cultures, two diverse markets, with two diverse types of sales model with a similar product brings the risk of compromise and getting stuck in between.
I feel this is the situation Lynk&Co is currently in.

Mainly the misalignment arising due to a cultural differences between the highest staff members, which are from China and the European staff seem to lead to a difficult position for the European departments.

I observed these cultural differences to manifest in terms of:
- view on corporate structure (strong, political hierarchy vs. horizontal workfloor)
- corporate policy (telling employees what to do vs. having employees tell you what should be done)
- risktaking (daring to present oneself outspoken, take risk)
- conflict approach (avoidant vs direct)
- view on how to innovate (looking at competition, copying vs trying to come up with a new thing to get advantage)
and some other fields.

Please note: this is a personal observation and a strongly simplified one at that.

Business model per market

Lynk&Co is active in Europe and parts of Asia but offers its brand defining ownership model only on the European market. The Asian markets follow the model of the Chinese market, which offers the car through the traditional model.
One might wonder why a country that has already successfully implemented bike, moped and scooter sharing services would be averse to sharing cars as well.
The reasoning behind this is mostly due to the difference in role attributed to cars because of cultural differences:
In China, more specifically in the urbanized areas of the country to which Lynk&Co is aiming its vehicles, a car is not just transportation but also regarded as a second living room.
Chinese working days are long, with many hours spent stuck in commuter traffic.
As it is a Chinese custom to take in-laws into their homes, this time in the car is for many Chinese breadwinners the only time they are truly alone and have some time away from their families and the crowded society.
The car often is the place for the breadwinners to have dinner and wind down before returning to their home.
People are not willing to share something such an intimate and personal relationship with.

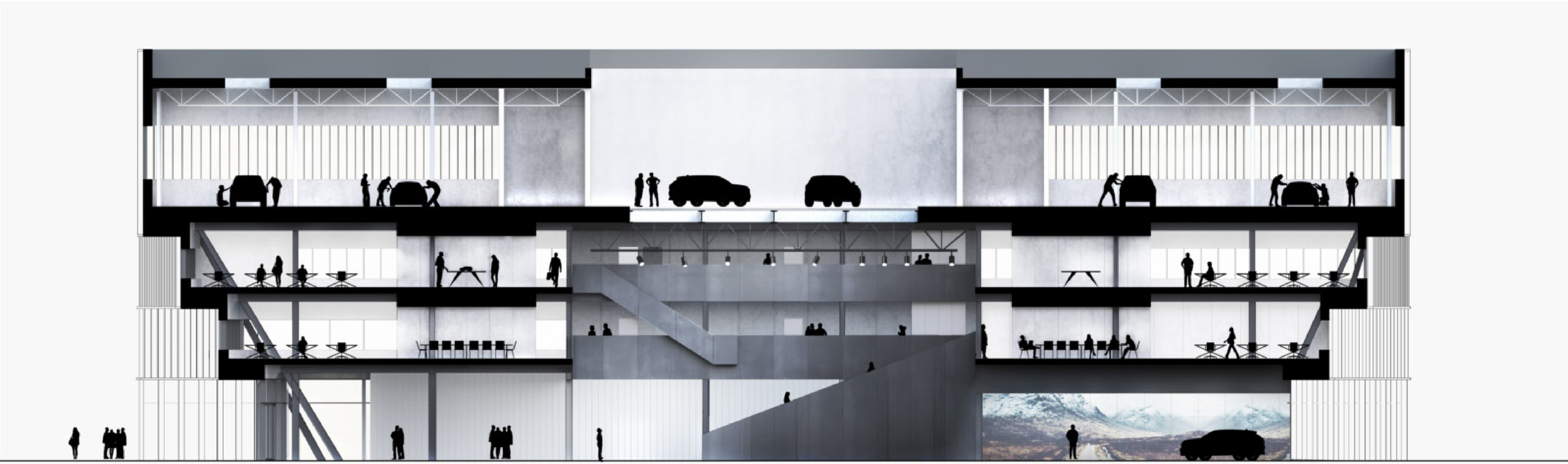


Fig 2 - Architect impresion of The Lynk&Co Design Center

Geely Design Center

This thesis was executed in Lynk&Co's HMI Department on location at the Geely Design Center on the UNI3 campus in Gothenburg, Sweden.

Part of a worldwide network of Geely Auto Group design studios, it functions as the global headquarters for Geely Design. The design center's building, finished in 2022, houses the design staff of two of Geely's sub-brands: Lynk & Co and Zeekr.

In Lynk & Co, the HMI department's operations span across the following fields:
UX and UI design, ergonomics and usability, information architecture, interaction design, visual design, user research and testing.

Fig 3 - The Lynk&Co Design Center

Scope and domain

This thesis project aims to provide a well reasoned, academic base to be used as a guideline for the design of the visual aspect of Lynk&Co's IVA for the European market, to be introduced in the period 2025-2028. This subsequently demonstrated through the concept presented in the end.

Brief

Over the years, the visual aspect of Lynk&Co's voice assistant Frank has been through various itterations. The reasoning behind it's design is built on differentiation, brand identity values and preferences expressed by high Lynk&Co staff in China. Without any actual research supporting design decisions, the changing designs were often received with mixed reactions from the European users. Lynk&Co want's to find out if there are preferences regarding the IVA visual in Europea and if so, it's implications for the design of future IVA's.
But does a visual make any difference if the IVA doesn't perform anyway?
Automakers and tech companies hail their IVA's as a safe and convenient way to operate the increasing amount of functionalities which users desire to operate alongside the driving function. Next to this, they see the IVA as a valuable touchpoint for the brand and powerful brand-experience tool.
Though adoption was initially steady, users are unhappy with the IVA experience.
Automakers and tech companies overestimate their IVAs and how successful it is in fulfilling the users needs. It is not recognized enough that IVA's still face many challenges which need to be addressed before they match user expectations. Currently, IVA's are more likely to be a risk than anything else.
If no action is undertaken, automakers risk a negative mental models on IVA's and the brands that feature them. Most importantly: users will discard the IVA technology and all the potential value it offers in a time when the faced challenges can be tackled.

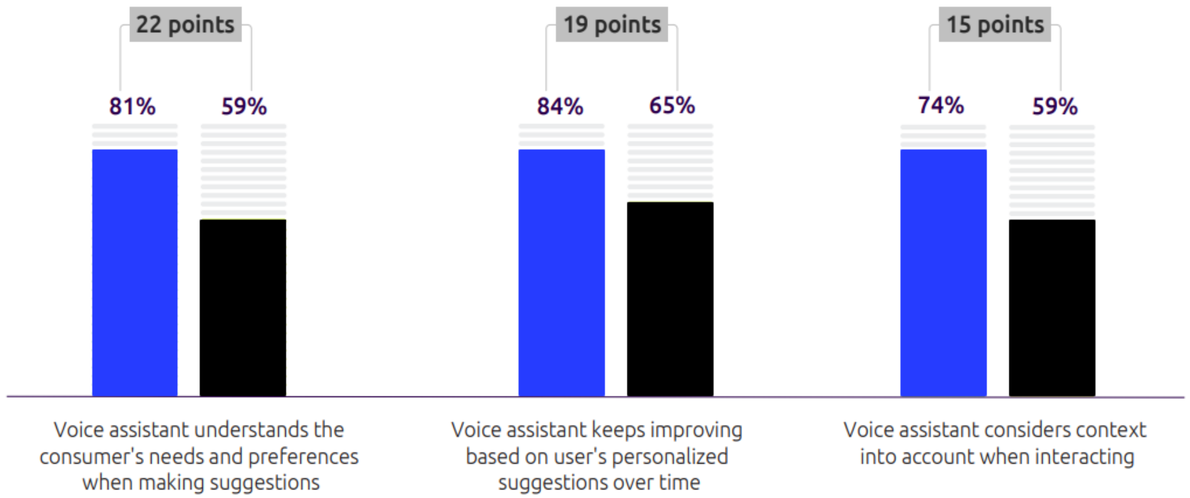


Fig 4 -Automotive organizations organize the capabilities of their IVA's; the points are the differences in percentage - From 'Voice on the go' - CRI (2019)

Approach

Multiple methods have been implemented during this thesis project to make up the design process leading to the final concept. I believe it is part of a designer's task to tailor the design method that will be utilized, to the project at hand.

The double diamond model forms the backbone of this thesis project.
Within the course of the double diamond model, the user centered design model acted as sub-structure. Inclusion of the user centered design process had two main reasons:
- The domain of this thesis project is the European market. With every step along the process, the statistics, needs, preferences have to be taken into account from the perspective of the European user in order to render a design solution that succesfully tends to this market.
- With the technology of the voice-assistant not functioning but offering a lot of potential, adoption has to remain and grow in the future. To do that succesfully, it is key to analyze what leads to an enhancement of adoption by the user.

Elements from the VIP design method only played a minimal role during the formation of the design requirements. When difficulties were experienced with the formation of a design space, the Human Product Interaction and Product Qualities steps motivated the set up of 4 requirements which, when put up against the user needs and brand requirements, rendered the elements making up the interaction and product qualities of the concept. These difficulties are represented by one of the two itterative cycles which canbe observed in the approach graphic. The earlier itterative cycle took place in the define phase of the process.

I also used the VIP design method during the concepting process leading up to the proposal.
Ideation through brainstorming or other "creative sessions" does not work for me.
Brainstorming was given a chance in this project but did not render a fruitful result.
I share the VIP design method's perspective: as long as one occupies its mind with the matter and allows this to simmer in the background of their head, rather than forcing oneself to come up with ideas, that mind will eventually render a concept idea which meets the requirements and challenges. Next, this concept idea can be refined into a final concept.

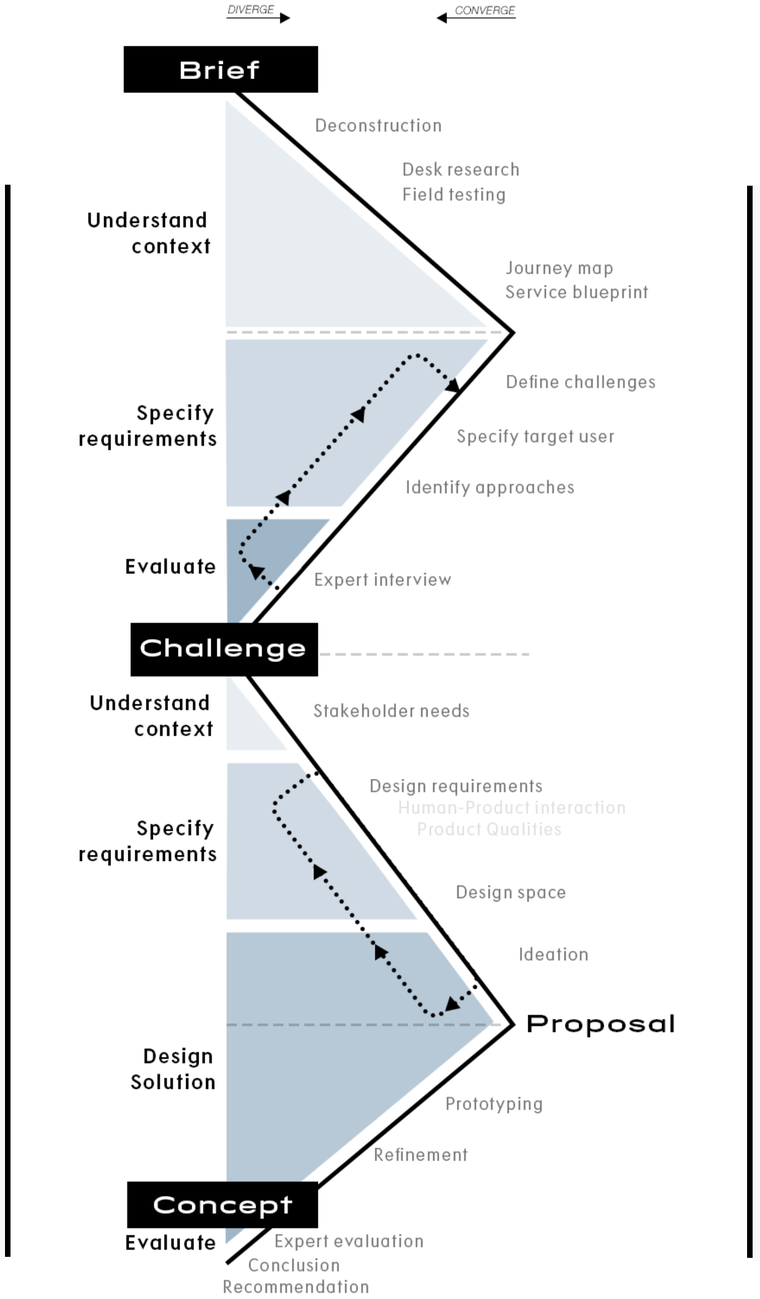


Fig 5 - Visual representation of the design approach.

Methods

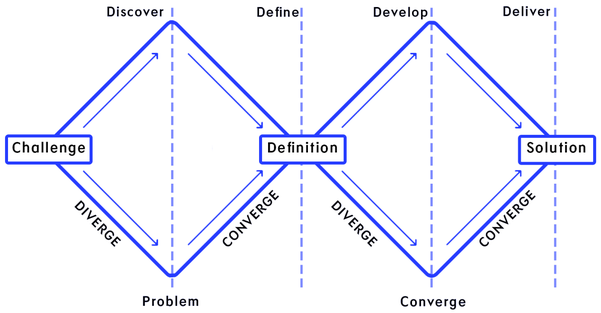


Fig 6 - Double Diamond framework

Double Diamond

The Double Diamond approach is a widely recognized framework in UX, service and product design, structuring the design process. Its course relates to design thinking.
The framework features two diamond-shaped diagrams, divided in four phases: *discover, define, develop* and *deliver*.
In the discover phase, designers explore and gain insights into the problem space. The define phase involves framing the problem and establishing design criteria. The develop phase focuses on generating a wide range of ideas and forming solutions. Finally, the deliver phase encompasses refining and implementing the chosen solution.

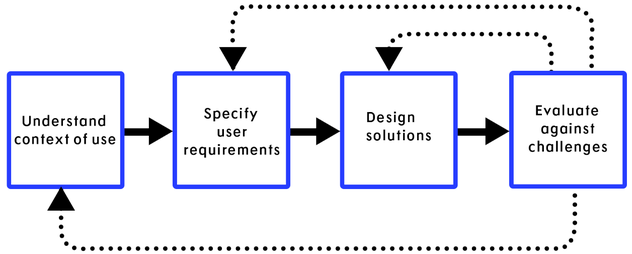


Fig 7 - User Centered Design framework

User Centered Design

The User-centered design (UCD) process focuses on users and their needs over the course of the design process.

First, the context is examined to find out who are the users of the to be designed service or product. Next, the requirements of the user are specified. However, further requirements regarding business, challenges, perspectives and opportunities may also be set.
The design step can contain multiple phases, building from a rough concept to a finalized product.
The final step, the evaluation, tests if the result of the design phase meets the requirements and/or challenges specified earlier.

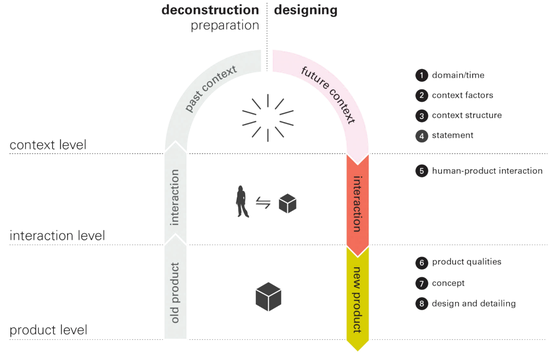


Fig 8 - VIP Framework

VIP

ViP (Vision in Product design) is a design method which is:
- context-driven: a future context is set up for which is to be designed
- Interaction-centered: this approach is focusing on what interaction is to be offered before determining the medium through which that will be offered. (designing the interaction before the product/service).

This method is a personal favourite, as it leads to the formation of a proper “why”, a raison d’etre, for a design.

Literature review

Safety and Comfort

Introduction

Amongst the most prevalent arguments used by automakers and tech companies producing voice systems the automotive context is that of enhanced safety (SoundHound Voice AI Blog, 2021).
This connection with safety is made by arguing that a VA allows drivers to interact with their vehicle without having to take their attention away from the driving task.

Organizations rephrase this smartly as "allowing drivers to keep eyes on the road and hands on the steering wheel". Probably because they are not 100% sure about claiming a VA is the solution to driver distraction and with that a positive contribution to cars' safety.

These parties' claims likely stem at least in-part from research conclusions in the field of affective design.
The term "affective" implies relating to affections or emotions. (Oxford English Dictionary, 2023).
Eyben et al (2010) argued that in the future, the potential for market success in automotive systems would likely be influenced by their role as a "next big thing" on par with automatic driving systems and intelligent safety measures designed to enhance driving safety.
Nowadays, this is an old source. That "future" described in 2010 is our current time.
Has the described potential been to be realized, like automakers and tech companies are presenting today? Do VAs actually contribute to safety?
Literature research and field research will point that out:

Distraction

In the article titled "Is Voice Interaction a Solution to Driver Distraction?"on his website "The Turn Signal Blog", a page on UX Design research in the automotive context, the writer opens by arguing that, users have the desire to operate a scala of non-driving related activities (called secondary functionalities) and that prohibiting these activities probably would only result in increased smartphone usage which is also unsafe. (Kessels, 2022)

It is up to designers to mitigate this problem in the best way possible.
The writer explains how people divide their attention which concludes that implications for safety of the VA versus other modes of input like touch can not be made based on a theoretical background.

The general estimate is that distraction plays a part in 5 - 25% of crashes in Europe. (Hurts et al., 2011 in: European Commission, 2018). More recent studies utilizing naturalistic driving research even indicate that the percentage of crashes attributed to distraction may be higher than this previously estimated range.(Dingus et al., 2016, 2019).

Moreover, the website of the European Commission, department transport and mobility - safety states that *"while exact figures on the number of accidents caused by distraction are not available, a Dutch study estimated that eliminating mobile phone use while driving would have prevented nearly 600 road deaths and hospital admissions in one year alone".*

The page divides types of distraction into categories and gives examples:

Type	Example
Physical distraction	When a driver has to use one or both hands for non-driving related tasks like calling or texting, using navigation, infotainment, eating, smoking.
Visual Distraction	When the driver's eyes stray from the road to look at the phone, infotainment etc.
Auditory Distraction	Ringing of a phone, conversation (phone, passenger)
Mental Distraction	When performing more than one mental task, listening to other conversations.

Fig 9 - Types of distraction and examples - European Commision

The 'Study on good practices for reducing road safety risks caused by road user distractions' (TRL, TNO, Rapp Trans, 2015) mentions about the current estimation of the influence of road user distraction on accidents in the EU that it plays a contributing role in approximately 10-30% of road accidents. However, the lack of coordination in data collection currently undermines the validity and reliability of this estimate.

Part of this study is a number of policy- and technology- related countermeasures to distraction getting examined by experts from various stakeholder groups. Amongst the technologies car manufacturers reported as most likely to reduce distraction were HMI technologies like head-up displays and voice recognition. While automakers and policymakers both agreed that HMI design is important for reducing driver distraction per the expert evaluation, the study notes that research institutes offered differing opinions, expressing the belief that technology as mentioned above might increase distraction. (TRL, TNO, Rapp Trans, 2015)

Preliminary standards containing performance based objectives intended to prevent the HMI from visually distracting drivers while these are executing the driving task, have already been developed in Japan, North America and Europe. (e.g., the European Statement of Principles for Driver Interactions with Advanced In-vehicle Information and Communication systems – EsoP)

The Dutch programme called Connecting Mobility and the ITS plan Netherlands 2013-2017 expressed the intention to enhance the valuation of the human factors of Intelligent Transportation Systems (ITS) applications in an effort to make technical applications safer and more effective.
The initial step conerns guidelines for safe HMI design regarding in-car information services.
With means serving to convey traffic related information (think traffic flow information) to be increasingly presented in-car and less on the roadside. (Kroon et al., 2014), there will be an increase in the amount and type of companies that will provide these services. As these services are likely to beprovided through in-car and mobile platforms, a potential source of distraction is introduced.
The following guidelines were set up to serve as a standard for these companies aiming to deliver a service while respecting the collective aim of road safety. Kroon et al (2014) refers to some of these guidelines regarding HMI modalities:

Visual distraction
- Information should not lead to glances that exceed two seconds 'eyes off the road'.
- Emotional content should be avoided.
- The display should not present more than four separate types of information units simultaneously in relation to an event.

Cognitive Load

In his pursuit of an answer to the question "is voice interaction a solution to driver distraction?" in the aforementioned article of the same name Kessels(2022) continues with the introduction of the term 'cognitive load'.

"Cognitive load refers to the amount of mental effort or resources required for a person to perform a particular task or process information. " (Sweller, 1988)

Cognitive load impairs performance in tasks which are non practiced or inherently variable but does not affect tasks which are automatized (well practised, consistently mapped).
Cognitive load can even have a positive effect, like on lane keeping. (Engström et al, 2017)

Though parts of driving become automated behaviour over time (depending on experience, driver skill, environment etc.), the lack of the adjusting ability to changing conditions and delayed recognition of road signs and danger, make driving under high cognitive load not ideal (Engström et al, 2017).

Cruscially, Kessels(2022) notes that while cognitive load affects driving, there is no significant relation between cognitive load effects and an increase of accidents.

An interesting relationship is observed between controlled experiments on the effects of voice-assistants on drivers like that of Strayer et al (2013, 2014, 2017) and real world driving statistics.
Strayer argues that the highest type of cognitive load in a car comes from interacting with a IVA, implying that interacting with an IVA enhances the risk of an accident.
One of these studies indicates that talking on the phone increases cognitive load, with only a minimal difference between a hand-held and hands-free phone conversation: controlled experiments established that the distraction comes from the conversation itself and is not influenced by the type of device employed. (Strayer, 2003)(Strayer, 2005)
Nevertheless, an analysis of real-world data reveals a distinct correlation between a decrease in accident rates and the adoption of hands-free devices.

Despite the quantifiable rise in cognitive load, conversation does not translate into a higher frequency of accidents. (Young, 2008) (Fitch, 2014) (Wijayaratna, 2019) Comparable outcomes are observed in conversations with passengers. (Ho, 2008)
I agree with Kessels' notion that the high cognitive load caused by interacting with an IVA says more about the design and userfriendliness of interacting with VA technology than it does to driver distraction.

Due to a lack of naturalistic driving studies and the mediocre quality of controlled experiments, not much can be said about distraction and IVA's.
As Kessels has performed the research I am after for much longer and much broader than I am able to do in my thesis, and that I do not have the means, skills or time to pthis means that theoretically, the question if an IVA is the solution to driver distraction and my question of the voice assistant actually being proven to be enhancing safety currently remains unanswered.

Conclusion

In the automotive context, distraction is unsafe and it is widely recognized that HMI technologies have the potential to reduce distraction when implemented well. One of those technologies is the IVA, even though additional research is still needed to definitively confirm that IVA's are the solution to driver distraction.
IVA's are currently not performing well enough to realize any potenial, rather the oposite. However, by taking IVA's taken seriously and designing them in a holistic matter designers in the auto industry can do their part in figuring out if the IVA will be a solution to driver distraction.
Three important aspects to take into account are visual distraction, error handling and perceived workload. (Kessels, 2022)

Affective Design

Automakers and tech companies are not the only parties emphasizing the beneficial effects of IVA / virtual assistant technology for safety and comfort.
Early notions of IVA's potential came from the field of affective design.

In 2010, Eyben et al described that a vehicle interacting with a driver, serving as a virtual partner, offered potential for the enhancing driving safety of current and future cars.

Rather than looking at aspects like distraction and cognitive load, studies in the affective field continue to emphasize the potential for improving road safety by taking human emotions into account.
In their literature survey outlining this field's combined knowledge, Braun et al (2021) mention that the field of affective design has evolved in the decade that had passed since Eyben et al(2010) published their study on advances in HCI (Human computer interaction): since then, studies have been examining the impact of emotion on driving and the context of emotions on the road and exploring methods aimed at regulating the driver's emotional state.It is now expected that as technology capabilities grow over time, cars will become increasingly able to map contextual determinants and with that, driver conditions like cognitive load as well.

As negative emotions such as anger, frustration, or sadness negatively influence driving performance, posing a risk to road safety for all other drivers (Braun, Schubert, Pfleging & Alt, 2019), and one viable technique that has been shown to regulate driver emotions is empathic voice interaction Braun et al (2019). This argues that it is realistic to expect that cars will be able to detect context and user state and in turn can influence the driver behaviour through emotion regulation and facilitate an emotional driver state in which the driver shows safer or less risky behaviour.

In the context of this field, virtual assistants and with that (we can assume) IVA's as well, are regarded as one of the affective systems that could be utilized to influence occupants emotion through their visual and behavioural elements.
If designed as an affective system, they are also argued to be able to enhance the user experience.
The atmoshphere in a car could be enhanced through micro interactions, for instance. An affective IVA would actually put additional value on the IVA's visual as it can be argued that when considering the IVA purely functional, a visual is often not needed since the voice commands being executed would take over the visual's function to feedback that the command was executed succesfully.

This scenario would put the emphasis on the benefits for the brand experience and an IVA's influence in that.

However, the benchmarking session with NIO's Nomi, executed simultaneously with this desk research and described in the next chapter, confirmed to me that the inclusion of an affective element is not the way to go.
This sentiment is shared by most western users, the European consumer places functionality above all else.

Yes, an affective IVA could reduce the negative emotions and with that potentially enhance road safety but in the end it still leaves users exactly at the same point as where they started, with their desired function yet to be executed. It does not add to a IVA's functionality and if that is not there, European users will quickly abandon the technology.

Conclusion

This 'affective' direction which focuses on the IVA influencing occupants' emotions and moods was explored but abandoned with the realization that an IVA's potential to operate a vehicle's functions more safely and comfortably would not be enhanced by the addition of an affective element.

Brand

The implied potential for IVAs stretches beyond safety and comfort. But similar tp these categories, critical analysis shows that the potential that automakers and tech companies imply is not achieved.

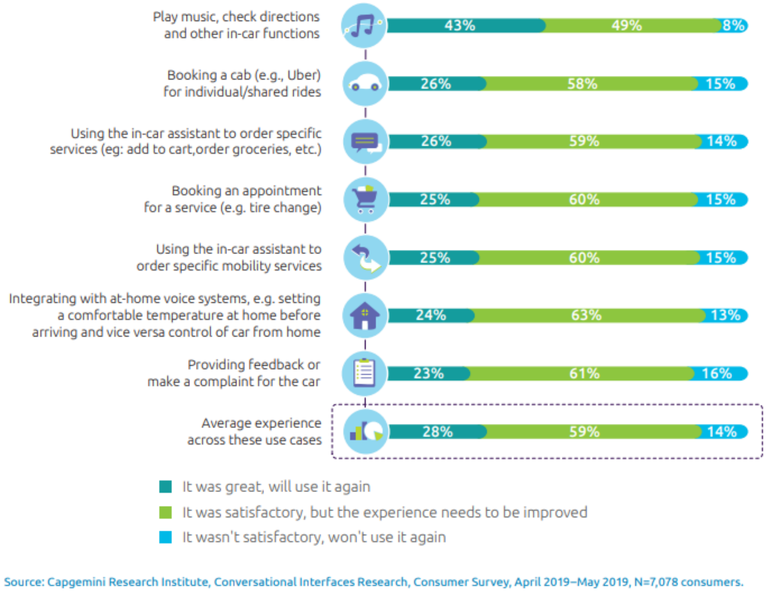
In the industry on IVA report 'Voice on the Go', Capgemini Research Institute(2019), the Michael Zagorsek, VP, Product Marketing at SoundHound Inc., developers of the Houndify voice AI platform describes "the opportunity to build loyalty by extending the relationship with the user beyond just the physical aspects of the car and into a much deeper interactive experience". Automakers seem to eat up this these words, with 72% of automotive executives also interviewed for this industry report expecting IVA's to play a vital role in business and customer engagement strategies.

Next 300 executives from the auto industry, the report mainly features results of their survey amongst 7078 people who have experience with using a VA in their car. The people interviewed are from the Europe, the USA or India.

Customers seem to see the potential too, in the chapter describing another of the three main topics, the growth of customer appetite, 95% mentioned to expect to be using voice assistants by 2022. 71% of consumers, on average, say they will increasingly use their voice assistants over other mediums of interaction over the coming three years. However, this was recorded before the COVID-19 pandemic so we can not say if these expectations have been realized or not. Finally, Nearly 50% of the surveyed people said to be already using the IVA to operate functions in their car.

Fig 10 -From 'Voice on the go', CRI (2019)

However, consumers are not happy with the IVAs' experience. 60% of consumers feel that the in-car voice experience must be improved. (CRI, 2019)



Source: Capgemini Research Institute, Conversational Interfaces Research, Consumer Survey, April 2019–May 2019, N=7,078 consumers.

Fig 11 - From 'Voice on the go', CRI (2019)

Statistics from Lynk&Co's feedback portal implemented in the car , reveal that the VA "Frank" is the consumers' biggest point of frustration.
Frank is a notoriously lacking implementation of VA technology, as it initially was implemented back in 2017 already when the Lynk&Co 01 was released in China.
It is remarkable that statistics like those in the 'Voice on the go' report (CRI, 2019) still show a relatively high adoption of the IVA: 49% was already using the IVA for operating functionalities in their car in 2019.

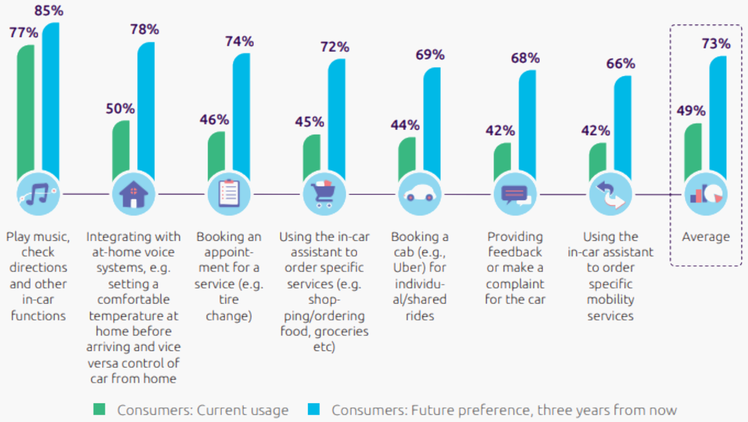


Fig 12 - From 'Voice on the go', CRI (2019)

During a usability study, Whitenton et al. (2018) observed a similar relation with in-house VA's. Even though these systems (Siri, Alexa, Google home) were plagued by problems, the adoption was still high.

In a similar fashion of how I am pointing out the adoption of IVAs to be in line with that of in-house VAs, the study mentions the phenomenon to be in analogy to that of adoption of the internet. Users are highly aware of the challenges but they simply avoid usability failure by keeping their interactions with the (I)VA limited to a set of simple features.

These are functions which suffer the least from poor language comprehension or lack of connected personalized information or actual intelligence.
The article couples this to an important risk : mediocre assistants may shape users' expectations, leading them to believe that VAs are only capable of basic interactions and discouraging them from exploring advanced functions in the future, even if assistants will be improved by then. This means that:
A)Adoption will be limited or drastically slowed leading to loss of potential advantages
B) The money and effort spent by automakers to provide new functionalities and elaborate on them is wasted as users avoid anything more complicated than the basic ones.

Back to the adoption being relatively high while users still claim the experience drastically needs to improve.
The cause that Whitenton et al.(2018) mention for this phenomenon is likely to be at least equally much the cause for the high adoption of IVAs as well. And it is surprisingly simple:
For now, the advantages of using the IVA system outweighs the frustration due to poor usability.

"Even a barely usable voice-based assistant may still be faster than pulling over while driving, or washing food off your hands in order to use a touchscreen" (Whitenton et al., 2018)

As IVA technology evolves, usability is expected to become more and more of an competitive advantage.
This was also observed with the iPhone, back in 2007.
People choose the system which solves usability problems. (Whitenton et al., 2017)
If the IVA is such a key component as they apparently believe, than solving usability problems is cruscial.

Conclusion

Statistics show that the adoption of voice-assistant technology has been growing steadily. But in order to guarantee increased engagement and user adoption of this technology, positive experiences with a VA are essential. Positive experiences will increase when the usability rises.

Field Research

Lynk&Co's Current IVA

Lynk&Co's current VA, Frank, was initially released in 2017.
In order to get to know more about Frank and the reasoning underlying its design, I booked a meeting with Caroline Hardhammer: Service Manager and Product Owner for Frank.

Fig 13 -Some of Frank's states in its current form

Name

Frank's name was mainly chosen with the intention to evoke an association with honesty and transparency.

Visual

Frank's first visual representation was designed by MSS in cooperation with the HMI department. As with its voice, Frank's visual representation was decided to not be too humanlike. Again, to emphasize "tech-y"and the digital aspect Lynk&Co desired to express.
In a short time Frank's visual representation went through a variety of iterations, to mostly mixed reactions of customers.
A short analysis of the current visual is included the chapter on the final design.

Voice

Initially, Frank's voice was decided to be male and robotic.
With Lynk&Co being brand new on the market, differentiating itself from the competition was top priority. This is why Frank got a male voice: VAs in the automotive context (but also outside of it) typically featured a female voice.
Similarly, the addition of a robotic tone aimed to distinguish Frank's voice from the human tone of voice featured in most other VAs as well as referencing Lynk&Co's emphasis on technology.
It's worth mentioning that even though it carries a male name and voice, Frank was gender neutral.
Jan Lösing of Lynk&Co's MSS department mentioned that after the introduction of a user feedback system in the Lynk&Co 01's infotainment system, the department received a lot of negative feedback on Frank's voice.
Users reported to be very confused by the voice and that they disliked the tone. As a result, Frank's voice was altered and changed into a more female sounding voice.
The confusion has remained however, as user's perceive a male name but a female voice.

Functionality

Frank's functionality is severely limited and was very poorly received from the get-go.
Its integration into the infotainment system faces a lot of the typical challenges that IVAs typically face and is regarded as worse than most systems. This problem largely has to do with cost. Top stakeholders in were not willing to spend more on an infotainment system with better integration possibilities.

Personality

A touch of personality is built into Frank through a set of responses to specific situations or prompts.
For instance, when Frank does not properly receive a response, it states "I'm sorry, I need to get my ears cleaned. Oh wait, I don't have ears".
Even though this touch of personality receives significantly less negative feedback than other elements, the limited set of responses is likely to get on users' nerves. This was even observed in the user tests described later in this chapter.

Conclusion

It is clear that during the creation of Frank, decision making was driven from a marketing and branding standpoint rather than on research and user preferences: differentiation had top priority. This explains why Frank's initial design contains flaws that could seem easy to have been avoided as well as why the attempts to improve it over time hardly caught on.

An example is Frank's voice. There is a reason the competition primarily uses female voices: where assigning a gender to a virtual assistant have been observed to enhance its perceived humanness, notable differences in gender perceptions have been identified with women often being perceived as possessing more favorable human qualities. These include friendliness, warmth, and empathy along with the ability to recognize and experience emotions (Borau et al., 2021).
It is worth mentioning that there are older studies that previously demonstrated that customers tend to prefer a female voice for the VA due to its superior ability to convey and evoke emotions (Eyssel, De Ruiter, Kuchenbrandt, Bobinger, & Hegel, 2012).

Another example is the visual, Frank's visual has seen various iterations, mostly driven by directions from stakeholders in China. These stakeholders look at the competition and if they see something they like, they copy it and put "their own sauce" over it hoping their interpretation will be favored.

Through building on academic sources and field research this thesis project will result in a design which offers a solid reasoning behind its design which can serve as a guideline for the company.

Benchmarking

In order to become familiar with the system and technology's state-of-art two competitors' regarded as the most advanced systems on the European market were examined through a test-drive and demonstration by representatives of the tested vehicles.

Nomi stands out amongst other IVAs in the European market: it features a physical element, a so-called 'bot'.
This bot, placed central on top of the dashboard has a spherical shape and features a little face displaying large eyes. The bot rotates in the X- and Y- direction to subtly simulate body movement.
Mercedes-Benz's MBUX uses a horizontally oriented abstract graphic as the main visual for its VA. On the high-end EQS model tested, the VA is duplicated in the ambient light rail that goes around the interior.

Fig 14 - Nio's Nomi

In today's context, it is understandable why Nomi is regarded as the most advanced IVA on the market. The voice technology behind the IVA works better than that of the competition and the bot's expressiveness initially delights.
Though MBUX also impresses with its lighting, the technology behind it is not as good as Nomi but more towards the lower level of t the competition. Mercedes-Benz claims they paid attention to its understanding of accents but MBUX failed to understand the (admittedly heavy) accent of an accompanying student with an Asian background.

Even with its technology being better than MBUX and the other IVA's on the market ‚Nomi's 'advancedness' is only relative in today's little window of actual IVA capability.
Rather than advanced, it would be more appropriate to describe Nomi as "seeming slightly less dysfunctional than the competition" (which, as is discussed in the next chapter, might be the actual intention).

Nomi's expressiveness initially lessens the frustration of IVA's dysfunctionality but this fades soon when one realizes that in the end, no progress has been gained towards the goal that led one to use the IVA in the first place.

MBUX's system is barely able to express any empathy, even with the additional lighting, featured in the EQS top-range model. However, this also eliminates the risk of annoying users with useless apologetic behaviour.

MBUX shows to which occupant it is listening by displaying the graphic above the central screen or that of the passenger. In the case of the EQS this is accompanied by the light rail shimmering in the area of the user that it is listening to.
When it is executing commands, it confirms these commands are being executed visually by for instance displaying red ambient light when the temperature is raised or blue light when it is cooled.

Fig 15 - Testing MBUX

MBUX's visual representation of the VA, be it the light or the abstract representation on the screen, only appears when it is active. When it is idle (i.e. on standby), it is simply not present at all. This is in conflict with Nielsen's first heuristic found in the literature research as well as Don Norman's 7 design principles: the user should always be able to see what the VA is doing as well as what is possible.

Nomi's designers thought about the intrusiveness of an always-ready, always-listening VA.
Rather than entering a typical "standby" mode or staring at you constantly like a dog cautiously awaiting its next command , Nomi turns it's head towards the rear of the car, stares into the distance and starts doing little interactions with itself displaying it as amusing itself using a variety of toys.
A subtle, yet well thought through touch that slightly alleviates the intrusivesensation of an ever present bot on the dashboard. An issue which would also be solved by not having the bot in the first place.

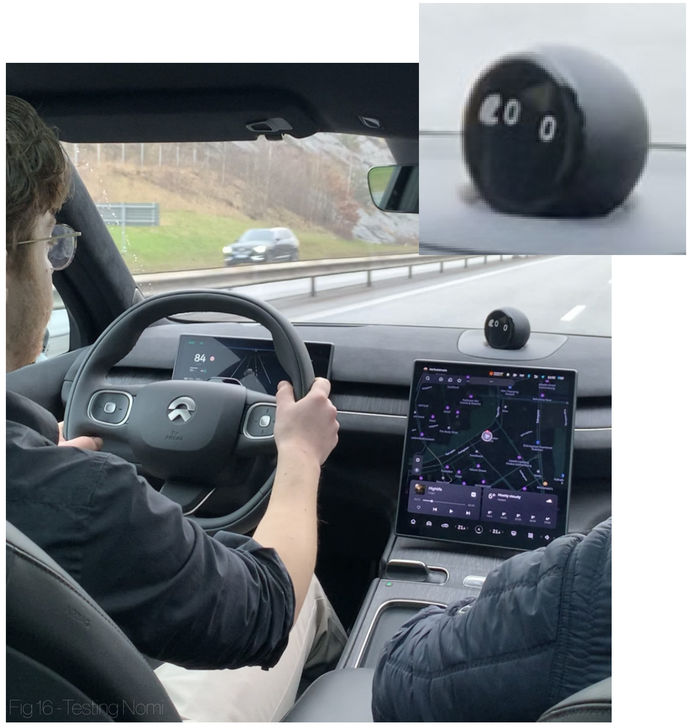


Fig 16 - Testing Nomi

Conclusion

Even the leading IVA systems in the European market, Mercedes-Benz's MBUX and Nio's NOMI a hardly add value when it comes to fulfilling their purpose.
What both VAs do well is displaying to whom the VA is listening or responding and Nomi shows an interesting approach of meeting Nielsen's first usability heuristic while avoiding intrusiveness.
Moreover, MBUX's ose of lighting to emphasize the execution of commands adds to the user experience and more importantly, can offer affirmation to drivers without requiring them to take their eyes of the road.
Remarkably, neither Nomi nor MBUX suggest alternative 'routes' to a succesful outcome when they fail to understand a specific command.

Most importantly, the contrast between the relatively expressive and emotional Nomi versus the pragmatic MBUX lead me to a bigger topic, discussed in the next chapter.

Emotion vs Function

Mercedes approach to compensating for its disfunctionality reflects the industry-typical practise in which disfunctionality gets underestimated and 'compensated' through the addition of seemingly useful, gimmicky functionalities like a story-telling tour guide (source).

Nomi's expressive and initially "whimsical" seeming experience indicates NIO has taken a different route: as described in chapter on benchmarking and the chapter on affective design, its lack of actual functionality highlights it's "affective" purpose where the user's frustration of NOMI's disfunctionality is lowered by NOMI's likeability.

Nio claims that Nomi is designed to create an emotional connection with the user and serve as a brand ambassador. The important question here is:
Do users on the European market want this from their IVA's?
People are open to IVA's that involve affecting computing (responding to users emotions) but on the premise that it is coupled to pragmatic use-cases (Braun, Broy, Schneegass, Alt., 2020). This is likely to be highly dependent of the succesful functionality of the IVA. In their study, Braun, Broy, Pfleging, and Alt (2019) confirmed their hypothesis that personalized interaction is most suitable for non-driving-related situations, such as infotainment and connected car features.
Comparing the difference in the European and Chinese culture as described before, we can reason that emotional companionship is not a desire that European consumers desire. Budiu(2019) found that users of Google Assistant, Siri and Alexa regarded these either as a brain, personal assistant or an interface.

When reasoning if taking the affective design approach would be/was a good decision for the course of the thesis and connecting the benchmarking to the affective design chapters, I found the affective approach to relate to the peak-end rule:
When recalling an experience, people remember the peaks (both negative and positive) and the end of that experience the most vividly. These elements decide if the experience will be judged as positive or not. (Frederikson et al., 1993)

While negative peaks are remembered more strongly than positive peaks (Kane, 2018), emphasizing the positive peaks and the end of an experience can still leave users with positive feelings or at least with a dramatically lower level of frustration than they actually would (or should) have. Limiting the negative associations while boasting the(little overall capabilities of their IVA is simply how brands aim to retain a positive image about the company and it's technological might in consumers minds.

However, it looks like this is not enough in Western markets, where consumers using IVAs end up avoiding dysfunctionality completely by keeping to simple functions or refraining from using the technology at all (NNgroup, 20??) as was already observed in 'brand' chapter of the literature when discussing the statistics from the 'Voice On the Go' industry report on IVA's (CRI, 2019) showing that people are willing to adopt the technology and use it, but feel that the experience leaves much to desire.

The unlikeliness of the emotional approach being a succesful approach to take is supported through looking at the critiques on the peak end-rule. Although it is an older study now, Kemp et al (2008) provided partial endorsement for the peak–end rule but also indicated that the rule was not remarkably effective in predicting remembered experiential value.
The study further revealed that the happiness associated with the most memorable portion of an experience held greater predictive power for remembered happiness compared to the happiness levels at the peak or the end.
Kemp et al (2008) also state that the peak-end-rule to turn complex mental evaluations into a relatively simple framework.

This serves as an addition to the reasons mentioned in the conclusion of the Affective Design chapter why the emotional approach was abandoned.

Looking outside the European market to the Chinese market, there is an interesting different view on (dysfunctional) IVAs.
Bot-type of VAs like NIO's Nomi are much more common, as well as highly humanized (anthropomorphized) (I)VAs.
As is mentioned in the introduction about the company and why there is no sharing system in China, one of the reasons was that a car serves as a second living room: something which does not occur in Europe (yet).
Even though not functioning in the practical sense, an IVA would in China still be valued for its emotional companionship.

Journey Map

A journey map was compiled in order to get a better understanding of the process a user goes through when communicating with an IVA, to points out challenges and opportunities by itself as well as a source of cross-referencing the challenges and opportunities found in the literature review.

Fig 17 - Some of the participants during the test

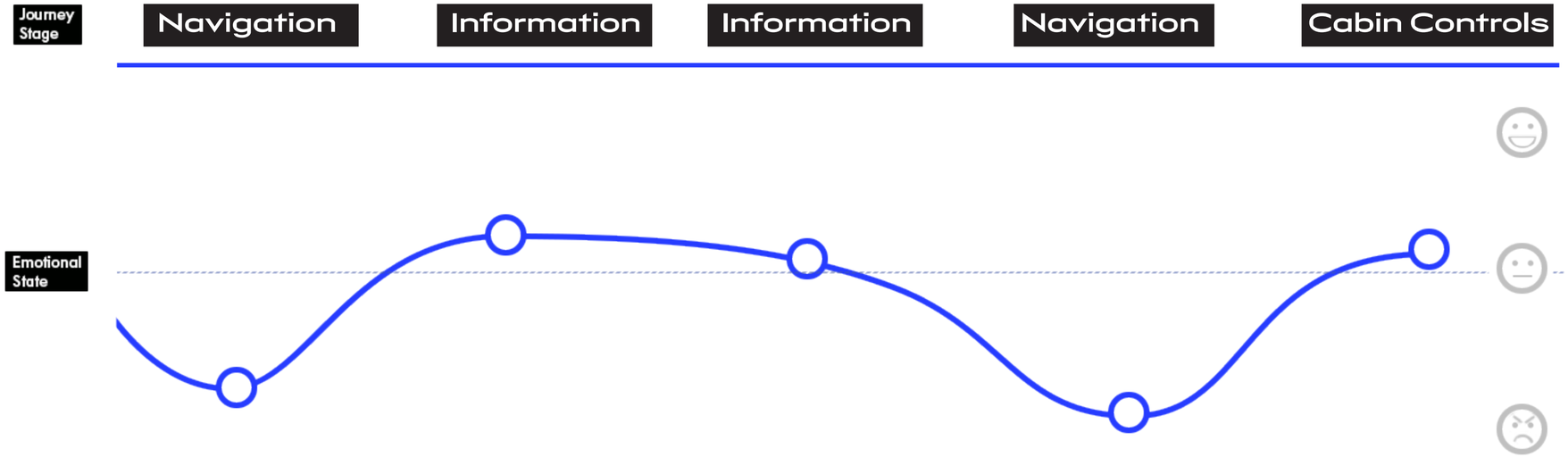


Fig 18 - User Journey Map

User test

A user test was organized to provide the material on which the journey map would be based.
The first part of the user test took place on the open road, with participants being tasked to navigate to a destination and back while having to operate various functionalities of the Lynk&Co 01 test-vehicle through the IVA.
The second part consistent of an ethnographic interview.
Before the test, participants were introduced to the test-vehicle and the IVA. A short distance was driven to make sure the participants felt comfortable with the test-vehicle.
Observation took place during the drive (I sat in the back seat) with additional camera-footage as a support.

One might wonder why, with the timeframe of the thesis set in 2025-2028, testing is done with technology that is already on the market and is not even good by today's standards let alone compared to VA technology that will be implemented in the future. The answer to that is that this usertest is less about the technology and more about the user.
Between now and 2025-2028, technology is likely to make drastic steps. The user however, is likely to change much less drastically in those few years.
Looking past the technology malfunctioning but more into the human responses is aimed to lead a user journey map.
The alternative purpose of the user test was to see if any and which findings from the literature would be reflected, serving as an in-part validation of sorts.

Distraction

During the observation it was noticeable how distracted the occupants were by the VA. The finding from literature that people tend to look where sound comes from (Reimer & Mehler, 2013) and look for clues when the interaction does not occur as desired were seen here as well.
In this case, most of the distraction came from incorrect error handling or a flawed HMI flow.
Humans have a way of handling distraction and if the traffic situation at hand requires more cognitive capacity than they have while trying to operate a functionality, they will leave it and avert the attention back to traffic at the cost of completing that interaction, postponing it till a moment when driving takes up less attention.
The design of the test which translates to a slightly higher push to operate a functionality, being only allowed to use the VA and having to refrain from taking the usual 'way out' through resorting to a touch-interaction or leaving the interaction at all, helps pointing out the flaws in the interaction relatively quickly.

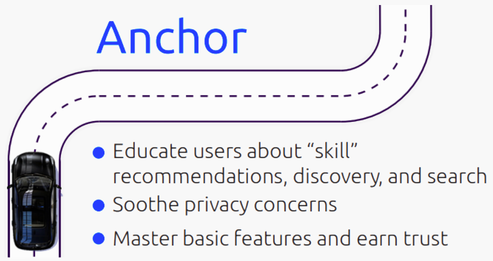


Fig 19 - Anchor phase - From 'Voice on the Go', CRI (2019)

Emotional State

It is clearly visible that the emotional state of the participants is generally negative. Any positivity seems to come from the IVA being less dysfunctional than a previous inte
raction rather coming from actually tending to user's needs i.e. instead of positives these interactions can better be viewed as "less negatives". Remarkably the users remembered these less bad parts fairly positive afterwards. However, the users HAD to use the VA during the test but admitted in the after-test interviews that "in real life" they would leave the VA and go for alternatives to reach their desired goal.This strokes with the "damage control" direction that automakers seem to be choosing as described in the "emotion vs functionality" chapter.

Conclusion

The included quotes from the interviews after the user test illustrate that the frustration found in the user test comes only partially from the technology lacking in power of capturing and interpreting commands correctly.
There seems to be a different part which comes from the user not knowing how to address Frank.
As is also mentioned inCapgemini Research Institute's "Voice on the go" industry report, (CRI, 2019) it is important to educate users on the VA's functionalities. Insufficient awareness of available skills hinder the voice experience and that adds that it is crucial for consumers not only to be aware of the existence of a functionality but also to know the specific commands that will activate said functionality.

Challenges

The literature review and field research render a set of challenges which are listed and assessed to evaluate where I can have the most impact.

Technological Challenges

The automotive interior is a challenging environment for VAs to operate effectively.

- Natural language understanding

The automotive interior is a challenging environment for VAs to operate effectively.
Multiple occupants speaking simultaneously, occupants speaking different languages or accents further complicate successful voice recognition.

- Ambient noise

In this complex environment in which factors such as road noise, varying acoustic and competing audio sources create difficulties in accurately capturing and interpreting user commands.

- Connectivity and integration

Built-in VAs require integration with various in-car systems as well as external services. Think of: infotainment, navigation, entertainment and other connected services.

Privacy and Data Security

In order to provide personalized services VAs collect and process vast amounts of user data, even more so with IVA's expected to connect with- and control smart devices at home in the future. Safeguarding user data, providing clear consent mechanisms and securing transmission and storage of information are significant challenges. This leads to the system processing a lot of consumer data.
In 2019, 50% of consumers surveyes for the "Voice on the go" industry reported to not trust VA's with the security of their personal data and 48% reported IVA's to be too intrusive and seeking personal information too much (CRI, 2019).

Usability Challenge

Usability is a critical factor in the adoption of VAs (Arpnikanondt et al., 2020) and a universal requirement for all user groups that must be establishedin order to deliver a satisfying product. (Khan et al. 2016)

The journey map shows that part of drivers' distress from IVA dysfunctionality can be written to unawareness about what the IVA can do and how these functions can be accessed.
This was confirmed by the findings summarized in the 'Voice on the go' industry report:
in order to book progress with the VA, a first step to be taken is to educate users about function (defined in the report as "skill") through recommendation, search and discovery. (CRI, 2019)

This is unrelated to the technological challenges described before and indicates a whole different field of challenges for the IVA in itself.
I define these as usability challenges, in line with the term 'usability gap' as described in a study on what people would want a perfect VA to do, how many of those needs can be addressed with current state-of-art VA and what people are doing with current state-of-art VA. (Budiu et al. 2019)
It describes a similar phenomenon to the one observed in the user-test, where features exist but are too hard to access for users (a reason for this could be that they are not aware of certain functions), whereas the 'utility gap' describes missing features. The graph indicates represents how, the total realized usefulness of the VA grows when these gaps are tackled.

The challenges facing IVA's are mostly highlighted from the technological side, if recognized at all, but usability inthe sense of knowing what the IVA can do and how it can be done is imported as well. The aformentioned study (Budiu et al. 2019) revealed that IVA's already are able to tend to quite a large percentage of user's needs.

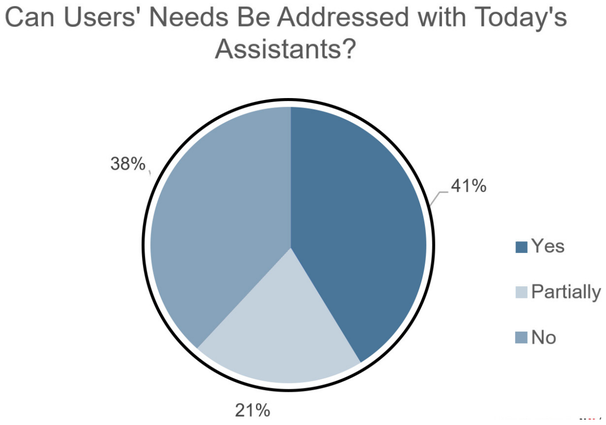


Fig 21 - 'The gaps between what's done today with current intelligent assistants, what's feasible, and what is needed' - From NNgroup.com

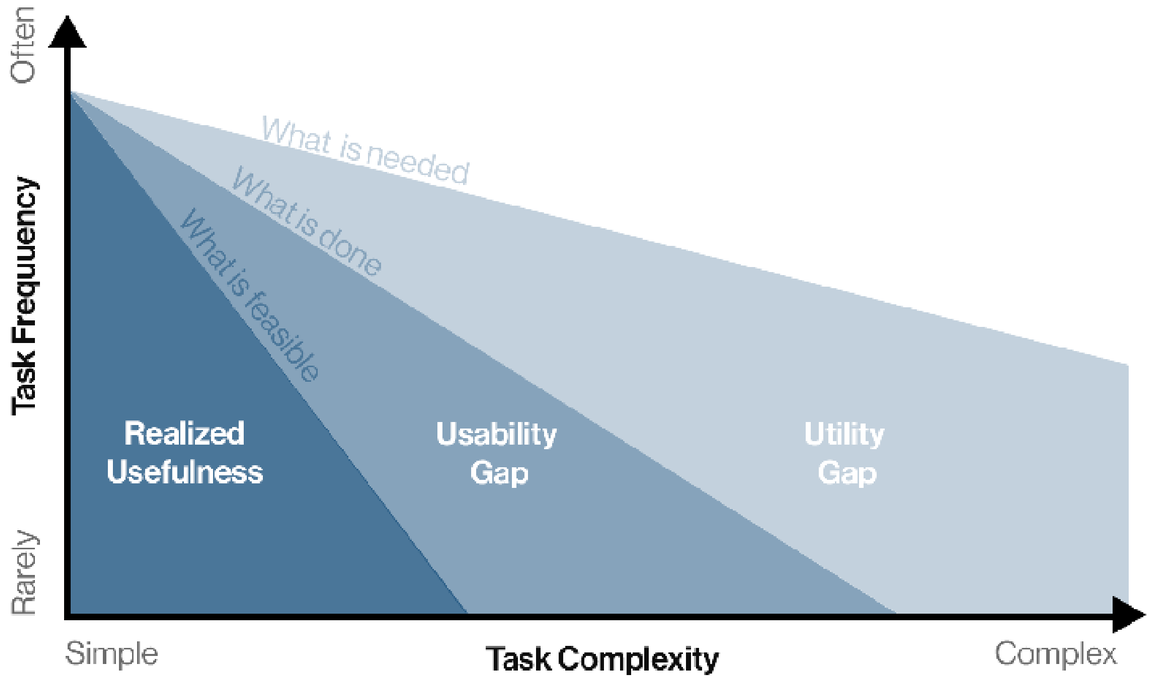


Fig 20 - 'The gaps between what's done today with current intelligent assistants, what's feasible, and what is needed' - From NNgroup.com

Ih this, we see part of the problem revealed:
Automakers overestimate their VAs and focus on closing the utility gap by adding functionalities.
Even if the part of the challenge is recognized that has to do with usability, it is regarded as a technological challenge.
However, the same study shows that even in the case where voice-assistant users were able to access functionalities

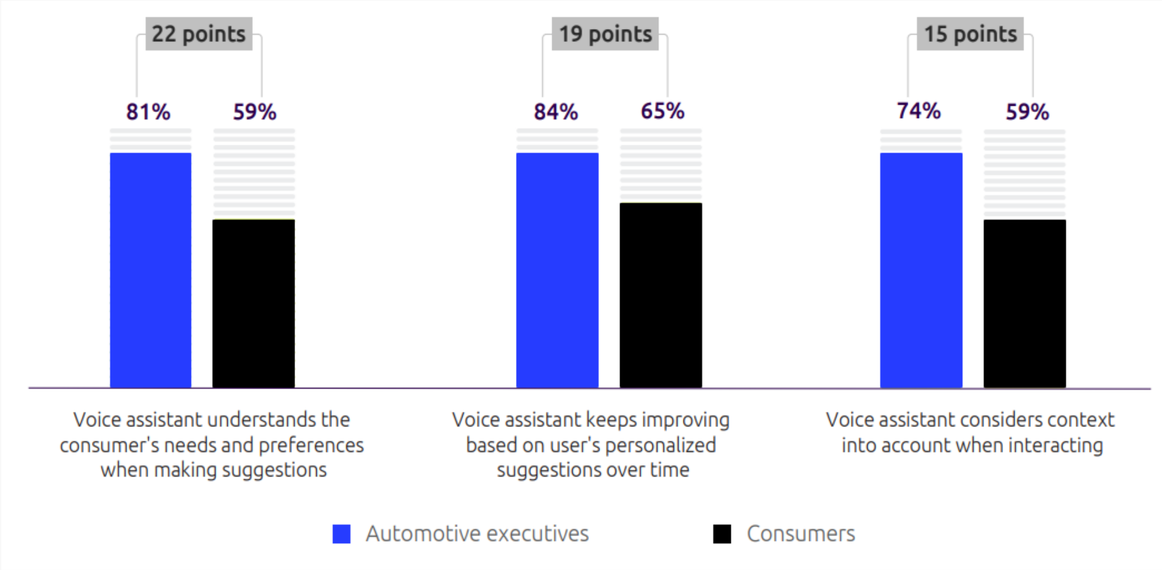


Fig 22 - Automotive organizations organize the capabilities of their IVA's: the points are the differences in percentage - From 'Voice on the go' - CRI (2019)

Conclusion

Achieving robust performance in such dynamic and noisy environments requires advanced signal processing, noise cancellation, and sophisticated machine learning algorithms to ensure accurate and reliable voice-assistant interactions within automotive interiors.

This part of the problem is likely to be solved within a couple of years. (nngroup)
Multiple microphones, better isolation and the implementation of AI.

The VA faces a wide variety of complex challenges.
As described, part of these challenges can be expected to be solved with the advance of technology.
However, it is important for automakers to realize that the challenge is not just a technological challenge.
Another part of the challenge comes from the implementation of that technology in an environment with a certain stakeholder. Automakers need to understand the stakeholders' way of reasoning and thinking in order to be able to look at that challenge holistically and recognize that it is a socio-technological challenge.

My challenge:
Removing the misalignment between user and technology by closing the usability gap, allowing stakeholders to realize the potential of in-car voice assistants.

Challenge

Removing the misalignment between user and technology by closing the usability gap.

Stakeholder

User

No demographics or statistics

When asked, Lynk&Co's MSS Department was unfortunately unable to provide any demographic data or other statistical information about their users or statistical information on type of usage. Only the statements captured in the Co:LAB feedback portal built into the car which do not tell anything about the users themselves, only the complaints. MSS did possess persona's but were not allowed to share these outside the company. Anaysis quickly revealed that there were so many persona's, describing such a wide field of users that the persona's became useless as they did not point out a specific user group in the end. Instead, general information on users of IVAs was consulted through Industry reports like the Voice on the Go report (CRI., 2019) Report X by voice bot, research articles and the user test. The implications resulting from these sources are described throughout this report.

Driver oriented focus

When converging in the "define" stage of the double diamond, the choice was made to focus on the driver because of two reasons:

Functionality:
When prioritizing functionality, which is the main concern for users in Europe, the VA functioning as intended is the most relevant for the driver above any other occupant.

If a driver is to be distracted as little as possible during the driving task the VA is the only option to access any function of the car that is not represented on a physical button within reach.
When the VA does not work the driver has no other option to resort to other than to give up achieving the goal or to take the attention away from the driving task.

Though other occupants in the vehicle may experience frustration when the VA does not work, they could always resort to alternative ways to achieve their goals by using a vehicle's touchscreens or physical buttons
The consequences of a non-functioning VA are much lower for occupants not driving the vehicle.

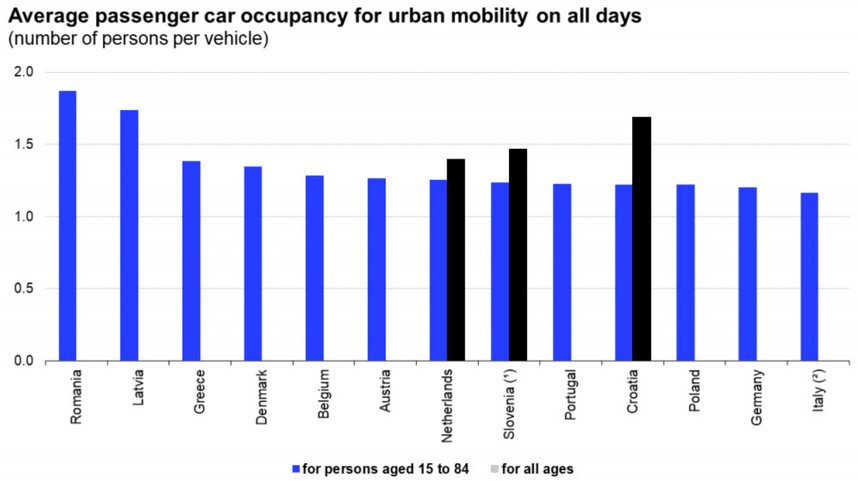


Fig 23 - Passenger occupation on urban traffic in 13 member states - From Eurostrat

Vehicle occupation statistics:
My second argument for focussing on the driver comes from statistics concerning the average passenger car occupancy for urban mobility on all days:

The average passenger automobile occupancy rate for the population of 15–84 years old is typically between 1.20 and 1.90 passengers, with a minimum of 1.17 in Italy (population of 15–80 years old) and a high of 1.87 in Romania. Obviously, the value is bigger when all ages are taken into account. For the three nations that permit this computation, Croatia has the highest average number of carpoolers per trip (see Figure 3), at 1.69.
Over all member states involved, the average is around 1,46 which is well below two passengers. This reflects what one can observe simply by looking around in the streets: the driver is often the only person in a vehicle.

Key User Needs

TRUST

Thrustworthiness
- Human capacities

Anthropomorphism
- Embodiment

- Behaviour :
Show understanding (empathy) and learning (proactivity)

Privacy concerns

Trust
Trustworthiness is what the user needs from the technology so the user will become more likely to adopt VA technology. Trustworthiness can be instilled in IVA's through anthropomorphization..
I define two types of anthropomorphization, called visual anthropomorphism, which concerns qualities like the visual elements, sounds, tone of voice etc. and behavioral anthropomorphism which is about characteristics.

CONTROL

What can I do?

How do I do it?

What is **IT** doing?

Customization

Personalization

Control
Strictly a sub-part of trust, the field research and literary review revealed the users' need for awareness about what the voice assistant is capable of as well as how that capability can be operated. Next to that, the user needs to be able to see what the IVA is doing in order to prevent distraction.
All of this was synthesized as the key user need of control.

Stakeholder

Brand Identity

Since the IVA is regarded to potentially add value to the brand experience,
we can not leave the company out of view when looking at the stakeholders.
Desired to be a brand representative, the IVA has to communicate the brand identity so that is what was looked into on the side of the company.
Currently, Lynk&Co Design has a planetary system intended to visualize the elements making up the 4 main design principles that the staff is supposed to take into account in their activities.
However, I struggled to recognize a substantial part of the nicely worded terms in the brand's activities.
Therefore, I decided to analyze the brand identity and resynthesize it to a number of terms which I felt to represent the core of the brand identity.

This brand identity was resynthesized after analyzing the following material:
- Internal brand documents
- Conversations with Lynk&Co staff
- A presentation on the 4 design principles by Senior Vice Present Lynk&Co Design Stefan Rosen
- Visiting 2 Lynk&Co clubs

After the resynthesis, I validated my work with the brand department of Lynk&Co in a short conversation with Ola Ingvarsson, chief designer at the Lynk&Co Brand Department.

In Europe, the cars have only been sold since 2021. For any brand as fresh to the market it is important to distinguish oneself and emphasize why it is a relevant alternative to the esablished competition.
On the European market, Lynk&Co intends to distinguish itself by it's all-in-one offering of mobility without the hassle of car ownership. Cars can not be acquired through dealerships,
consumers can get to know the vehicle in the clubs but have to order them online.
This no nonsense way of offering is reflected in the lack of options to choose from when ordering a car: the car comes only in two colors, for instance.

The lack of and non traditionality conquer space on the market by leaving people with a strong impression. The European design staff sees this need for distinctiveness.
But the Chinese stakeholders are very cautious regarding the brand's outspokenness.
This results in a misalignment in the views of the stakeholders in China and the design staff in Sweden.
Rather than one clear direction, it seems to want to play safe, cover multiple fields resulting in the brand standing out nowhere in particular. This is also displayed in the brand's design principles.

Fig 24 - Lynk&Co Design's values and principles - From Lynk&Co Design

Confident

Relatively new to a highly competitive market, Lynk&Co has to conquer its space on the market and for that, it needs to put it's shoulders out and show what its values are.
Next to hasslefree ownership model, Lynk&Co aimsto achieve this by leaving consumers with a lasting impression.
An example is it's use of provocating marketing statements like "leave the ownershit behind".
Though it may sound superficial, it does grab people's attention (good and bad) while referring to the brand's ownership model.
The lack of fear for creating dividedness amongst consumers should be put forward more if the brand wants to appeal to the younger users. The vehicles offered by Lynk&Co are mostly urban SUV's with a strong, planted stance; this already reflects 'confidence' well.

Quirky

One term that keeps returning when you ask Lynk&Co staff about the brand is quirkiness, while it is not represented in internal documents. This aspect is currently under represented in the vehicle. (If anything, the available wheel designs feature asymmetricly coloured spoks and the positioning of the DRL lights and indicators high on top of the bonnet and design of the taillights are different from what is currently on the market) but the marketed non-conformist attitude as it is represented by the outlandish, colourful design of the clubs should be emphasized more in the car itself.
This is one example where further outspokenness is currently limited by the different values of the Chinese stakeholders.

Engaging tech

An example of Lynk&Co's observed confidence in distinguishing itself by taking another route than most of the competition: Lynk&Co aims to highlight technology in a market that is currently characterized by the 'shy-tech' trend initiated by Tesla, that eliminated as many buttons as possibleby transferring everything in to the CSD. Lynk&Co aims to reel users in with the digital experience in the vehicle. Lighting, sound, animation - all intended to deliver a gaming-inspired audiovisual experience.
More than the mobility the consumer asks for, but Lynk&Co believes in "more is more". I do not, but it IS clearly reflected in the brand perspective and activities so it belongs in the brand identity. Included in this are gamification and playfullness.

Fig 25 -Lynk&Co 01 Design details

Design space

Requirements and design space

The challenge is defined and the key user needs and the brand identity are identitied.
After various iteration for design spaces made through utilization of a spiderweb format,
the final design space was found by formulating requirements in the form of 4 questions and putting
those against the key user needs and brand identity aspects.

	What should it do?	How should it interact?	What should it look like?	How should it behave?	
Trust	Show human capacity Soothe privacy concerns	**Proactive** Learning Context awareness	***More human, but only just enough.*** - Privacy intrusion - Uncanny valley - Non distracting		
Control	Show what it can do Show how that can be done **[Usability]**	Feature Introduction Feature Discovery	Signifiers, Affordances, Feedback, Conceptual model, Restraints.	**Driving:** Pragmatic	**Non-driving:** Show Personality Bold, engaging, playful
	Let user know what it is doing	Always show state	Show receiving, outputting, processing, error state or idle.	Short, clear notification	Deeper explanation
Brand	Provide memorable experience	Functionality first, then comfort	Reflect brand identity: Tech-look	Reflect brand identity: Confident Quirky Engaging	

Fig 26 - The design space

Designing for Trust

	What should it do?	How should it interact?	What should it look like?	How should it behave?
Trust	Show human capacity Soothe privacy concerns	**Proactive** Learning Predicting Context awareness Empathic	***More human, but only just enough.*** - Privacy intrusion - Uncanny valley - Non distracting	

Fig 27 -Designing for Trust

Adoption and aproval

*Trust is a complex notion comprising the conviction in an individual's intentions to act with benevolence, integrity, predictability, or competence (*McKnight & Chervany, 2001) This definition of trust makes it clear why it is relevant for adoption a study by (Borau, Otterbring, Laporte, & Fosso Wamba, 2021) states that in order to increase the approval and the use of a VA it is advised to include human capacities in the machines because these human capacities suggest a human level of competence.
This means that a higher level of trust(worthiness) leads to a higher level of adoption.

This definition of trust makes it clear why it is relevant for adoption: technology is adopted better if it is perceived as more human for the reason that it is perceived as more capable.
Gaining trust is cruscial for the future of the VA. (Voice on the Go, CRI, (2019) . As trust is essential with its possible potential.

Anthropomorphization

A significant factor influencing trust in any nonhuman entity is anthropomorphism (Waytz, Cacioppo, & Epley, 2010). Anthropomorphism is described as the attribution of human form, personality or characteristics to something non-human, as an animal, object, or god. (Oxford English Dictionary, 2023).

Visual Anthropomorphization

In an attempt to gain awareness on how to get people to adopt autonomous driving cars in the future, much research has been done on increasing trust in the scenario of a virtual assistant representing a (semi) autonomous vehicle.
(A virtual assistant is similar to a VA, but more comprehensive)
This field of research has mostly approached anthropomorphization in the sense of the "form", relating to what in this thesis is described as "the visual representation", and has studied this tactic from different sub-angles:

- Studies have delved into the significance of visual embodiment. (Reinhardt, Hillen, Wolfs, 2020), (Yee, Bailenson, Rickertsen, 2007), (Kim, Bolling, Haesler, Bailenson, 2007), found that it plays a crucial role in creating a pleasant interaction, especially when the user's visual attention is not required. However, the exact level of realism in the embodiment may not be as crucial.
- More specific studies looked into the advantages of applying a humanlike face for virtual assistance and which specific fascial features are the most important to apply. (Edsinger, O'Reilly, 2005)(Blow, Deutenhahn, Appleby, Nehaniv, Lee, 2006) (Breazeal, 2002).

During their respective experiments in this field, Kalegina, Schroeder, Allchin, Berlin, and Cakmak (2018) have found that faces that lacked some or multiple of these elements and were consecutively found less human, were also found less trustworthy.
With Li Dingjun, Li & Rau, Pei-Luen & Li, Ye. (2010)'s demonstrating in their study that a robot's visual embodiment significantly influences users' likeability and that there is a notable correlation between likeability and trust in the robots, one could say that likeability influences trustworthiness as well. (It is clear that this is what the designers of NOMI concluded.)
However, that does not directly mean that implementing a human face in the VA is the way to go.
Because People are wired to respond to faces. Therefore, the balance between face and abstract is balance between recognition speed/control and distraction.

Behavioural Anthropomorphization

Anthropomorphism also concerns personality and characteristics. These qualities encompass aspects like emotion, intention, conscious feeling and agency, which is the ability to engage in rational thinking. (Gray, Gray, & Wegner, 2007)
This cognitive process often arises from our natural tendency to understand and relate to the world around us through the lens of human experiences and social interactions.
In philosophy, definitions of 'humanness' describe these mental capabilities as crucial to being human. (Dennett, 1978, Locke, 1997).
Moreover, humannes tends to be characterized through emotions that suggest higher order mental processes like self-awareness and memory. (Leyens et al., 2000) as well as qualities that include cognition and emotion (Haslam, 2006).
Though these sources are older, it is clear that next to form, anthropomorphization also concerns behaviour.

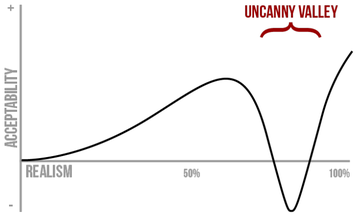
Human capacities in the machines as mentioned by (Borau et al,2021) include verbal and non-verbal contact (Borau et al., 2021). This humanlike interaction with the VA helps to increase trust and the relationship between the machine and the user (Borau et al., 2021) and with that, adoption as was reasoned in the first paragraph of Designing for trust.

Waytz, Heafner and Epley(2014) conducted a study to investigate how anthropomorphizing technology influences people's trust through its competence. The findings revealed that as the technology's humanlike attributes increased, participants showed higher levels of trust in its ability to perform competently.
In essence, the study indicates that technology is perceived to perform better when it exhibits human-like characteristics.
Human characteristics do not just involve simple elements like a face or a body but rather deeper human characteristics which are described as "a humanlike mind, capable of thinking and feeling". This can be distilled into the notion that attributing human characteristics, a humanlike mind, human behaviour to the VA will lead to an increase of trust in the technology.

That leaves the question which type of characteristics is suitable in the context of the VA and this project.

Conclusion

When it comes to the adoption of a VA, trust is cruscial.
Trust can be instilled in a VA through anthropomorphization.
Where earlier studies focused on making something look human (defined by me as visual anthropomorphization) to instill trust in technology systems, more recent studies have revealed that instilling human characteristics in technology systems through behaviour (defined by me as behavioural anthropomorphization) is more relevant.



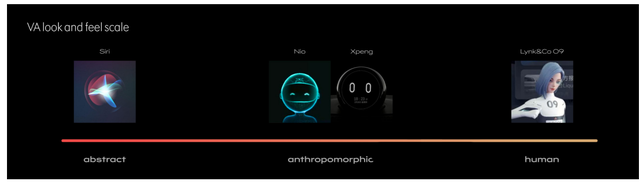


Fig 28 - Lynk&Co Design's values and principles - From Lynk&Co Design

Designing for Control

	What should it do?	How should it interact?	What should it look like?	How should it behave?	
Control	Show what it can do Show how that can be done [**Usability**]	Feature Introduction Feature Discovery	Signifiers, Affordances, Feedback, Conceptual model, Restraints.	**Driving:** Pragmatic	**Non-driving:** Show Personality
	Let user know what it is doing	Always show state	Show receiving, outputting, processing, error state or idle.	Short, clear notification	Deeper explanation

Fig 29 -Designing for Control

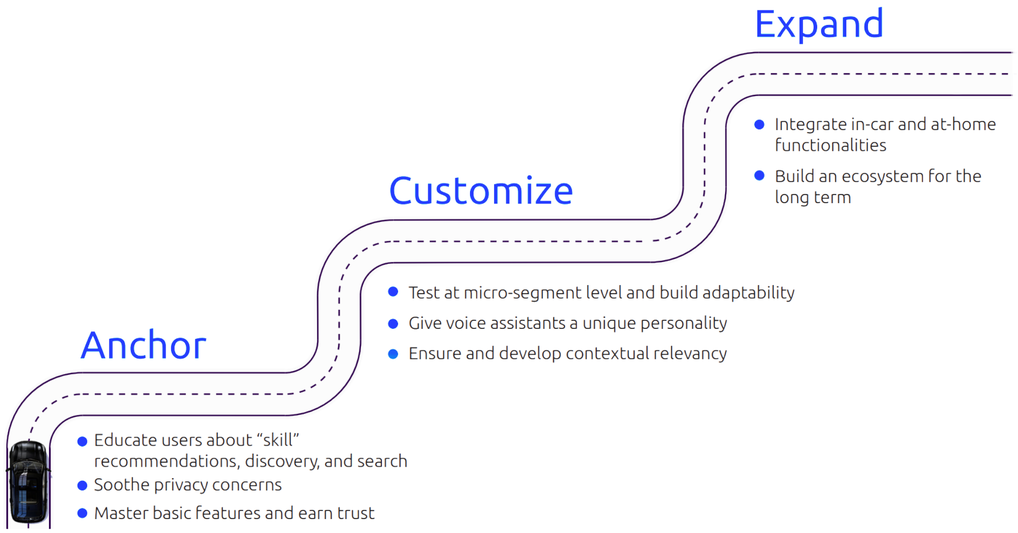


Fig 30 -The phases and steps necessary for IVA adopion - From 'Voice on the go' - CRI (2019)

Having been observed across all test-subjects during the field test, the considerations that eventually were found to be along the line of *"What can I do?", "How can I do this?"* and *"What is IT (the VA) doing?"* were determined to be key elements indicating a need for control amongst users of IVAs.

That these considerations are important for the future of IVAs is indicated by Capgemini Research Institution's report 'Voice on the go' (2019) describing that it is essential to educate users about "skills" (in this thesis indicated as functions) as a part of what they call the Anchoring phase. Educating users about "skill" recommendations, discovery and search is a way to address the first two questions representing of the considerations observed by field test participants.

This is still leaves the consideration "What is IT (the VA) doing?" unaddressed while also leading to the need for a way to perform that education.

The solution was found through an article by Kathryn Whitenton (2017) in which she describes how audio signifiers are used to convey VAs' functionalities and refers to 'the gulf of execution' and 'the gulf of evaluation'.

Fig 31-Interaction framework- From "The design of Everyday Things' by Don Norman (2013)

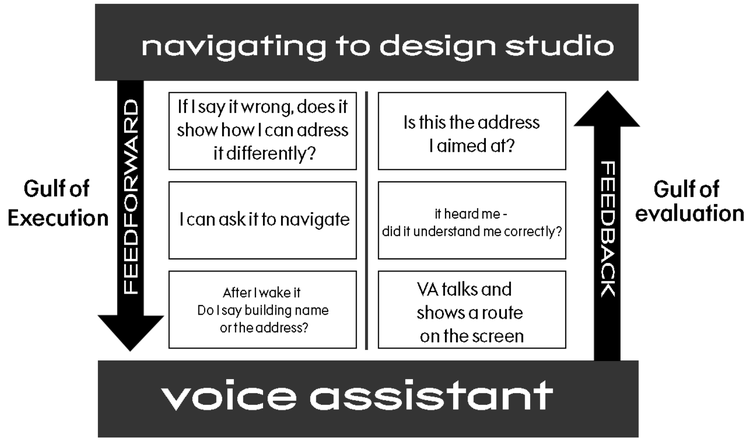


Fig 32 -Interaction framework in case of navigating to design studio- From "The design of Everyday Things' by Don Norman

The Gulf of Execution and the Gulf of Evaluation

In his book "The Design of Everyday Things" Don Norman mentions that to successfully interact with any system, people must be able to(Norman., 2013):
(1) **figure out what actions to take** in order to achieve a specific goal [the Gulf of Execution]
(2) **understand the results** of those actions [The Gulf of Evaluation]
He describes this as (1) crossing the **Gulf of Execution** and(2) crossing **Gulf of Evaluation** respectively.

In the context of the IVA this translate to:
Users must be aware of:
(1)which of their direct needs can be addressed by using the IVA
(2)the feedback from IVA to the user / understanding the state of the IVA.

Norman's book includes a model displaying the barriers a user usually comes across when crossing the gulf of execution and gulf of evaluationn, leading to the introduces his seven fundamental principles of design which are necessary to crossing those barriers.
(It was only after founding this model, that the considerations of the field test participants were summarized to the three questions mentioned in the first paragraph.)

Discoverability | Feedback | Conceptual Model | Affordances | Signifiers | Mappings | Constraints

When designing the concept, these seven barriers are what needs to be taken into consideration to address part of the key user need of control.
Related to Normans's Gulf of Evaluation is Nielsen's set of usability heuristics.

Showing the state

The first one is especially relevant for the design of a VA:

"System Status
When users know the current system status, they learn the outcome of their prior interactions and determine next steps." (Nielsen., 1994)

In the case of the IVA, this system status is called "state" and is displayed by the VAs' visual element. The design of the state is further elaborated on in the Concept chapter.

(One might argue that ideally, a VA would need no visual representation as the successful execution of a command would be the confirmation that a command has been executed. However there are enough exemptions to this rule to render a VA visual still relevant.)

In the context of in-house VAs described in Kathryn Whitenton(2017)'s article most VAs do not include a screen, which means that users have to imagine or remember the commands or queries that lead to their desired goal. This increases the cognitive load.
It is argued that it is best to include a visual signifiers with audio cues when a screen is available.
But in the automotive context, screens are the foremost cause of distraction.
This means that in the design phase, the need for control and the prevention of distraction will have to be weighed against each other.

Designing for Brand

	What should it do?	How should it interact?	What should it look like?	How should it behave?
Brand	Provide memorable experience	Functionality first, then comfort	Reflect brand identity: Tech-look	Reflect brand identity: Confident Quirky Engaging

Fig 33 -Designing for Brand

Brand representative

The supervisory team of Lynk&Co expressed that the brand desires the VA to serve as a brand representative. The literature research pointed out the perceived potential that is behind this desire.

Functionality first

It is described earlier in this report that technology is perceived as more capable when it is shows human characteristics because it suggest competence. This competence refers to the VA being able to achieve it's goal, for which it has to function well.
In Europe, IVAs are not regarded as a companion, but as a tool.
Siri, Alexa, and Google Assistant users perceive these platforms in three distinct manners: as an interface, a personalized assistant, or a cognitive system. (Budiu et al. 2018.)
This shows an emphasis on its function as a tool, rather than a companion, which means that contributing to the functionality of the technology is more important for a VA than tackling disfunctionality through affective strategies like NIO does with NOMI for instance.

Reflecting the brand identity

In it's look and behaviour, it has to reflect the brand identity that has been synthesized earlier.

Guidelines for designing an IVA

Based on his UI/UX research into IVAs, the writer of The Turn Signal Blog article described earlier in the literary review compiled a set of guidelines for the design of a VA.
There is a total of 18 guidelines divided over the following categories:

- 'General design'
- 'Tightly integrate the VA with the rest of the interface'
- 'Make it personal'
- 'Error handling'
- 'Adapt to the driving context'

These guidelines are on quite a general level but relevant to mention as they represent some of the research I took into account with the design phase that felt too unspecific to include in my design space.

1. Auditory information should come from the same location as visual information.
2. Always show the state of the system
3. Allow for voice and manual activation.
4. Be aware of visual distraction.
[5. Choose best input and otput modality.]
6. Allow drivers to reference any element that is visible on the display.
[7. Dont make the voice UI full screen]
8. Vary responses
9. Match the personality and emotion of the driver.
10. Be aware of the context of the driver
11. Ask direct questions.
12. ORevebt error loopt, always vary the prompt if misunderstood
13. Adapt to the level of the user
14. Keep the number of interactions to a minimum.
15. Deliver a message when the driver is not engaged
16.Wait longer because the driver might be otherwise engaged.
17. Let drivers control the voice assistant
18. Play around with voice assistants!

Fig 34 -Guidelines for Designing an in-car voice assistant - From The Turn Signal Blog - Kessels (2022)

Concept

The proposed concept mainly concerns behavioural elements added to the visual aspect of the IVA.
The biggest change appearance-wise is that the new IVA-visual moves horizontally along an area on the dashboard, placed above the DIM and CSD, stretching from one to the other.

A slider switch formed the analogy for the horizontal movement within a constrained area.
The initial idea for a sliding movement arose from a the desire to express the IVA approaching the user through a physical movement. I realized the IVA could 'slide' towards the user and that this form offered opportunities for inclusion of more The slider element is very suitable to display the various elements of the concept idea.

One of two functions of this horizontal visual is to represent approaching the user, by moving from the end that is farther away from the driver towards the end which is closer to the driver .
The other function is to indicate in which of the two predetermined modes the IVA is operating.
As well as the transition from one mode to the other.
By indicating which mode it is in, it indicates the depth of communication as is described in the next chapter.
In the end, the decision was made to let these modes depend on the car's state: driving or parked.
Other motivations for the determining modes were considered like cognitive load but were not pursued in the end. (Appendix)

The choice to make the area over which the IVA "slides" constrained, like a slider switch, is to make sure the user always knows where to look for the IVA. This makes the visual follow the design principle set up by Norman, described in the 'Design for control' sub-chapter of the chapter on "Design space".

2 Modes: DIM and CSD
- Position signifies the mode (Control)Always present (showing state)
- Feeling of control for users (Control)
Approaches the user
- Showing proactivity (Thrust)
- Shows confidence (Brand identity)
Slider metaphor
- Digi-physical element (Brand)
Clear area where VA ''lives''
- Constrained (Control)
Blocking interaction
- Negating proactivity (Control)

Depth of communication

Mediation

It is realistic to assume that AI driven conversational VAs will have their place in our cars in the time period 2025-2028. As mentioned earlier in the report, Mercedes-Benz is already beta testing ChatGPT software in their vehicles. (Mercedes-Benz takes in-car voice control to a new level with ChatGPT, 2023) This translates to users having easy access to an unlimited amount of information and functionalities while driving.
In itself, this poses a new threat regarding distraction and added cognitive load. It is in line with the purpose of the IVA to mediate that amount of information and allowed functionalities. This concept does that by making a distinction through operating in one of two available two modes. The mode the IVA is determined by if the car is driving or not driving and in turn, determines the depth of the communication of the IVA. This aspect mainly tends to the control-needs of the users.

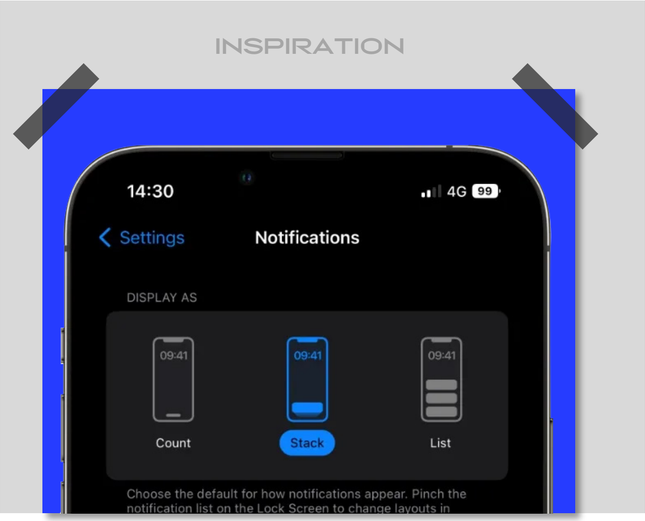


Fig.35 - The inspiration for the depth of communication came from the System of the Apple notification center.

Mode 1

When the car is driving, the IVA enters mode 1.
Even though there is no direct connection between cognitive load and accidents, (as discussed in the literature review) the focus of this driver should be as much with the driving task as possible.
Glances away from the road, totaling more than 2 seconds for any purpose increase near-crash/crash risk by at least two times that of normal, baseline driving. (Dingus et al. 2006)

In mode 1, the IVA's depth of communication is relatively shallow.
The IVA is polite but pragmatic and to-the-point. It will allow limited communication and store the results of deeper, more intricate queries to when mode 2 is entered.
It will also indicate this to the driver, teaching the driver indirectly which moments are and are not suited for elaborate interaction with the vehicle's systems. This pragmatic way of communication serves to limit the distraction while the driver is occupied with the driving task.

In this mode the IVA is located front of the driver so the driver perceives it in the peripheral vision when the driver's view is focused on the road. The driver does not need to take eyes of the road to perceive the IVA and is also not distracted by it.
In the 'worst-case scenario' and the driver's focus does shift to the IVA, the eyes will not have to wander too far off and are more likely to return within the aforementioned 2 seconds.

Since the IVA is meant take up as little as possible focus of the driver in this mode, the visual in this mode is displayed in a low fidelity appearance. This also serves as a symbolic illustration for the relatively 'simple' set of interactions the VA will allow in this mode.

Fig 36 -Mode 1 and Mode 2

Mode 2

Mode 2 is activated when the car is not driving (neutral or parked).
In general, a driver is not required to constantly have eyes on the road and hands on the steering wheel as strictly when a car is stationary as when it is driving. The driver has more “room” to turn attention towards the IVA.

In this mode, the purpose of the IVA is less about operation functions, but more about serving as an assistant to the user. The depth of communication of the IVA is deep and this mode is also where it shows it’s personality. Personality positively benefit the relationship a user will build a VA and the display of personality features is rated most appropriate in settings where the driver is not preoccupied with the primary task of driving. (Braun, Broy, Pfleging, and Alt, 2019)
The envisioned personality reflects the brand identity values set up earlier and is confident, quirky and engaging.

Similar to the personality, visual embodiment is important for a pleasant interaction, especially when the user’s visual attention is not required by the driving task.
Therefore, the visual is slightly more elaborate in this mode as well as to signify the more elaborate functionalities it allows.

As decided earlier, this IVA is designed for drivers. My current solution for the scenario where a passenger desires deeper communication (mode 2) while it will only communicate relatively shallow with the driver while driving is by making a distinction between driver and passenger based on either voice recognition or area where the voice is registered. The IVA will allowto deeper requests of passengers but still respond in limited words as to not distract the driver. When the driver’s gaze wanders to the screen, the IVA’s visual redirects it which is exlained in the next chapter.

Levels of Proactivity

Introduction

Next to the depth of communication, the main element of this concept is it's proactive behaviour.
The proactive behaviour is primarily featured in the driving context.

The practical purpose of the proactive behaviour is to give users insight in what the voice assistant can do and how the users can apply this to achieve their goals through an as little as possible distracting interaction. This is how the voice assistant tends to the key user need for control.

With its proactivity, the IVA implies to possess a number of human capacities like learning, context-awareness,
in order to enhance the users perception of it's humannes and with that it's competence > trust> the adoption of the technology.

Fig 37 - The inspiration for the depth of communication came from the System of the Apple notification center.

Feature introduction

During feature introduction the IVA makes the user aware of what it can do and how that could be done with the IVA.
Feature introduction takes place on first-time interaction, or after the system noticed manual operation of a functionality for which the IVA would be a more appropriate way of operation.
After the IVA approaches the user, it will make the user aware it can do this task for the user in the future. It then gives an example of a command but doesn't require specific commands due to AI language processing technology. It formulates and build it's sentences in a different ways to enhance the perceived humannes.

The VA detects that the user hasn't utilized a specific feature, in this case, the voice-controlled climate control. It subtly interrupts the driving context with an attention-grabbing prompt, informing the user about the existence of the feature and its potential benefits. The VA then gives a brief a demonstration to showcase how the feature works.

By taking the initiative to introduce a feature and additionally making the user aware about which moment is suitable, the VA encourages the user to explore and leverage the functionality that may enhance their driving experience. It serves as a helpful guide, providing information and guidance on features previously untapped through the IVA, ensuring that the user can make the most of the available functions of their car (and deemed suitable) while they are driving.

User-based proactivity

The second type of proactivity is based on the user's behaviour.
The VA analyzes interaction history, preferences, recognizes patterns and uses that to suggest relevant features tailored to the user. This type of proactivity teaches users it could ask the IVA to execute functions which depend on the user's behaviour.

In order to avoid this type of suggestions being perceived as too intrusivene by the user, the degree of personalization start at a low level and is increased over time.

- Early stage user-based suggestion example:
During a driver's commute home from work, the VA could ask if they would be interested in having food delivered.
- Medium stage user-based suggestion example: "Since you often stop at coffee place X on your way too work, you might like this new coffeeplace I found which is on your route and has shorter waiting times. "
- Late stage user-based suggestion example:
"I've noticed you ... don't use the me(the car) on Wednesday evenings, would you like me to display myself as available for borrowing(by Lynk&Co members) uring these peroids? "

Additionally, also it make clear on what data the suggestion it does is based.
"I have noticed that.." "As you ..." "Since you..."
Finally, if the user still feels this is too obtrusive, the user has the option to regulate the level of intrusiveness in the settings screen mentioned in the "Settings" sub-chapter further on.

Context based proactivity

The third type of proactivity is context-based proactivity.
The VA offers suggestions based on the current situation, current user behaviour and environmental factors. This type of proactivity teaches users it could ask the IVA to execute functions which depend on the current context.

"Were passing the Eiffel tower! I could tell you something about this, or other cultural points of interests you pass."

"We are nearing roadworks, I can look for a route around them."

Proactive safety

Within context based behaviour there is also opportunity for the IVA to take action for safety.
For example: Eye tracking technology can realistically be expected to appear in our vehicles within the scope of the thesis project. The eye-tracking data can be directed towards the IVA system.
When the driver is driving (IVA in mode 1) and this system detects the driver's gaze focusing on the CSD for a specific amount of time, the IVA's visual will act with a movement intended to redirect the driver's gaze back to the road: the visual disappears from its position in front of the driver and appears above the CSD in bright red (symbolic for warning) to shortly grab the drivers' attention and rapidly slides back to it's position above the DIM, in front of the drivero with a "rolling movement" to enhance the motion while its' color changes to white to signify it's directing the drivers gaze from a dangerous area (red is a color ssociated with danger) back towards the safe area (white is a color associated with safeness) return to 'idle mode'. Next, the visual dims down to signify it's return to idle mode.
The rolling movement is accopanied by a subtle clicking, scrolling sound.

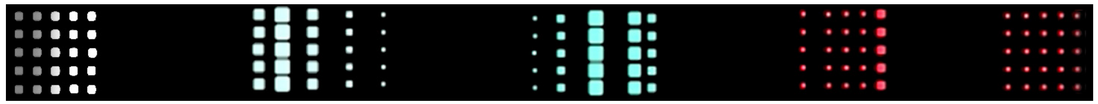


Fig 38 - The visual of the IVA when it direct the driver's gaze, from right to left.

Settings

The IVA has a specific settings window in the car's system which displays the settings that can be adjusted, progress of the user and the tasks which are stored.

Fig.39 - The settings window

Proactivity level

The proactivity-level bar shows the overall level of proactivity of the VA.
With this bar, the user can manipulate how often the VA will approach the user to do a suggestion.

Advanced

In the advanced options, this level of proactivity can be tailored per specific category of functionalities within the reach of the VA.
Higher levels of proactivity will result in a steeper learning curve and thus the user will become aware about more functionalities of the VA in a specific period of time.

Suggestions and progress

The suggestions and progress bar serves to show the progress of the user and skill with the functionalities in the various levels of category of functionalities.

Tasks

In the tasks tab, the VA stores information related to requests that were done in mode 1 that went beyond the amount of information the VA will display in that mode.

Personal account

All data included in the IVA and settings are connected to the user's personal account on the Lynk&Co app. This way, users always have their own VA with them independently of which Lynk&Co car they are driving or if there are multiple people often driving the same vehicle. This does mean that users always need to bring their phone with them.

Material

The technology envisioned for the implementation of the concept is called “smart surface”.
Smart surfaces can be regarded as a combination of a material and a touchscreen.
With smart surfaces, lit-up, touchable elements are be projected through materials like fabric, wood or plastic. It is less obtrusive than a screen and can also be ‘just’ a material when the interactive elements are not lit up.

The companies MUI Lab and Tactotek are in the forefront of developing this material, with Tactotek already working with suppliers towards implementation in the automotive market; it is a realistic use for this type of material. The light can be so bright that direct sunlight does not make it less visible.

It would be possible to have the visual only appear when the IVA is active, but in agreement with Nielsen’s first usability heuristics(Nielsen., 1994) I decided that the visual is always there, within the horizontally constrained area that in turns adheres to Don Norman’s 7 Design principles (Norman, 2013) as described in the “Design for control” sub-chapter of the “Concept” chapter.

Fig 40 -Examples of smart texture applications

Sound

Even though it is not part of the domain of this thesis project, the presentation of the new concept would not be complete if it still contained the sounds and flawed voice of the current Lynk&Co VA. To signify the importance of a VA being designed holistically, attention has been paid to the sounds and the voice that go with the concept of the VA visual.

Audiovisual Congruence

A VA does not only feature vocal sounds.
Short, audibles called earcues can act as simple clear signifiers, similar to like audible pictograms.
Together with the sound engineer of the HMI department, sounds were created that align with the elements that were synthesized to a brand identity.

Tone of voice

As mentioned in the description of current Frank, regarding the use of a female voice:
Where assigning a gender to the Virtual Assistant (VA) has been observed to enhance its perceived humanness (Borau et al., 2021). Notable differences in gender perceptions have been identified, with women often being perceived as possessing more favorable human qualities, such as friendliness, warmth, and empathy, along with the ability to recognize and experience emotions (Borau et al., 2021).
It is worth mentioning that older studies previously demonstrated that customers tend to prefer a female voice for the VA due to its superior ability to convey and evoke emotions (Eyssel et al., 2012).

Taking into account a voice-assistants role as a brand representative, a slight hint of roboticness is included to hint at the brand’s desire to emphasize its techy character.
This is the argumentation for my choice of a female voice with a robotic tone to it.

Visual

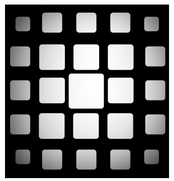
The choice was made to keep with the visual that Frank currently has.
Understahdably, this may seem to deny the previously mentioned point of the visual element adding to a higher humanness of the VA, which is in turn important for enhanced trust.
However, the following aspects were considered:

- The current visual adheres to the brand identity elements as I have observed and redefined them:
  The square main shape distinguishes itself from most VA visuals that feature rounded, circular shapes like Siri or Google Assistant.
  The straight, strong lines of the square elements displays a confidence. while it's movement shows a playful quirkiness. The gridlike, pixelated appearance displays a tech-inspired look.

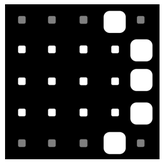
- Also, the design for the VA adds the dimention of behaviour to the VA and does that on multiple levels. This is a lot to grasp for new users as well as more experienced users alike. Maintaining the existing visual offers users a familiar aspect that they can 'grab onto' while getting to familiar with the added behavioural dimention.

- Even though an effort was made to make the VA visual as little distracting as possible by allowing it to exist in the peripheral vision rather than focus needed to put on it, it is undeniable that the moving elements of the VA moving across the dashboard will not eliminate distraction totally and through it's mere existance will add a degree of distraction.
  Taking into account that humans are wired to focus on memetic qualities and pick out faces, adding fascial elements would have added to this distraction and with that would have crossed the boundary of what I deemed allowable.

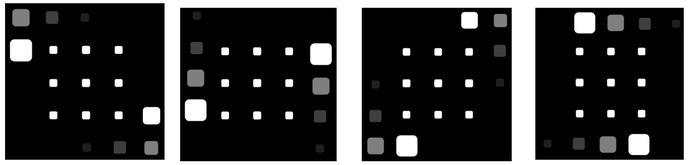
Speaking



Listening



Processing



Idle

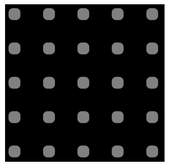


Fig 41 - The 4 states of the IVA in the concept

Mode-Switch

Proactive suggestion

Proactive safety

Fig 42 -IVA visual per scenario

Final Design Spread

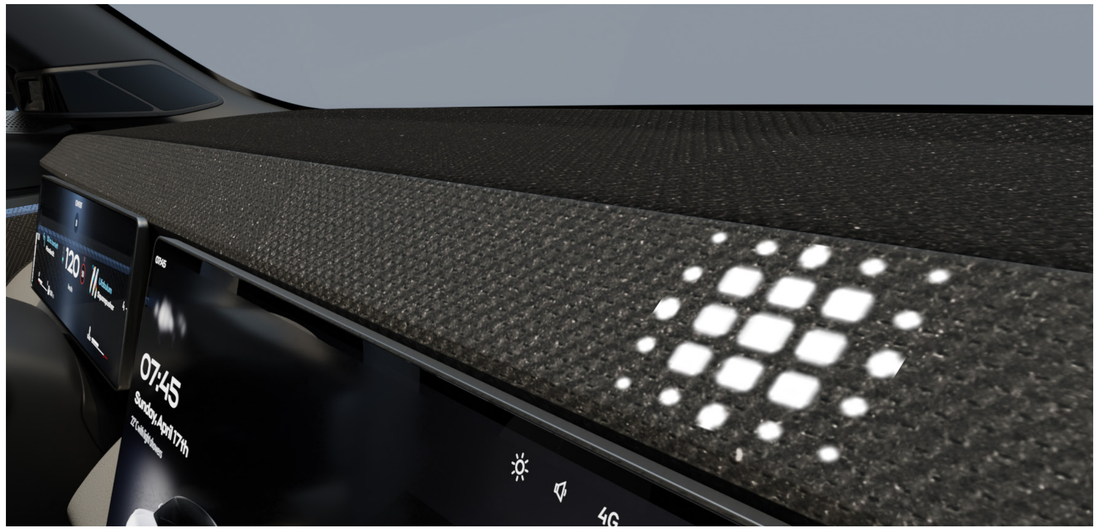


Fig 43 - The final implementation

Testing and evaluation

Six experts were asked to evaluate if the concept appropriately addresses the challenge and if it is a viable, original solution covering the user needs while also being in line with the brand.
After a summary of the process towards its formation the evaluation took place along the course of an open-structured interview.
Initial questions were the same for all experts while subsequent questions would be based on their earlier answers and aspects they emphasized as well as on their specific field of expertise.
Four of the interviewed experts were from within the company and the two other experts were connected to TU Delft. The evaluation is summarized per the main topics which were addressed.

The experts:

Stefano Oliva (Lynk&Co, Chief - Digital and Technology | Advanced and Speculative Design | Brand and User Experience)

Bilal Bateh (Lynk&Co, HMI Lead Designer)
Active in the field of European Market, marketing background.

Stephen Gioriou (Lynk&Co, HMI Product Owner)
Expertise in digital and technological area

Samuel Wijk (Lynk&Co, HMI Chief Designer)
Expertise in graphic aspect, digital experience

Nicole van Nes (Professor Human Centered Design for Smart Mobility at TU Delft & Group Head Human Factors in Vehicle Automation at SWOV Institute for Road Safety Research)

Oscar Oviedo (Professor in Responsible Risk Management & Human Factors Engineering at TU Delft)
Areas of expertise include human-systems integration, misuse of technology, digital work, and transport safety and security.

Fig 44 -Expert evaluation test-setup

Due to practical reasons as well as both physical and digital interior models not allowed to be shown to people from outside the studio, the experts outside of the studio were given an introduction to the concept through a short presentation.

Function vs emotion
All experts understood and supported the choice for functionality over emotion in the context of this thesis. Most argued from their own perspective that they would not like an IVA mainly focused on emotion / affective aspects.

Technology: All experts do stress the importance of the IVA's technology being the biggest determinant for the realization of its potential. When asked, all experts confirmed that the assumption that AI technology is likely to solve most of the IVA's technological challenges by the time it is 2025-2028 is a legitimate one to make.

Challenge definition
The elephant in the room regarding the challenges facing the voice assistant are the technological challenges. The experts did acknowledge that these are not the only challenges though and that in the circumstances of the thesis, I have found a relevant and interesting challenge. OO described: on a scale of 100, 80% Might be due to technological challenges, 15 percent usability and 5% privacy.

Distraction
OO and **SO** commented on the paradoxical element in adding a visual to a voice assistant which was designed to lower distraction. These two experts also mentioned that in an ideal solution, screens would not have to be barely featured in a car but with the notion that this goes for a timeframe farther than that of this thesis. **SW** was less strict and argued this concept could be a good direction towards system that lower driver distraction and may even help focus the drivers attention.

Originality
All experts praised the originality of the concept.
The sliding movement is perceived as very modern. *It feels unique and is used in a way that is not copy paste but at the same time it is in line with familiar approaches.* This quote indirectly confirmed the slider switch analogy to be implemented just right.
Experts expressed appreciation for avoiding the easy route of going for an in screen solution. **SO** sees an evolution of this visual serving as all a driver would need, eliminating screens.
BB mentioned the sliding visual being suitable for implementation across a soundbar and even added that this could become an iconic interior element.

After presenting the thesis to the company, Christine Gall Lynk&Co Head of HMI Design) and Joachim Heyden (Lynk&Co Chief of HMI Design) both expressed their fondness of the versatility of the concept's embodiment with respect to the ability of being implemented in a wide range of vehicles i.e. confirming I have successfully catered to this requirement of the company.

Humanness
SW deemed getting accross the humanness as one of the more challenging parts of this thesis. It could be like an onboarding experience that empowers users to make the most of the VA and explore all its functionalities could be like an onboarding. like is that the VA won't need to repeatedly explain its capabilities once it becomes familiar with the user. As the user interacts with the VA over time, it learning from the users preferences and habits, making its responses more tailored and intuitive to our needs.

Cognitive Load
NN would have liked to see the distinction between mode 1 and mode 2 to be more based on cognitive load. She mentioned that it might be able to have a deeper, level 2 mode depth of communication, which is in the concept reserved only to non-driving moments, when the driver is driving along an empty stretch of highway.
She admits that this is a difficult area to navigate in though, because it has to be precisely determined what you would communicate in order to avoid ending up deliberately distracting the driver from the driving task, ignoring the 2-second-rule.
Cognitive load is a topic full of nuances and researchers are still working on how to measure it properly. **NN** deemed the decision to go for making the black-and-white distinction between driving-not driving to be the best option with the timeframe of 2025 - 2028 and the lack of proper academic underpinnings for any other decision in mind. Exactly this thought process is what I went through and is described in the appendices.

Layeredness of information
OO mentioned that the effect of distraction differs per person and is also dependent on driver skill (as described in this thesis).
While all experts liked the layeredness in various aspects of the concept like the proactive behaviour and the depth of information, **OO** and **NN** particularly evaluated it as a clear approach to for structuring a relatively intricate system.

Abstract vs Anthropomorphised
All experts responded positively to retaining the visual element and its abstraction after I provided them with the reasoning for it. The experts with relevant expertise mentioned the level of abstraction of the visual suiting the European market well.
SO mentioned VA visuals in the West being almost all abstract and backs this up by describing that European users have shown to have a higher sensitivity for abstraction and a higher capacity of accepting it.

Towards implementation
Since the eventual deliverable was only to be developed on "concept" level, actual implementation related elements like cost and manufacturing were not taken into account further than the concept existing out of real(istic) technology.
SO and **BB** mentioned the cost being the highest barrier for implementation of this concept.
This goes for almost every part of the car though.
SO: *Like every manufacturer, Geely strives to exude premium quality in the vehicles they produce but Lynk&Co is supposed to be the more affordable one (compared to its sister brand Zeekr for instance. Budgets are very limited and maintained meticulously.*
SG assessed that the coding and programming behind this concept would not be nothing out of the ordinary, neither would the electronic infrastructure be.
Technology wise, the use of smart-texture and audio as the concept is built is **SO** also noted putting cost against gain. What is the gain for automakers to implement the concept? The results of the concept is likely to be noticed indirectly. When put up against other elements that could be implemented into a car, anything that will make money directly and add to the profit margin of the car is likely to receive priority during the moment of budget allocation. The personal reflection early in the report which notes that automakers simply do not have to care about actual safety, yet only perceived safety since that is only what is relevant when selling vehicles comes to mind.
NN, **BB**, **SG** and **SW** emphasized the importance of the IVA needing to be able to adapt to the users preferences for amount of approaches quickly in order to avoid approaching the user too much in the early phases.
SW: *It needs to be both good with perceiving and processing so it's actually helping you shorten the time of getting to a functionality.*

Privacy
Most experts mentioned privacy as a relevant factor: there is some doubt how users would react on an IVA approaching THEM instead of the other way around.
BB: *I would take the route you went with as well, though I would maybe make it a bit more flexible on the implementation side. Letting the user decide the level of intrusiveness*

Addressing the challenge:
As expected, **SW**, **BB**, **SO**, **GG**, **OO** mentioned that the only real way to assess the final proposal's success in addressing the challenge is through real-world testing but understand that is not possible.
Based on their respective backgrounds and fields of expertise, the experts assess this final proposal as properly addressing the challenge and sub-challenges as far as it is possible within the scope and domain, with respect to the timeframe and resources available for a thesis project itself.
BB: *the way your concept teaches, is a good way of giving the user awareness what you can do to bridge that misalignment you mention in your challenge.*

Tone:
Though knowing it was out of the scope, BB, SW and SO mentioned the importance of the tone of the voice assistant. The experts were happy to see this element recognized, reflected upon and included in the concept and animations demonstrating the IVA's functionality.

Technology:
BB, SG, SW were asked on the techology of the concept specifically: the smart-surface for the dashboard was seemed as a nice application of the technology and definitely feasible.
BB: *technology-wise it is feasible, it would just be the exact place of implementation in the interior where some issues might arise.*
SW: *You avoided the common risk of making something TOO futuristic, like an idea that requires users to have lenses stitched to their eyes or something like that. But it's also not a low hanging fruit technology wise. It's currently very fresh and would fit the scope well.*

Verdict:
Based on their respective backgrounds and fields of expertise, the experts assess this final proposal as properly addressing the challenge and sub-challenges as far as it is possible within the scope and domain, with respect to the timeframe and resources available for a thesis project itself.

Discussion

Modes and Cognitive Load

Initially, the mode was to depend on the amount of cognitive load which in turn would be assessed by the car's environmental awareness due to sensors and data like traffic density.
However, there is quite some variation in the amount of cognitive load and its implications for distraction. One can't say "high cognitive load is worse than low cognitive load", for instance. The difference between cognitive loads is more nuanced than this fairly black and white interpretation, as is described in Kessel's article "The Role of Cognitive Load in Automotive UX Design", released as this thesis project was ongoing (illustrating that research on this topic is far from finished.

It is a fact that too little cognitive load can also be a risk. In the case of a too low cognitive load, the driver is more likely to get 'bored' and therefore more susceptible to distraction.

By designing the concept in a way that the car can determine when the cognitive load is likely to be very low and send the voice assistant in to make a proactive suggestion at that moment, safety is enhanced as well as cognitive load implications being included in the concept.

But having the depth of information depend on the amount of cognitive load is not possible as there are many factors in play and much research still needed.
Therefore, I chose the 'safe' path and had the modes depend on "driving" or "parked".

Clubs

Lynk&Co's desire to be a disruptor translates to a non-conformist attitude to dealerships as well:
Instead of dealerships or showrooms, Lynk&Co has "clubs".
These clubs are clearly intended to enhance the brand's image beyond what it can achieve with the single vehicle it offers on the European market.
The clubs offer an environment that could be best described as a combination between an urban art gallery/coffee bar/pop up store in which a range of local sustainable products are offered that carry the "sustainability as a hip and premium lifestyle motivation" idea that Lynk&Co seems to want to express.
The featured art aims to express a quirky boldness which isn't as strongly represented in the car itself. Moreover, the car is often placed in the back of the club as it is claimed to want to emphasize the "lifestyle" rather than the car itself.

Unfortunately for Lynk&Co, the clubs are not working out as intended. Even though the brand rapidly gains members and continuous to break records, the clubs remain strikingly empty and it's easy to understand why: it's hard to find what their actual purpose is next to achieving as providing material to advertise it's non-conformist attitude with.
Seemingly aimed at a younger crowd, the environment appeals to a group of people that do not drive cars but use alternative ways of transportation to get around town.
Getting those younger people into relatively expensive cars which they can live without may well pose impossible challenge to tackle.
Simultaneously, the older crowd (kindly described by Lynk&Co as "the young at heart") who can afford the car and whose curiosity is peeked by the sharing model and it's advantages, does not really care for the lifestyle aspect these clubs are about but rather than the attractive pricing and offered convenience.
Simply put: the people who want the car, don't want the lifestyle. The people who like the lifestyle, don't want the car.
The ownership model and car itself have proven to be enough by itself to book succes.

Teaching process

With today's IVA's, users have to know what the IVA can and can't do and also have to memorize and recall the commands required to execute its functions.
Thanks to the development of AI language processing technology users will not have to recall how to specifically formulate the commands anymore.
Recall is one of the two types of memory retrieval distinguished in the field of psychology, with the other one being recognition.
In his 10 usability heuristics for UI design Jakob Nielsen(1994) emphasizes the use of recognition rather than recalling in UI design.

With it's proactive behaviour, the IVA concept primarily aims to give users insight about the 'what' (what it can do) but (initially) still includes an example to give insight in the 'how' (how a command be formulated). However with no specifically formulated commands required anymore but a virtually unlimited amount of information to be accessed with the advent of ChatGPT-like in our vehices, the 'how' becomes less important while the 'when' becomes increasingly important to be addressed.

The concept already tends to teach users about 'when' (not)to address functions or information by the moment it does a proactive suggestion as well as through allowing what can (not) be accessied in the modes.
An additional aspect was explored, where the proactive behaviour would adress the "when" part of that challenge as well, using the desired 'recoognition' type of memory retrieval.
The considered strategies through which this was to be achieved are called cognitive conditioning and priming.

Conditioning and priming.
Priming is where *exposure to a stimulus influences behavior in subsequent, possibly unrelated actions..* (Budiu, 2016).
It is comparable but different to cognitive cognition. Simply put, the difference is the following: In conditioning, a stimulus becomes connected with an action. The stimulus then immediately prompts the action. In priming, a stimulus is also connected to an action but the time between the occurrence of the stimulus and execution of the action can be longer and the relation between the type of stimulus and action can also be more vague.

How it was envisioned to work
Already, by choosing when to come in for a proactive suggestion, the IVA gives the user a sense of 'when' is the suitable moment to address a function similar to the one that the suggestion is about.
During this exploration, the idea for these methods to be implemented in the concept was as follows:

Phase 1:
- Dependent on the type (infotainment, communication, navigation etc.) of function (action) it mentions, the visual element of the IVA takes on a certain color.
This way, the IVA creates a relation between a stimulus (color) and an action (function).
For example: when mentioning navigation related tasks, the IVA visual turns purple.
- Over multiple drives, this is repeated a couple of times to enhance the strength of the connection.
- Then, it initiates the next phase.

Phase 2:
- In order to strengthen the user's sense of not only what but also when the IVA could be used, rather than saying"Hey I could do this for you" , the IVA will ask the user "Do you want me to do *navigation related task X* for you right now?", with the IVA visual colors purple.
- Again, this type of interaction would be repeated over a multiple drives to strengthen the connection.
- Then, it initiates the next phase.

Phase 3:
- Next to a sense of what type of function or information can best be accessed at a given moment ('when'), the user has an internal association between a type of function and a color. (a user might even be subconsciously prepared for a stimulus)
- Now, when the IVA comes in for a suggestion it only shows it does not verbally address the user, mentions no function, just shows it's purple visual element in the color matching *navigation related task X* which the system deemed suitable in the moment and prompted the IVA to do the suggestion.
- The user notices the purple visual and subconsciously makes the connection to the type of function connected to that. If deemed suitable by the user, this user is likely to give a command to operate *navigation related task X*, seemingly all on its own.
- The last step, ideally 'the end goal'. Already not addressing the user vocally, the IVA also stops showing the visual for its proactive behaviour. The teaching process is finished.
The user knows what type of functionalities the IVA can do and has a sense for which moment is most suitable. The user can now operate the IVA without feeling the need for a screen.

The visual now only exists to show which mode it is in and is as little distracting as possible.

Limitations

Journey map

Oversimplification:
User journey maps have the potential to oversimplify the complexity of user experiences. They condense a user's journey into a linear representation, which may overlook important nuances and variations in user paths. By focusing on a generalized view, user journey maps risk failing to capture specific interactions and user behaviors.

Subjectivity:
The creation of a user journey map involves subjective elements. The creators' assumptions, interpretations, and insights shape the map, introducing a degree of bias. Different creators may have varying perspectives on user experiences, leading to different maps and potentially influencing the resulting insights. It is crucial to be mindful of this subjectivity and strive for a balanced representation of user experiences.

Incompleteness:
User journey maps provide a high-level overview of the user experience. They are typically based on aggregated data or user research, which may not capture the full range of user behaviors and scenarios. Unique or exceptional cases, edge scenarios, or unanticipated user interactions might not be adequately represented in the map. Complementing user journey maps with additional research methods, such as user interviews or usability testing, can help uncover these nuances.

Relevance over time:
User behaviors, needs, and expectations evolve over time. This ongoing evolution can render previously created user journey maps outdated or less relevant. Changes in technology, market trends, or user preferences can impact the accuracy and usefulness of existing maps. Regular updates and revisions are necessary to ensure that user journey maps stay aligned with the current user experience landscape.

Expert interviews

The process of conducting interviews like this is characterized by mostly significant time requirements. This is due to the need of arranging interviews, conducting them, and analyzing the collected data afterwards.
As with desk research there is potential for biases. Here, it lies in the risk of influencing respondents' answers. Factors from the interviewer's background may influence the respondent's reactions and subsequently their responses.
Another possible drawback of interview studies is the reduced level of anonymity they offer to respondents. This concern is particularly significant for many individuals who may hesitate to share personal or sensitive information due to the face-to-face interaction inherent in interviews.

Desk research

In the context of my thesis, it is important to acknowledge the limitations of desk research. Since it relies on existing sources, it may only render partial answers, either in terms of precision or timeliness of information. The availability and quality of information can significantly vary depending on the industry and geographical context.
Additionally, the process of conducting desk research can be challenging as valuable information may be difficult to find and requires substantial effort before uncovering a noteworthy piece of information.
Furthermore, it is crucial to be aware of potential biases in public information. These sources can carry inherent biases that must be taken into account when analyzing and interpreting the data found through desk research.

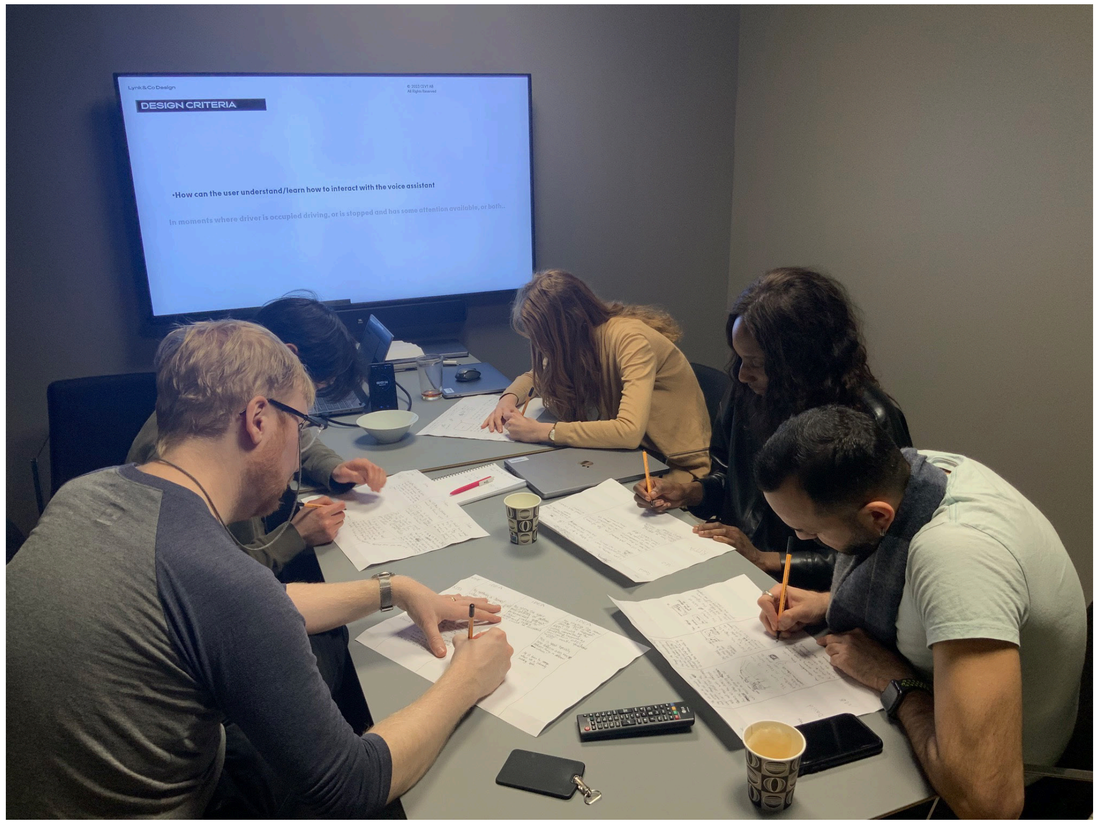


Fig 45 -3-6-5 Brainwriting creative session

Creative session

In any project, creative sessions encounter a number of limitations:
Firstly, dominant voices or group dynamics can impede the generation of diverse ideas, as certain individuals may overshadow others, leading to a bias towards their perspectives.
Secondly, the emphasis on generating a high quantity of ideas within a limited timeframe may undermine the depth and originality of the concepts produced.
Additionally, relying primarily on verbal communication during brainstorming sessions may exclude non-verbal or less proficient participants, limiting the diversity of contributions.
Lastly, the time constraints and structured nature of brainstorming environments can restrict the exploration of unconventional ideas, potentially hindering breakthrough solutions that challenge existing norms.

3-6-5 Brainwriting

Even though creative sessions often feel forced to me and fail to give me any fruitful result while involving a cost in terms of effort and time, I decided I could not disregard this process without giving it an honest chance first. Therefore I organized a creative session during the beginning of the ideation phase.

The method I used was 3-6-5 brainwriting.
The participants were designers or developers in Lynk&Co's HMI Department, selected with a diverse as possible background of experience in mind.

First, participants are introduced to a statement, goal, or issue which is to be 'tackled'.
Next, there will be 6 round (for 6 participants, in this case 2 backup participants were ill so I ended up with 5 people thus 5 rounds) of 5 minutes in which the participants have to write down 3 ideas. After each round, the participants have to pass on the piece of paper with their ideas on to the next participant, to serve as inspiration or to be built upon by that participant.

Afterwards, the design were discussed with all the participants.
In the end, I ended up not using any material as it proved to be hard to ask participants for something that tackled a whole myriad of sub-challenges without giving them a proper design space.

Appendices

Expert talk: Chief Brand Design Ola Ingvarsson

At an internal event I was able to get a hold of Chief Brand Designer Ola Ingvarsson to ask him why the design principles contain many aspects that are fairly generic/non brand-specific or not noticeably reflected within the brand.

Ola explained this by mentioning that a company or brand has "to protect itself" on a number of fronts and that it is better to include aspects in the brand identity rather than leaving an area "uncovered".
He acknowledged that by emphasizing everything, you risk emphasizing nothing.
It is here too, that the difference in culture and view on corporate aspects compared to China comes forward.

Ola also agreed with my synthesis on the brand and especially felt stong about the Quirky and Confident aspects, Lynk&CO having to be more allowed to provoke in the European market.

Recommendations

Brand

It would be good for the brand in Europe if the vehicles are allowed to better match the bold marketing terms and the non-conformist attitude as presented by Lynk&Co.
I believe that if the misalignment due to cultural differences is resolved, and the European design staff gets full freedom, the brand has true value to add to the market.
I would also recommend Lynk&Co as well as automakers to really look into what users actually want instead of what rthey would like to sell to the user, think of emotional companions for instance.
Do people really want that?

Cognitive Load

Nicole van Nes mentioned kn her review: it would be nice if the distinction between mode 1 and mode 2 can be made on the basis of Cognitive Load rather than a black-and-white distinction based on driving an parking.

Interior screens

By design, any visual element in the car potentially distract the driver from keeping eyes on the road. Screens distract drivers and touchscreens do not allow them to operate their vehicle's functionalities without having to look at it. If I were a car manufacturer, I'd declare a "war on touchscreens" or at least reduce the amount of screens in our vehices rather than enhance it as is currently the trend. On short term, I would do more research into glanceability of visuals. It might still distract but at least does not require drivers to take focus away from the road.

Priming for teaching

I would still like to do more research on priming, in an effort to create a stronger memory of what is (subconsciously) taught by the IVA.

Interior screens

Screens distract drivers and touchscreens do not allow them to operate their vehicle's functionalities without having to look at it. If I were a car manufacturer, I'd declare a "war on touchscreens" or at least reduce the amount of screens in our vehices rather than enhance it as is currently the trend.

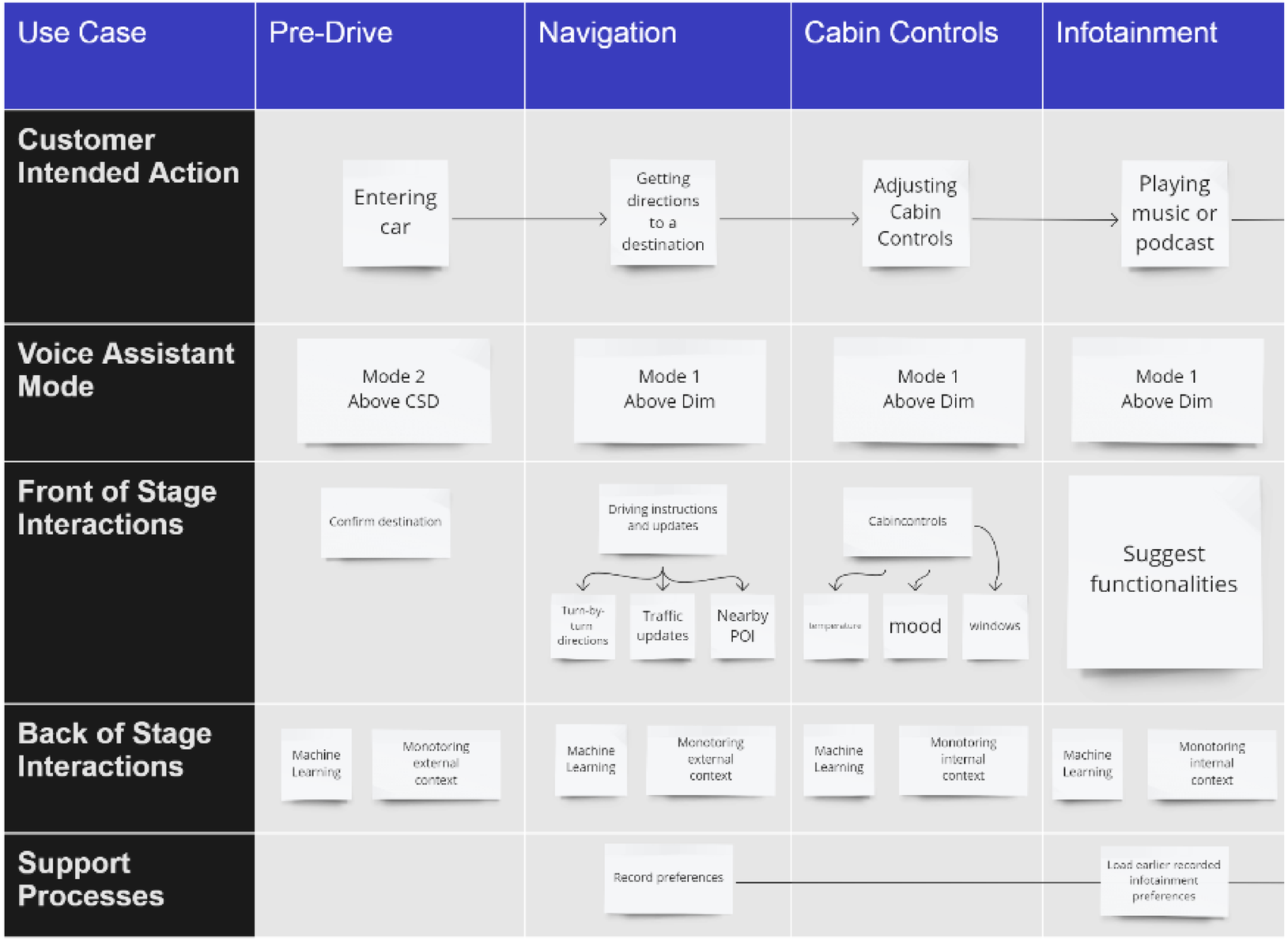
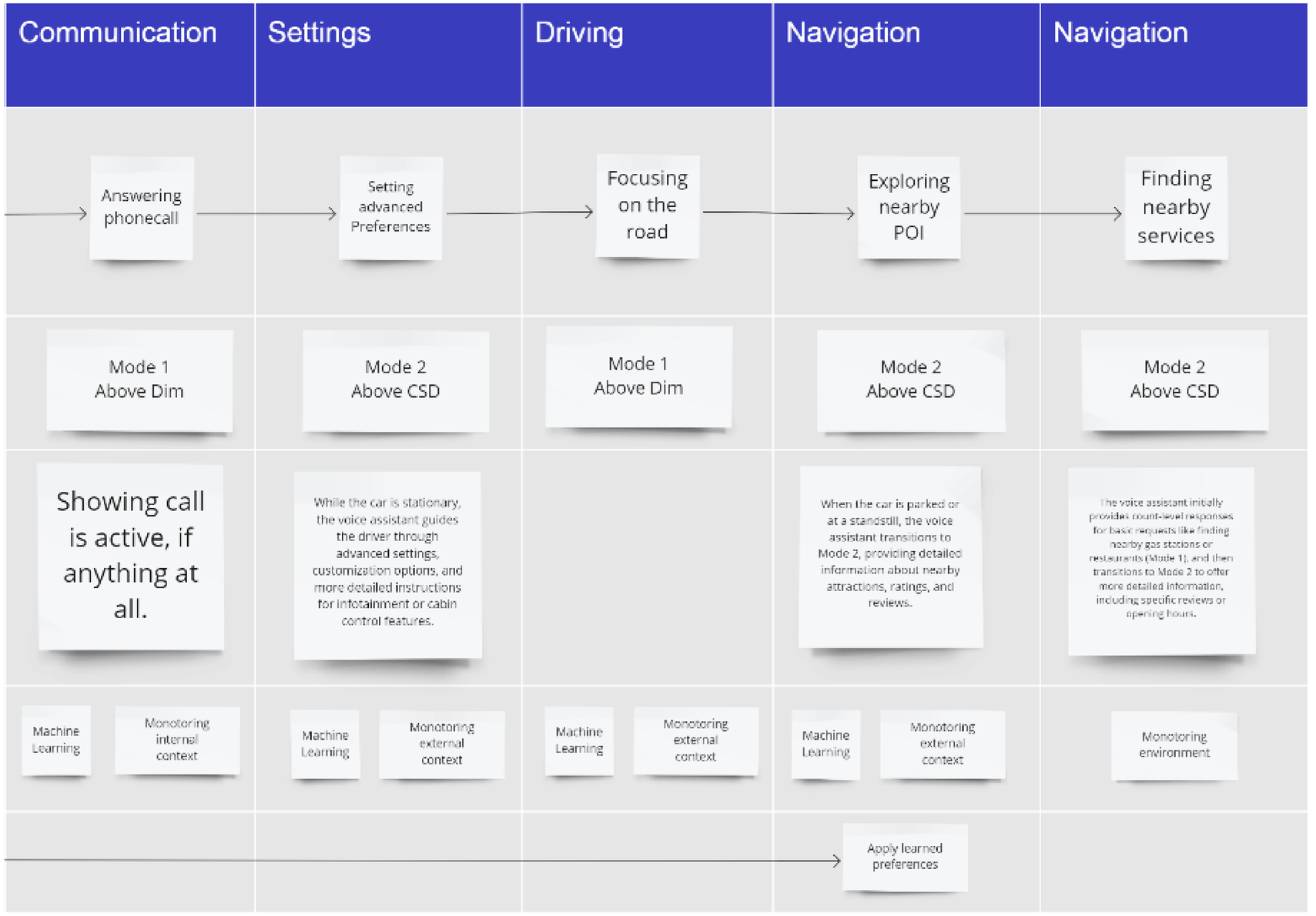


Fig 46 -The settings window


Communication
Settings
Driving
Navigation
Navigation
Answering phonecall
Setting advanced Preferences
Focusing on the road
Exploring nearby POI
Finding nearby services
Mode 1 Above Dim
Mode 2 Above CSD
Mode 1 Above Dim
Mode 2 Above CSD
Mode 2 Above CSD
Showing call is active, if anything at all.
While the car is stationary, the voice assistant guides the driver through advanced settings, customization options, and more detailed instructions for infotainment or cabin control features.
When the car is parked or at a standstill, the voice assistant transitions to Mode 2, providing detailed information about nearby attractions, ratings, and reviews.
The voice assistant initially provides count-level responses for basic requests like finding nearby gas stations or restaurants (Mode 1), and then transitions to Mode 2 to offer more detailed information, including specific reviews or opening hours.
Machine Learning
Monotoring internal context
Machine Learning
Monotoring external context
Machine Learning
Monotoring external context
Machine Learning
Monotoring external context
Monotoring environment
Apply learned preferences

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images:

Source: Capgemini Research Institute, Conversational Interfaces Research, Consumer Surver, April 2019 - May 2019, N=7,078 consumers

In-car voice assistants in different markets

project title

Please state the title of your graduation project (above) and the start date and end date (below). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

start date 16 - 01 - 2023 25 - 06 - 2023 end date

INTRODUCTION **

Please describe, the context of your project, and address the main stakeholders (interests) within this context in a concise yet complete manner. Who are involved, what do they value and how do they currently operate within the given context? What are the main opportunities and limitations you are currently aware of (cultural- and social norms, resources (time, money,...), technology, ...).

This thesis project focuses on the visual part of Lynk&Co's future in-car voice assistant (also known as VA). Lynk&Co is a relatively young Chinese-Swedish automotive brand active in parts of Europe and Asia. I will join the HMI (Human Machine Interface) department at the Geely Design Studio in Gothenburg, Sweden.
Currently, Lynk&Co's VA is universal for the European and Chinese market, lagging behind the competition and has no proper academic research substantiating the design. The visual aspect of the VA is limited to a graphic representation of the companion comparable to Siri or Google assistant. For the future VA I am allowed to go as broad as I want, on the conditions it is substantiated by user needs and preferences and is realistically implementable in the timeframe of 2025-2028. With the evolution of technology, user's automotive needs have grown from "getting from A to B" towards higher expectations of the experience. As stated in Capgemini Research Institute's report on in-car voice assistants: "Voice assistants provide automotive organizations with a great opportunity to enhance the customer experience". (Voice on the Go, Capgemini Research Institute, 2019)
Moreover, it states that "Consumers already use in-car voice assistants extensively and this is only going to surge, still nearly 60% of consumers feel that the in-car voice experience must be improved."
Before VA's can achieve their full potential, a multitude of challenges needs to be tackled so that users can maximally benefit from an increase in key user experience aspects like safety and comfort while also having a more natural interaction with their vehicle. Voice assistants are complex, consumers say that their current in-car voice assistant is confusing, and they prefer manual input options for additional control. Equally, users feel that their in-car voice assistants often fail to understand them. If one needs additional manual input for a VA to function (and a screen to see if everything went as desired), the complete point of being able to communicate while keeping ones eyes on the road and hands on the steering wheel is practically gone (one of the key advantages of a voice assistant!)
Another challenge lies in trust: "50% of consumers said they do not trust voice assistants with the safety and security of their personal data" (Microsoft's 2019 Voice report, 2019). Trust is essential for the continued adoption and acceptance of VA technology. Capgemini's report divides the main opportunities to address these and other challenges in three areas:
Anchoring (educating consumers, assuaging consumer concerns, earning trust), customization and expansion.
Lynk&Co's motivation for acting on these opportunities seems clear: a positive experience is a driver for higher customer engagement. Essential for a brand that has tasted succes with it's first car on the European market and has a lot more in development. The company expressed to me that the future VA is intended to be a "brand image builder".
Regarding limitations: it is known that the Western world (West-Europe) and the USA is far behind Asia as it comes to the use and adoption of virtual/conversational assisants, of which a voice assistant is part. Not everything that is or will be possible in the future can be expected to be adopted in a equal measure globally. Time is another limit that is relating to that as well: the design (concept) that is to be developed has to be realistic for a timespan of max five years.

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introduction (continued): space for images

image / figure 1:

image / figure 2:

PROBLEM DEFINITION **

Limit and define the scope and solution space of your project to one that is manageable within one Master Graduation Project of 30 EC (= 20 full time weeks or 100 working days) and clearly indicate what issue(s) should be addressed in this project.

Discussing the project with Lynk&Co, it was decided that I would focus my research and concept proposal on the European market. Later, findings on user needs and preferences in the European market may be compared to similar findings on the Chinese market.
I intend the scope for my thesis project to be around "anchoring" phase as defined by the Capgemini report.
Addressing the essential user need that is trust and the phenomenon plagueing voice assistants occuring referred to as the 'usability gap': the gap between the technological capability of VA's in ideal conditions (which only exist in companies' minds) and what's actually achieved by users in reality.
This phenomenon is especially dominant in the in-car context and even with the advancement of technology this gap is expected to continue to exist for years to come.
I want to focus on this phase because I feel it is the most essential for future succes of the voice assistant in the automotive context and very interesting for the visual part of a VA.

ASSIGNMENT **

State in 2 or 3 sentences what you are going to research, design, create and / or generate, that will solve (part of) the issue(s) pointed out in "problem definition". Then illustrate this assignment by indicating what kind of solution you expect and / or aim to deliver, for instance: a product, a product-service combination, a strategy illustrated through product or product-service combination ideas, ... In case of a Specialisation and/or Annotation, make sure the assignment reflects this/these.

I expect to generate a set of/ framework for visual elements leading to a significantly more succesfull interaction and user satisfaction rate. AdditionallyI will research if and how I can enhance the trust in consumers through the use of visual elements. Finally I will research Lynk&Co's brand identity and interpret their design principles as a part of the visuals as the voice assistant is desired to be a brand image builder in

I expect to deliver a concept containing a framework/set of visual elements, either embodied (graphic, virtual, physical) or non-embodied(light) which adress users' VA usability needs by guiding/assisting/educating users in basic use cases as well as with skill discovery, skills search and proactive functionalities.
This set of visuals/framework is to be included alongside the audio/vocal aspect of the future in-car voice assistant and will be visualized through a 3D model/animation/environment, possibly accompanied by a physical prototype which can be used to test and validate an increase in the succesfullness of the interaction, user satisfaction rate and trust.
The set of visuals/framework will cover the basic features/primary use-cases included in an in-car voice assistant.

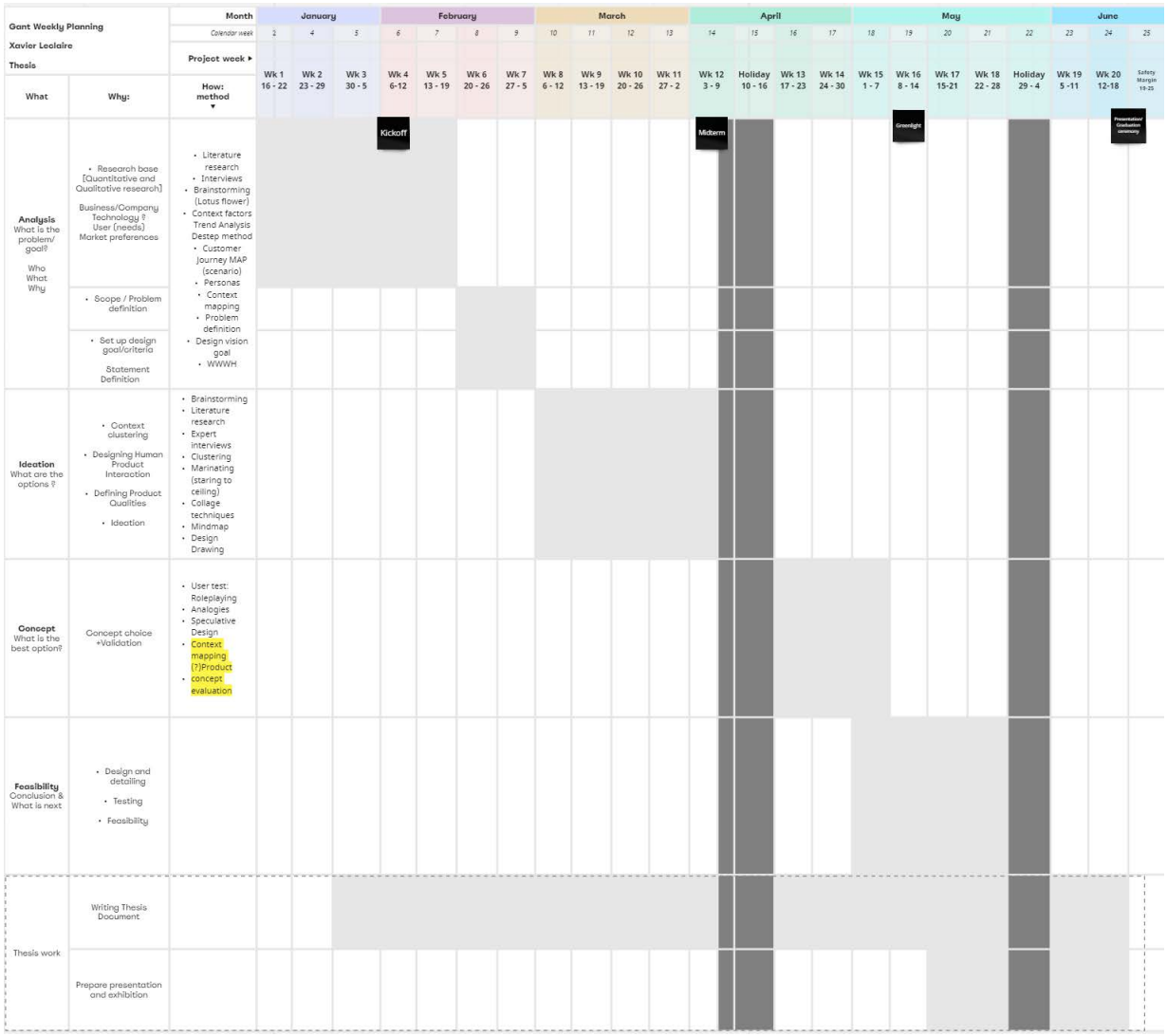
Initials & Name XYR Leclaire Student number 4287010

Title of Project In-car voice assistants in different markets

PLANNING AND APPROACH **

Include a Gantt Chart (replace the example below - more examples can be found in Manual 2) that shows the different phases of your project, deliverables you have in mind, meetings, and how you plan to spend your time. Please note that all activities should fit within the given net time of 30 EC = 20 full time weeks or 100 working days, and your planning should include a kick-off meeting, mid-term meeting, green light meeting and graduation ceremony. Illustrate your Gantt Chart by, for instance, explaining your approach, and please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any, for instance because of holidays or parallel activities.

start date 16 - 1 - 2023 25 - 6 - 2023 end date



Initials & Name XYR Leclaire Student number 4287010

Title of Project In-car voice assistants in different markets

MOTIVATION AND PERSONAL AMBITIONS

Explain why you set up this project, what competences you want to prove and learn. For example: acquired competences from your MSc programme, the elective semester, extra-curricular activities (etc.) and point out the competences you have yet developed. Optionally, describe which personal learning ambitions you explicitly want to address in this project, on top of the learning objectives of the Graduation Project, such as: in depth knowledge a on specific subject, broadening your competences or experimenting with a specific tool and/or methodology, ... Stick to no more than five ambitions.

The main reason for setting up this project is very simple:
Cars are my passion and being an automotive designer has been a lifelong goal of mine.
During my studies that goal grew to encompass mobility design as a whole, to be amongst the designers in the forefront shaping the future of mobility in any way, shape or form.
The thesis project offered by Geely/Lynk & Co aligns perfectly with that and poses the perfect next step towards the achievement of that goal.

Moreover, during my professional career I ultimately would like to be in a position that allows me to be the bridge between research and design (engineering) departments. With this thesis project about voice assistants which involves mainly research and embodiment I get to do a thesis project which aligns with that function.

Finally, over the last years I have been drawn to the work and approach of Geely's daughter companies Volvo, Polestar, Lynk&Co and Zeekr. Together with my desire to move to Sweden, this made that graduating at one of these company's European design studio's which happen to be located in Gothenburg was by far my perfect graduation scenario.

Competences I want to prove:
- Competency in relevant parts of ViP Design approach including ability to iterate and return to earlier steps in process
- Visual skills and 3D modeling developed in electives and free time
- Research skills
- Embodiment skills, hands-on skills, physical prototyping
- Creativity; coming up with unique solutions and unique interpretation of issues

Competences I want to learn:
- Connecting research and embodiment fluently
- How to use/mix/adapt (parts of) design approaches to create a process that is logical, clear and suits the context of a project as well as suiting my needs (maintaining oversight, clarity regarding WHAT, WHY, HOW, WHEN of my activities)
- Upgrade visual skills and Blender 3D modelling towards professional automotive design level.
- Relevant implementation of design methods in the phases of the design approach that is used.

Additional learning ambitions that I have:
- Providing myself with/ and managing a clear (online) work environment. (Miro, Figma)
- Continueing growth in working with my neurodivergency incl. harnassing my focus, planning and time management.
- Decision making

FINAL COMMENTS

In case your project brief needs final comments, please add any information you think is relevant.

Initials & Name XYR Leclaire Student number 4287010

Title of Project In-car voice assistants in different markets