Exploring the Factors that Influence Trust in Voice Assistants in the DACH Region

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Abstract

Voice assistants (VAs) have gained popularity in recent years due to advances in artificial intelligence, natural language processing, and the internet of things. Despite their potential to revolutionize human-technology interactions, the adoption of VAs has been limited by concerns about privacy and trust. To better understand how to address these barriers, this study aims to identify the factors influencing trust in VAs and explore ways to improve trust. Four hypotheses were formulated based on existing literature and user interviews: H1, brand trust has a positive impact on overall trust in VAs; H2, hedonic value perception has a positive effect on general trust in VAs; H2a, hedonic value perception has a more significant impact on general trust in VAs than utilitarian value perception; and H3, older adults have more trust in VAs compared to other age groups. A survey of participants from the DACH region was conducted and analyzed, confirming H1, H2, and H3 but negating H2a. These findings highlight the importance of brand trust and hedonic value perception in building trust in VAs and suggest that older adults may be more trusting of the technology.

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Resumo

Os assistentes de voz (VAs) ganharam popularidade nos últimos anos devido aos avanços na inteligência artificial, no processamento da linguagem natural, e na Internet das coisas. Apesar do seu potencial para revogar as interacções humano-tecnologia, a adopção de assistentes de voz tem sido limitada por preocupações sobre privacidade e confiança. Para melhor compreender como abordar estas barreiras, este estudo visa identificar os factores que influenciam a confiança nos VAs e explorar formas de melhorar a confiança. Quatro hipóteses foram formuladas com base na literatura existente e em entrevistas a utilizadores: H1, a confiança na marca tem um impacto positivo na confiança global em VAs; H2, a percepção do valor hedónico tem um impacto positivo na confiança geral em VAs; H2a, a percepção do valor hedónico tem um impacto maior na confiança geral em VAs do que a percepção do valor utilitário; e H3, os adultos mais velhos têm mais confiança em VAs em comparação com outros grupos etários. Foi realizado e analisado um inquérito aos participantes da região DACH, confirmando H1, H2, e H3, mas negando H2a. Estes resultados salientam a importância da confiança na marca e da percepção do valor hedónico na construção da confiança em VAs e sugerem que os adultos mais velhos podem ter mais confiança na tecnologia.

Título: Explorando os Factores que Influenciam a Confiança nos Assistentes de Voz na Região DACH

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Palavras-chave: Assistentes de voz, Trust, Brand Trust, Percepção de Valor Hedónico e Utilitário.

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1. Introduction

Voice assistants (VAs) are software programs designed to interact with users through voice commands. These assistants can perform a wide range of tasks, from setting reminders and sending texts to playing music and answering questions. With advances in the field of artificial intelligence (AI), the increasing popularity of smart speakers, and the widespread adoption of voice-enabled devices, the use of VAs has exploded in recent years.

VAs use advanced AI and Natural Language Processing (NLP) techniques to understand and respond to user voice commands. The technology consists of several components. First, speech recognition algorithms are used to understand the user's spoken words and convert the audio signal into text. In the next step, NLP techniques are used to analyze the meaning of the spoken words. This includes syntax, semantics, and context of the spoken words to understand what the user is asking for. Once the VA understands what the user is asking for, it takes action by retrieving information from the Internet, controlling connected devices, or performing other desired functions.

Both the understanding of voice commands and the functional scope of VAs are improving due to technological progress. This results primarily from three developments:

- Advances in the field of NLP: VAs will become increasingly capable of understanding and responding to more complex and diverse commands from users.
- Increasing personalization: VAs will become more personalized, considering the user's preferences, history, and location to provide more relevant and helpful information and recommendations.
- Increasing integration of VAs with other systems and devices and advances in the Internet of Things (IoT): VAs are increasingly integrated with other devices, e.g., smart home systems, and with other systems, e.g., Healthcare and financial systems provide more comprehensive and convenient services.

As a result, VAs are becoming more and more helpful, and at the same time, conversations seem more and more natural, whether via smartphone, in the car, or via a smart speaker. As the field progresses, human interaction with technology could be revolutionized in the coming years.

VAs could thus develop into a comprehensive assistant that makes tedious tasks easier or completely relieves us of them. However, one factor that still hinders the widespread adoption of VAs is the users' trust in the technology. Surveys and studies have shown that consumers have

major privacy concerns when using VAs. On the one hand, they fear that the device is potentially always listening in, and on the other hand, they are concerned that personal information shared with the VA is potentially stored and could be read by providers or third parties, especially since very sensitive data must be shared for VAs to function, such as contact lists or location data.

For VA providers, users' privacy concerns and lack of trust are major barriers. Providers must therefore address the question of what factors influence trust in the technology and how this can possibly be improved. These issues are addressed in this paper.

Based on a market overview and a literature review in chapter two of this thesis, four hypotheses regarding trustworthiness in VAs are formulated, which will be evaluated in the further course by means of qualitative and quantitative analysis:

- H1: Brand trust has a positive impact on the overall trust level of VAs.
- H2: Hedonic value perception of VAs has a positive impact on the overall trust level of VAs.
- H2a: Hedonic value perception has a higher impact on the overall trust level of VAs compared to utilitarian value perception.
- H3: Older adults trust VAs more compared to the other age groups.

The analysis focused on the DACH region, as it is the largest market for VAs in Europe. Part three of this paper presents the methodology of the quantitative and qualitative analysis and part four gives an overview of the results, which are then discussed in part five. Part six derives implications for practice from the discussion of the results. Subsequently, the limitations of the analysis are explained, and the results are summarized.

The results of the quantitative analysis indicate that hypotheses 1, 2, and 3 can be confirmed and are statistically significant. Specifically, the data showed that brand trust, hedonic value perception, and age all had a significant positive impact on the overall trust level of VAs. However, hypothesis 2a could not be confirmed by the data: Utilitarian value perception was found to have a more significant impact on the overall trust of VAs than hedonic value perception.

2. Theoretical Framework and Hypotheses

2.1. Voice Assistants Industry Analysis

The desire for humans to engage in conversation with computers has been depicted in various science fiction movies over the years. Examples include the 1968 film "2001: A Space Odyssey," which featured a talking computer named HAL, and the 2013 film "Her," which tells the story of a man who develops a relationship with Samantha, a highly advanced artificial intelligence operating system (Malodia, Islam, Kaur, & Dhir, 2021). Whether it is Apple's Siri, Amazon's Alexa, or Microsoft's Cortana, in today's reality, we find various technologies that are reminiscent of these or similar science fiction titles. The technologies are getting better and better in terms of understanding the questions, answering the questions, and distinguishing the contexts. They have long been ubiquitous for many people in their smartphones, car, or smart speaker.

Usually, the VA devices are "woken up" or activated by a signal word such as "Hey Siri" in the case of Apple's Siri or "Okay Google" in the case of Google Assistant. As soon as the user gives a voice input, the device converts it into text form using Automated Speech Recognition (ASR). The systems then use Natural Language Processing (NLP) algorithms to understand the text fragments' syntax, semantics, and context. A so-called Dialog Manager performs AI-based steps necessary to answer the query, and then Text-to-Speech (TTS) technology generates the VA's acoustic output. Machine learning algorithms ensure that the software is trained based on user input and learns as it is used (Monitor Deloitte, 2018).

Contrary to what many believe, VAs have not only been in use since the appearance of Amazon's Alexa or Apple's Siri. The technology has been experimented with for decades, but only the technological progress in AI in recent years has led to the technology being commercially viable. The early VA software Shoebox was developed by IBM back in 1961 and could recognize 16 spoken words, including the digits 0 through 9. The device, which was about the size of a shoebox, had a microphone and various lights that lit up when a number was called (IBM, 2016). With the Shoebox, IBM laid a foundation for modern VAs.

The first VA with a broad audience was Apple's Siri, which was integrated into the iOS operating system with the release of the iPhone 4S in 2011. Microsoft followed it with Cortana (2013), Amazon with Alexa (2014), and Google with the Assistant (2016). The progress of VAs since then has been remarkable, mainly related to the research advances in the field of NLP (Hoy,

2018). According to Hirschberg and Manning (2015), these developments are related to four reasons:

1. an increased computing power
2. the availability of large amounts of linguistic data
3. the development of successful machine learning (ML) models
4. an increased understanding of the human language and its use in social contexts

Further progress results from the improved personalization of VAs. Modern machine learning algorithms allow the devices to "get to know" individual users better and better and thus adapt to their preferences and habits in the best possible way. This is achieved, for example, through user settings, the analysis of location data, or conversation history.

Another factor that has influenced the development and adaptation of VAs massively in recent years is the progress made in the field of the Internet of Things (IoT). The IoT is a network of physical devices, vehicles, buildings, and other objects that have sensors, software, and network connectivity, enabling the collection and exchange of data. As more devices become connected to the internet and capable of generating and exchanging data, more devices can be controlled by VAs and the data generated by these devices can be used to improve the accuracy and functionality of the VAs. The connection of devices such as thermostats, window blinds, coffee machines or security cameras to the internet can make them accessible by VA and increase the number of use cases of VAs.

The adoption pattern of VAs in Germany correlates with the US market with a two-year lag due to the later introduction of the devices (Kinsella, 2021) supported by the interest of German consumers: in 2020, around 24% of the population owned at least one smart speaker (Beyto, 2020). Although figures for the entire DACH region (Germany, Austria, and Switzerland) are not currently available, it can be assumed that they are similar to those of Germany due to the country's dominance in the region (comprising over 80% of the DACH region) and the cultural and economic proximity of the countries.

As of 2022, Amazon's Alexa is the most used VA in Germany, followed by Google's Assistant and Apple's Siri (Statista, 2022). In this respect, the German market differs from the US market, where Google's Assistant is used by 27% of Internet users, followed by Siri by 26% and Alexa by around 21%. This is also caused by the fact that 88% of users in the US market use VAs on their smartphones (eMarketer, 2022). The most popular smart speaker in Germany is Amazon's

Echo (Alexa) with 78% of the total number of voice speakers, followed by Google's Home (Google Assistant) with 14% and Apple's HomePod (Siri) with 12% (Statista, 2022). According to a study by Insight Partners (2022), the global market volume for VAs amounted to USD 7 billion in 2021 and is expected to grow to around USD 48 billion by 2028 (CAGR of about 32% p.a.).

2.2. Trust in Human-Virtual Assistant Interactions

Human interpersonal interactions have been in the spotlight of studies and research for decades. Many psychologists have tried to identify the social mechanisms behind the mutual desire to share information with other social actors. Those interactions are characterized by uncertainty and threat since it is impossible to predict the partner's perception (McEvily & Tortoriello, 2011). Therefore, there is no interaction without trust that allows human beings to mitigate those risks. The most well-known definition of trust was elaborated by Mayer et al. (1995):

> *"Trust is the willingness of a party to be vulnerable to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party."*

According to different models of trust, the characteristics of both the trustor (the actor who gives the trust) and the trustee (the one who receives the trust) determine the level of trust. However, the characteristics that form the foundation for trust depend on the perceived nature of the trustee, which differs between human and machine trustees (Lankton et al., 2015; Lee and See, 2004).

Typical dimensions used for human-robot interaction evaluation are understandability, technical competence, perceived reliability, faith, and personal attachment (Kauppinen, Brain, & Moore, 2002). But in order to evaluate people's interactions with VAs, it is first necessary to understand how people perceive VAs when communicating with them. The reason for this is that many studies show that humans often apply human characteristics or attributes to computers when interacting with them. Muir (1987), for instance, unveils that the level of trust in machines depends on the same familiar attributes of interpersonal communication. Reeves and Nass (1996) introduced the media equation theory, which suggests that human beings treat computers, television, and new media like real people and places. This theory proposes that individuals apply the human-

to-human interaction rule to a robotic agent featuring human characteristics whilst being fully aware of the fact that they are interacting with a machine (Klowait, 2018). They further suggested that social rules and dynamics governing interpersonal interactions can be extended to human-robot interactions. According to the study, one of the major factors that influence people's perception of computers is anthropomorphism, the tendency to attribute human characteristics to non-human entities (Kim & Sundar, 2012; Epley, Waytz, Akalis, & Cacioppo, 2008).

Moreover, a seminal article by Nass and Moon (2000) describes a consistent anthropocentric attitude toward computers by people in natural and laboratory settings, even though these people agreed that computers are not humans and should not be treated as such. The "Computers are social actors" (CASA) paradigm emerged from research showing that humans unconsciously use the same social heuristics for interacting with computers as they do with other humans due to computers evoking similar social attributes as humans. Furthermore, the following experiments reveal that people 1). apply gender stereotypes to the computer's voice output (Nass, Moon, & Green, 1997); 2). experience a sense of reciprocity in relation to the computer's support (Fogg & Nass, 1997); 3). label technology by general or special changing the perception of the content absorbed (Nass & Moon, 2000); 4). impose features of their own personality type on the computer (Nass, Fogg, & Moon, 1996).

Since machine learning algorithms train VAs to reply in a natural language for the user, and the manner of speaking is similar to that of a real person, their subjectivity increases significantly. According to the cited research, social rules and dynamics managing interpersonal interaction can be applied to human-robot interaction. Thus, the results of studies show that people identify machines with social actors and apply existing norms of interpersonal relations to them, attributing anthropomorphic characters and characteristics to devices (Kim, Schmitt, & Thalmann, 2019). Weidmüller (2022) shows that scales developed for human-human interactions might be, after all, applicable to human-VA-interactions.

Consequently, it can be highlighted that VA-related trust issues, in general, are similar to interhuman ones. There is still controversy on the topic of trust between people and VAs due to the lack of research. It seems reasonable that the perception of trust is somewhere in between traditional human-computer and human-human interactions. Thus, the goal of this analysis is to identify the factors that influence trust in VAs and to explore ways to enhance trust in the technology.

2.3. Voice Assistants and Brand Trust

According to a report from Edelman (2021), 81% of consumers think about the brand when considering making a purchase. Brand trust is a very powerful dimension for the buyers as it defines their relationship with the concrete products, whether it will be a one-time purchase or an infinitely recurring one. People choose brands that have social purposes and "we" values. Trustworthy brands can retain loyal customers that support and recommend their products or services. The importance of brand trust is so high that, according to a survey, 44% of consumers will give up brands they love if they do not trust the company anymore (PwC, 2022).

Given the findings above, it becomes apparent how influential brand trust is when making a purchase decision. Therefore, to determine the most effective tools to boost brand trust, it is necessary to understand the basic concepts and processes of the formation of this trust relationship between the consumer and the brand.

The brand relationship paradigm can be attributed to two catalysts. Blackston (1992) was the first to emphasize that brands themselves are active relationship partners and called not only for people's perceptions and attitudes toward brands but also for a structure that reciprocates what people thought of them. Fournier (1998) takes this idea of an active brand partner and presents a typology of 15 brand relationships based on phenomenological research. The existence of previous research that states that consumers easily attach human characteristics to brands (Aaker, 1997) and think about them as humans (Blackston, 1993) and Levy 1985) testify that there is a certain brand-consumer relationship that can be further analyzed.

In turn, trust is one of the pillars that bonds the consumer and the brand. According to Bainbridge (1997) and (1999), trust is the most important attribute any brand can own. However, there is no universal definition of brand trust because most definitions are created depending on the attributes that certain researchers include in the list of factors influencing brand trust. One of the most popular interpretations is made by Lassoued and Hobbs (2015), who state that brand trust is defined as the confident expectations of an individual that a certain brand's performance equals its stated functions.

Another key point is that the factors that influence the formation of brand trust evolve over time, firstly, because there is more data and research, and secondly, because of changes in consumer habits and customer values. Thus, at the end of the 20th century, researchers discovered that expectancy is one of the key factors affecting (brand) trust (Barber, 1983). Another crucial factor

is reliability which is mostly related to a technical or competence-based nature (Andaleeb, 1992). Both factors lead to the predictability that the brand satisfies needs in a positive way, becoming central to repurchasing decisions in relational exchange (Morgan & Hunt, 1994). In general, the literature generally assumes that trust is defined by persuasions such as competence, honesty, and goodwill (Coulter & Coulter, 2002). Moreover, consumers believe that reliability, consistency, competence, responsibility, helpfulness, fairness, and honesty increase trust in the brand (e.g., Altman and Taylor, 1973; Chaudhuri and Holbrook, 2001).

Brand trust is important to consumers of different ages, genders, incomes, and statuses and relates to products and services in a variety of categories, despite some differences in attributes (Delgado-Ballester, 2004). Consequently, it seems particularly interesting to explore the effects of a brand on the level of trust in VAs. The dramatic decline in trust in technology companies, as demonstrated in the Edelman Trust Barometer report (Edelman, 2021), which shows that trust in technology has fallen below 60%, makes the examination of the positions of major companies in the VA market, particularly relevant for assessing trust.

All the listed factors, in one way or another, affect the credibility of a brand from any category. Some studies, however, specifically investigated the factors influencing the same kind of relationship between the consumer and VAs (Maroufkhani, Asadi, Ghobakhloo, Jannesari, & Ismail, 2022). Those factors include quality of interaction (Nasirian, Ahmadian, & Lee, 2017); trust in corporations' adherence to social contracts in connection to smart personal assistant data (Liao, Vitak, Kumar, Zimmer, & Kritikos, 2019); utilitarian, symbolic, and social benefits (McLean & Osei-Frimpong, 2019); attractiveness, and emotional attachments (Siddike & Kohda, 2018). Further adding to this list is a study by Chi et al. (2020), who, based on previous research, identify six predictors associated with the use of artificial intelligence devices in service industries, namely social influence, hedonistic motivation, anthropomorphism, performance expectation, effort expectation, and emotion.

There is a significant amount of research on brand trust and the factors that influence it. However, this study focuses specifically on the relationship between brand trust and overall trust VAs. For example, a survey conducted by The Washington Post (Kelly & Guskin, 2021) found that users have more trust in Amazon and Google than Apple when it comes to handling their personal data and online activity. However, it is not clear whether this means that users are more likely to use Google Assistant or Alexa instead of Siri. For this analysis, it is therefore essential to

understand the relationship between brand trust and trust in the technology. Based on the research on the relationship between brand trust and consumer behavior, it is likely that brand trust has a strong positive effect on user trust in VAs.

2.4. Hedonic and Utilitarian Value Perception of Voice Assistants

In the literature, consumption is generally viewed as either hedonic or utilitarian. (Batra & Ahtola, 1991). Consumers' attitudes can be described as two-dimensional because they purchase goods and services for two main reasons. One dimension pertains to hedonic satisfaction, which involves emotional factors, while the other dimension relates to utilitarian satisfaction, which encompasses functional aspects and purposes unrelated to emotional factors. (Batra & Ahtola, 1991).

Gursoy et al. (2019) find that performance expectancy resulting from social influence and hedonic elements positively promotes close emotional boundaries, thus helping increase users' willingness to accept technological innovations. Therefore, VA's advantages need to be analyzed and explored comprehensively from utilitarian and hedonic perspectives as existing related research is still tentative.

Utilitarian motivations are often the main concern for users to purchase technical products. DeLone and McLean (2003) proposed a model for evaluating technical information systems from a utilitarian perspective, which identified three key factors that contribute to user performance: accuracy, responsiveness, and compatibility. These factors reflect the degree to which AI assistants provide correct, timely, and consistent services that meet user needs. According to Chung, Ko, Joung, & Kim (2020), providing users with trustworthy and accurate information evokes their reliance on VAs and positive attitudes in terms of user perceptions. Thus they may use assistants when they are faced with similar problems again (Ashfaq, Yun, Yu, & Correia Loureiro, 2020). Research also suggests that responsiveness offers timely service and contributes to increasing users' overall evaluation of the product's utility (Pelau, Dabija, & Ene, 2021). Compatibility ensures the consistency between technology and users' past experience (Zolkepli & Kamarulzaman, 2015), and it is considered to be a highly correlated factor with user personalization, which drives user adoption (Tornatzky & Klein, 1982).

Studies suggest that users experience hedonic value when they benefit from aspects other than utilitarian value, such as emotional connections with brands or products (Babin, Darden, & Griffin, 1994). Gursoy et al. (2019) find that users use AI devices with hedonic motivations,

viewing VAs as a novelty item and part of an innovative consumer experience (in contrast to general or traditional shopping experiences), while some simply enjoy the communication or satisfy their curiosity (Fryer, Coniam, Carpenter, & Lăpușneanu, 2020). Modern VAs can communicate with users in a more human-like manner and establish effective boundaries, which means that users no longer need to be proactive when interacting with them. Instead, they can simply use the VA's natural communication methods to get what they need.

VA users generally experience pleasure during their interaction with the device and have fun talking to it (Rzepka, 2019). Some users even feel gratification, as they think the VA helps them to make their daily life easier, makes them laugh, and is always available to help them. They find the VA friendly, kind, and caring and some users even consider it as a friend. According to Jones (2018), friendly interaction with the VA has a positive influence on brand attachment. McLean and Osei-Frimpong (2019) combined the U&GT, a psychological model of motivation, with technology theories to analyze the motivation behind the adoption and use of in-home virtual assistants (VAs). Their results showed that VAs provide individuals with utilitarian, symbolic, and social benefits in addition to hedonic benefits. The findings indicate that hedonic benefits are a key motivator for individuals to use VAs. According to Canziani and MacSween (2021), hedonic attitudes toward voice and device utility are the primary factors influencing the ordering of smart home devices. Maroufkhani et al. (2022) examined the relationship between brand loyalty and the intention to continue using VAs, as well as how brand credibility influences the overall perceived value of these assistants. The study surveyed Chinese users of AliGenie, Alibaba's VA, and found, among other things, that both hedonic and utilitarian features had a significant positive influence on the perceived value of VAs. They also found that participants placed a higher value on hedonic features than utility features when evaluating the value of VAs.

Based on the existing literature, it can therefore be concluded that, in addition to the utilitarian value perception, the hedonic value perception also plays a role in the trust and perceived value of technology. For the present analysis, this leads to the hypothesis that the hedonic value perception has a positive influence on the trust in VAs. Based on the cited findings of the study by Maroufkhani et al. (2022), it is also hypothesized that the hedonic value perception has a greater positive influence on overall trust in VAs than the utilitarian value perception.

2.5. Age-related Differences in Voice Assistants' Perception

According to a PwC study (2018), younger consumers (18-24-year-olds) are adopting voice technology at a faster rate than their older counterparts. On the other hand, younger customers tend to use their VAs less. The report goes on to say that although the total number of people using VAs has grown rapidly in recent years, the total number of people using them on a daily basis has remained relatively static.

Recent studies reveal that older users usually have positive perceptions when first encountering a smart speaker (Blair & Abdullah, 2019). Moreover, older users tend to prefer voice commands over other methods like clicking or typing (Wulf & Tscheligi, 2014). However, a smart speaker is not an exception when it comes to new technologies that older adults endorse at a slower rate than younger adults (Vaportzis, Clausen, & Gow, 2017). Therefore, although voice technology is growing rapidly and is anticipated by older adults, the adoption rates among young people are significantly higher. Recent data indicates that young American adults aged 18-29 are more likely to own a smart speaker than those aged 60 and older (Kinsella, 2019).

Previous studies have sought to investigate the perception differences of technologies for various age groups. In this matter, Arfi et al. (2021) distinguish between two types of consumers: those who were born in the new century and are thus considered IoT natives and those who belong to other generations and are thus considered IoT immigrants. IoT natives are unfazed by perceived risks, but IoT immigrants are more likely to take them into account. Another study conducted on the user acceptance of smart bracelets by different age groups revealed that the expectations of the older participants were closely related to their state of health. Privacy issues are less important to older adults, who are also more likely to share information with family members than younger people (Zhong & Verma, 2019). In a study conducted by Ghorayeb et al. (2021), the authors found that among older adults who had already tried out smart home monitoring technologies, the acceptance of the technology gradually increased over time. These participants, who had already experience with the technology, expressed fewer concerns than adults who had no experience with the technology regarding privacy, trust, and usability. However, the experienced participants did have more concerns about the utility of the technology (Ghorayeb, Comber, & Gooberman-Hill, 2021). Thereby, no consensus has yet been reached in the literature as to the significance of age group and trust in VAs, considering the potential of VAs for older adults and their low adoption rate. However, based on three cited factors, there is reason to believe that older users have greater trust in VAs: 1) they are more likely to have a positive perception when engaging with VAs for

the first time; 2) they prefer voice commands over typing or clicking; 3) they generally have fewer concerns about privacy issues compared to younger adults. From the results, it is hypothesized that the age of the participants has a positive impact on trust in VAs.

2.6. Hypotheses and Research Model

Based on the analysis of the existing literature, the following hypotheses are posed exploring the role of brand, utilitarian and hedonic value perception, and age on the level of the overall trustworthiness of VAs.

H1: Brand trust has a positive impact on the overall trust level of VAs.

H2: Hedonic value perception of VAs has a positive impact on the overall trust level of VAs.

H2a: Hedonic value perception has a higher impact on the overall trust level of VAs compared to utilitarian value perception.

H3: Older adults trust VAs more compared to the other age groups.

According to the information collected in the previous chapter and the formulated hypothesis presented above, the following conceptual model was developed:
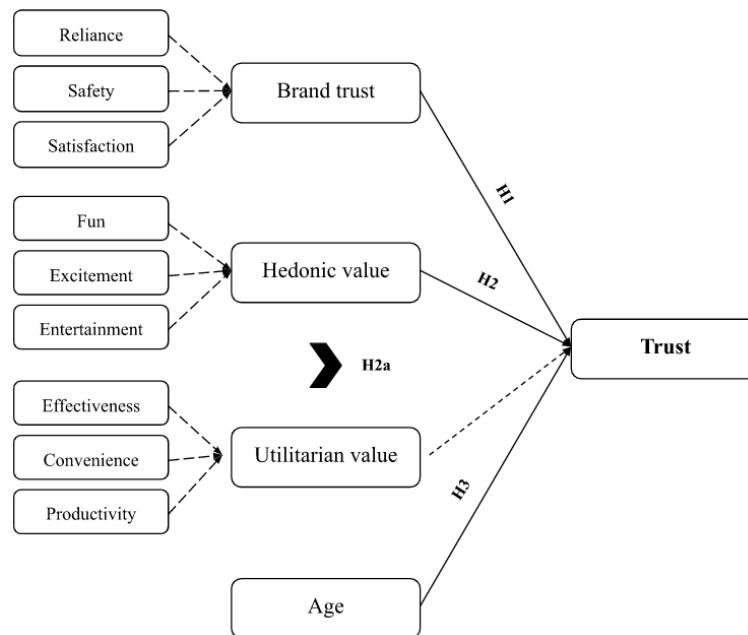

Figure 1. Proposed conceptual model

The proposed model illustrates the relation between brand trust, hedonic and utilitarian value perception, and age with the overall trustworthiness of VAs. The model suggests, based on the hypotheses formulated, that hedonic features have a stronger relationship with the trustworthiness of the VA than utilitarian features.

3. Methodology

3.1. Choice of research method

The purpose of this study is to examine the factors that influence consumer attitudes toward the adoption of VAs in the DACH region, with a particular focus on the role of trustworthiness. The goal is to understand what drives or hinders consumers from using VAs and how trustworthiness plays a role in this adoption.

The first step of the analysis is to collect secondary data on the relevant literature concerning the subject of the study, which allows a better understanding of the topic and to establish a cause-and-effect relationship. The next step is to validate whether the potential hypotheses are relevant and contribute to the real industry. Therefore, several interviews with Product Managers and Marketing Specialists from Amazon, Apple, and Google are conducted, enabling confirmation of the validity of the research question and the hypotheses and enriching the analysis with professional insights. Primary data collection followed by qualitative research is carried out through in-depth interviews, allowing to collect firsthand information on consumers' perceptions, purchase drivers, and barriers regarding the adoption of VAs, as well as verifying the established (Appendix 1). Further, the quantitative research is developed as a part of the quantitative research, designed to statistically support or refute the hypotheses posed (Appendix 2,3).

This combination of approaches is known as mixed-methods research and has gained widespread acceptance among scientists as a way to explore and evaluate different aspects of the same subject.

3.1.1. Qualitative Method

The qualitative method is a crucial component of any research work as it provides a rich and in-depth understanding of the topic being studied. This type of research allows to collect detailed information from a small number of participants through methods such as interviews, focus groups, and observations (Holton & Burnett, 2005).

The in-depth interview method is chosen for the current work as it can provide valuable insights into the experiences, perceptions, and motivations of the participants, which can help to shed light on the research question and provide a nuanced understanding of the topic (Legard, Keegan, & Ward, 2003). Individual in-depth interviews are chosen because this approach allows for a more thorough understanding of the topic compared to other data collection methods (Boyce

& Neale, 2006). The use of in-depth interviews as a research method has been credited to sociologist William Isaac Thomas and social psychologist Robert Ezra Park, who conducted in-depth interviews with immigrants in the early 20th century to study their experiences and attitudes.

Prior to launching the online survey, it is essential to test the relevance of the hypotheses based on an overview of existing literature and interviews with experts from the industry. Therefore, eight VA users of different age groups and occupations living in the DACH region are interviewed. Each interview lasted 20-40 minutes, and four male and four female respondents participated in the interviews. All respondents currently reside in the the-DACH region (Germany, Austria, and Switzerland). Their ages ranged from 22 to 83 years, with the average age being 42 years old. In terms of occupation, the group is very diversified: entrepreneur, lawyer, product manager, student (Management), psychologist, retired, and consultant.

The goal is to find out general attitudes to VAs and, more specifically, to try to deepen analysis about the factors that could have a positive/negative impact on their overall trust in VAs (Appendix 1). Therefore, the structure is as follows:

I.   General attitudes toward VAs

II.   Trust-related questions

The key insights are as follows:

1. The most popular device to use VAs is still the phone, but more than half of respondents actively use smart speakers.
2. The most frequently used features remain basic such as setting the alarm/timer, turning music and radio on, and checking the weather.
3. The majority experience an emotional attachment to the VA and refer to it using the pronouns she/her.
4. According to the respondents, the two main disadvantages of VAs are privacy issues and a lack of functionality awareness. Meanwhile, younger people are the ones that are worried about data-related issues.
5. Each of the interviewees noted that their attitudes toward VAs changed over the course of their use, from an emotional one at the beginning to a utilitarian perception in the aftermath.

6. As for brands, the interviewees used either Apple on the smartphone or Amazon with their smart speaker, and many have pointed out that perhaps their choice of VAs is due to the brands and their attitudes towards them.

The results of the interviews confirm the existing course of work and established hypotheses. At this stage, it is decided not to add new hypotheses, as adding too many hypotheses can make the study overly complex and difficult to interpret. Having a clear and focused research question is important for ensuring that the study is well-designed and that the results can be accurately interpreted.

3.1.2. Primary Data Quantitative Research

Findings obtained during the interviews provide the framework for the quantitative analysis that is commonly used in the scientific approach due to several reasons: it allows to collect data that is specific to the research question and hypotheses, to gather more accurate and reliable information, and to have more control over the data collection process (Hox & Boeije, 2005). One of the common methods of primary data research, a survey is used for the following analysis, as it allows researchers to collect data from a large number of participants in a relatively short amount of time.

Therefore, an online questionnaire is developed using Qualtrics. The questionnaire is pretested by seven people in order to ensure the validity and reliability of the questions and the structure. The pretest allows gathering feedback and identifying any potential problems with the questionnaire that could impact the final results (Hunt, Sparkman Jr, & Wilcox, 1982). Subsequently, the survey is distributed with a QR code in person and through social media. The questionnaire is designed with 23 questions and targeted to VA users residing in the DACH region, aiming to identify their consumption habits, the main issues faced and the level of trust.

Two filter questions related to geographic location (the DACH region) and the usage of VAs (used at least once) are asked in order to improve the accuracy and reliability of the survey results by ensuring that the sample is representative of the target population, and amplify the response rate and reduce survey fatigue (Bishop, Oldendick, & Tuchfarber, 1983).

The remaining questions are distributed between five groups:

   I.   General questions about VAs

II.   The overall level of trust

III.   Brand trust

IV.   Hedonic or utilitarian value perception

V.   Demographics

3.2. Sample size and data collection

The sample size for a survey is the number of people who are included in the study. There are several factors to consider when determining the sample size for a survey, including the size of the population being studied, the level of precision desired, and the resources available for the study (Israel, 1992).

There are several formulas that can be used to calculate the sample size depending on the objectives of the research. The following formula was used in the current thesis:

$$Sample\ size = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + (\frac{z^2 \times p(1-p)}{e^2 N})}$$

First, it is necessary to calculate the population size (p), therefore approximate numbers of German, Austrian and Swiss populations above 18 were summed and multiplied by 0.6 (based on the statistics, around 60% of adults in the DACH region are using VAs). As a result, *__p=50.500.000; confidence level=95%__ → __z=1.96; e=10%.__* Substituting these values into the formula, we obtain the number of required respondents: **97**. Thus, a clear goal for the number of participants is set in order to obtain relevant and statistically significant information.

Responses were collected in the period from the 17th of November till the 9th of December. The total number of participants is 215; 203 of whom are residents or living in the DACH region, 112 of them had previous experience engaging with VAs, and 97 fully completed the survey and passed the attention check question. Therefore, a total number of 97 valid responses is analyzed using the IBM SPSS software in addition to Python and Microsoft Excel.

4. Analysis and Results

4.1. Sample Characterization

There are 97 respondents who completed the survey, with 52 (53.6%) being male and 45 (46.4%) being female. The biggest group of respondents is between the ages of 18 and 24 (26.8%), followed by those aged 25 to 34 (18.6%). The other age groups have roughly the same number of responses (12.4% - 14.4%). The majority of respondents (55.7%) is originally from Germany. In terms of the highest level of education, 46.4% of respondents hold a Bachelor's degree. In terms of occupation, the two largest groups are employed (41.2%) and students (39.2%), and the annual household income varies widely, with the two biggest groups earning less than €10,000 (20.6%) or between €100,000 and €149,999 (18.6%). Almost half of the respondents (42.3%) lived in households of two people, and in terms of marital status, approximately one-third were single, one-third were in a relationship, and one-third were married. Some results are presented underneath, and a full overview can be found in Appendix 3.
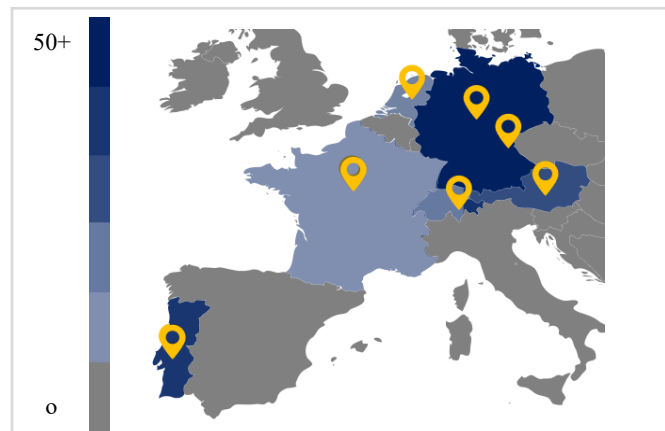

Figure 2: Gender distribution

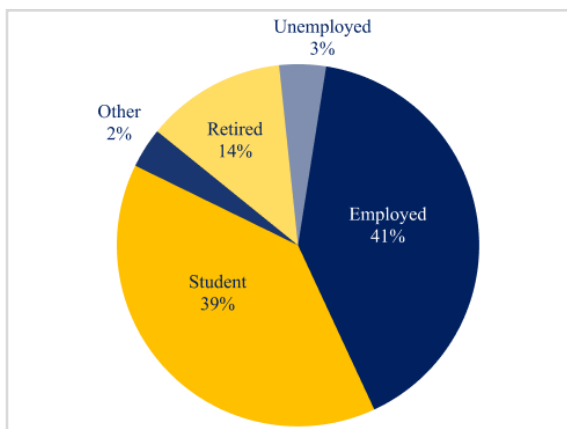*Figure 1: Country of origin*

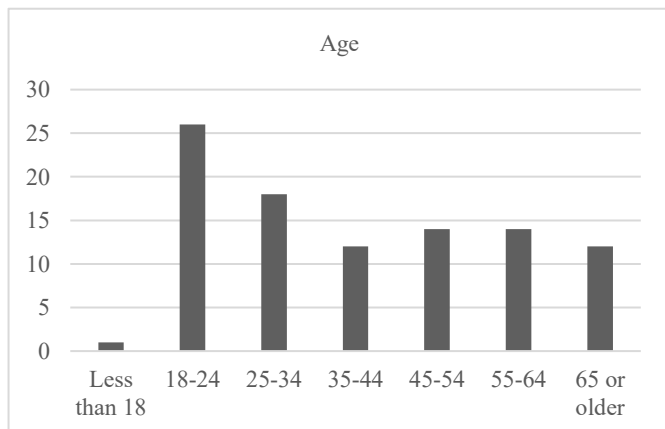*Figure 3: Occupation distribution*

Figure 4: Age distribution

4.2. Usage and Experience with Virtual Assistants

Filtered by Q1 and Q2, respondents addressed several general questions about the usage of VAs. According to the results, the most common device for issuing commands to a VA is a smartphone (42.7%), followed by a smart speaker (25.5%) and a car (12.1%). When asked about their experiences with VAs, the most popular command was "Set a timer or reminder" (18.3%), followed by "Check the weather/news" (14.3%), "Play music" (13.0%), and "Ask a quick question" (13.0%). Additionally, it was found that almost half of the respondents use VAs on a daily basis (41.2%). In terms of VAs used, the largest group (47.4%) uses Apple's Siri most frequently, followed by Amazon's Alexa (35.1%) and Google's Assistant (16.5%). 1% of respondents use another VA most often.

Smartphone	Smart speaker	Car	TV remote	Laptop	Wearables	Tablet
43%	26%	12%	5%	5%	5%	4%
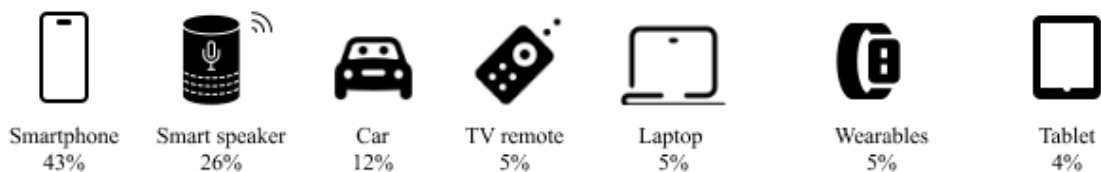
Figure 5: VAs usage by device

The relationship between age and the usage of virtual assistants VAs was interesting to examine, as some sources suggested that younger people use VAs less frequently and use fewer functions. To investigate this, the relationship between age and usage as well as age and functions was analyzed using the crosstabs function. However, a Chi-square Test showed a p-value of more than 0.05, meaning that the null hypothesis that the two variables are independent could not be rejected. This indicates that there is no significant relationship between age and VA usage and used functions among the participants (Appendix 3).

4.3. Hypothesis Testing

To analyze the impact of the hypotheses on overall trust level, it is important to examine the Likert scales used to measure it. The Cronbach's alpha, which measures the reliability or internal consistency of Likert scales, is used to determine the extent to which the items on the scale measure the same concept. A Likert scale is generally considered reliable if the alpha coefficient is 0.7 or

higher. In this case, the reliability of the Likert scales is confirmed as Cronbach's alpha is 0.879, so the scales can be analyzed as a mean (Appendix 3).

Hypothesis 1: Brand trust has a positive impact on the overall trust level of VA.

To assess the impact of brand trust on overall trust in VAs, several Likert scales measuring trust in individual brands (Apple, Amazon, and Google) are combined (Cronbach's alpha > 0.7) and linear regression is run. The model summary shows that 67% of the variation in overall trust can be explained by brand trust. The ANOVA table reveals that the regression model predicts overall trust significantly well ($p < 0.001$). The regression equation is: *Overall trust = 0.331 + 0.820 (Brand trust)*, indicating that when the level of brand trust increases by one unit, overall trust increases by 0.820. This result suggests that there is a positive correlation between overall trust in VAs and brand trust.

Hypothesis 2: Hedonic value perception of VAs has a positive impact on the overall trust level of VAs.

To assess the relationship between overall trust in VAs and hedonic value perception, the reliability of the scales is first tested using Cronbach's alpha. The alpha coefficient is above 0.7 for both utilitarian scales and hedonic scales. Next, linear regression is run, and the model summary shows that 38% of the variation in overall trust can be explained by hedonic perception. The ANOVA table reveals that the regression model significantly predicts overall trust ($p < 0.001$). The regression equation is: *Overall trust = 1.247 + 0.610 (Hedonic perception)*, indicating that when the level of "Hedonic perception" increases by one point, the overall trust in VAs increases by 0.610. This result suggests that there is a positive correlation between overall trust in VAs and hedonic perception.

Hypothesis 2a: Hedonic value perception has a higher impact on the overall trust level of VAs compared to utilitarian value perception.

To test the hypothesis and compare the impact of utilitarian and hedonic perception on overall trust in virtual assistants (VAs), a multiple regression is run. The model summary shows that 51% of the variation in overall trust can be explained by the independent variables. The ANOVA table reveals that the regression model significantly predicts overall trust ($p < 0.001$). The

regression equation is: *Overall trust = 0.347 + 0.321 (Hedonic perception) + 0.501 (Utilitarian perception)*, indicating that when the level of utilitarian perception increases by one point, overall trust in VAs increases by 0.501, and when the level of hedonic perception increases by one point, overall trust increases by 0.321, ceteris paribus. This result suggests that there is a positive correlation between overall trust in VAs and both hedonic and utilitarian perception, but the hypothesis is rejected as utilitarian perception has a greater influence on overall trust.

Hypothesis 3: Older adults trust VAs more compared to the other age groups.

To test the hypothesis about the relationship between age and trust in VAs, dummy variables are created for the categorical age data and linear regression was run. The model summary shows that 32% of the variation in overall trust can be explained by age. The ANOVA table reveals that the regression model significantly predicts overall trust ($p < 0.001$). The regression equation is: *Overall trust = 5,000 - 2,375 (age 18 to 24) - 2,361 (age 25 to 34) - 1,688 (age 35 to 44) - 1,589 (age 45 to 54) - 1,107 (age 55 to 64) - 0,979 (age over 65)*, indicating that older people have higher levels of trust in VAs compared to younger age groups. Although the p-values for the age groups 55 to 64 and over 65 are greater than 0.1, this does not necessarily mean that the hypothesis is rejected. It could simply mean that the relationship between trust in VAs and age group is not as strong as expected or that there are other factors that have a stronger effect on trust in VAs. Overall, the results suggest that younger age groups have lower levels of trust in VAs compared to older ones.

Hypothesis	Results
H1: Brand trust has a positive impact on the overall trust level of voice assistants	*Overall trust = 0,331 + 0,820×(Brand trust);* $p < 0.001$ Therefore, H1 is **not rejected**. According to this sample, there is a positive impact of brand trust n the overall trust level of voice assistants.

H2: Hedonic value perception of voice assistants has a positive impact on the overall trust level of voice assistants	*Overall trust = 1,247 + 0,610(Hedonic);* p < 0.001 Therefore, H2 is **not rejected**. According to this sample, there is a positive impact of hedonic value perception on the overall trust level of voice assistants.
H2a: Hedonic value perception has a higher impact on the overall trust level of voice assistants compared to a utilitarian value perception	*Overall trust = 0,347 + 0,321(Hedonic) + 0,501(Utilitarian);* $p_h < 0.001$, $p_u < 0.001$ Therefore, H2a is **rejected**. According to this sample, utilitarian value perception has a higher impact on the overall trust level of voice assistants compared to a hedonic one.
H3: Older adults trust voice assistants more compared to the other age groups	*Overall trust = 5,000 - 2,375(from 18 to 24) - 2,361(from 25 to 34) - 1,688(from 35 to 44) - 1,589(from 45 to 54) - 1,107(from 55 to 64) - 0,979(more than 65);* $p_1 = 0.010$, $p_2 = 0.011$, $p_3 = 0.070$, $p_4 = 0.086$, $p_5 = 0.230$, $p_6 = 0.291$ Therefore, H3 is **not rejected**. According to this sample, older adults trust voice assistants more compared to the other age groups.

Table 1: Hypotheses and results from the statistical tests

5. Discussion

According to the results of the analysis, one of the four hypotheses cannot be proven, while strong evidence was found to confirm the other three hypotheses. The following discussion analyzes and evaluates each of the results separately.

First, it was necessary to evaluate whether the issue of trust is a major one when it comes to the adoption of VAs. Indeed, most of the respondents indicate that trust (active listening and data privacy issue) is the biggest problem in their opinion (Q5).

Based on the analysis, it is confirmed that brand trust (H1) is an important factor that can positively influence the level of trust in VAs. When a consumer trusts a brand, they are more likely to trust the products and services that the brand offers. In the case of VAs, this means that consumers who trust a particular brand are more likely to trust the VA that the brand offers.

The analysis shows that hedonic value perception (H2) has a significant impact on the overall trust that consumers have in VAs. When a VA provides a pleasant and enjoyable user experience, it can increase the trust that consumers have in the product, which has previously been shown by Gursoy et al. (2019) for AI devices as a whole. This is because a positive user experience can lead to increased satisfaction and a sense of reliability and dependability, which are important factors in building trust. On the other hand, if a VA provides a poor user experience or is difficult to use, it can negatively impact trust. Consumers may be less likely to use the VA if the level of trust in it is low.

According to the analysis of the survey results, it turned out that hedonic perception is not more significant in relation to the overall level of trust compared to a utilitarian value perception (H2a). Utilitarian value perception may have a stronger influence on overall trust in VAs compared to hedonic value perception because the utilitarian value is often more closely related to the primary purpose of the VA. Consumers are likely to rely on their VA to perform a variety of tasks and provide information, and they will be more likely to trust the VA if it is able to do so effectively and efficiently.

The results show that both hedonic value perception and utilitarian value perception are important factors that can influence trust in VAs. A VA that is both useful and enjoyable to use is likely to be more trusted and used by consumers compared to one that is lacking in either of these areas. Therefore, it is important for VA developers to focus not only on the utilitarian but also on the hedonic aspect to build trust with consumers.

Considering the relation between different age groups and trust in VAs (H3), older people are more likely to trust VAs compared to younger people. This could be due to a variety of factors, including differences in technology usage patterns and familiarity with gadgets. Another reason could be that older users prefer voice commands compared to clicking or typing (Wulf & Tscheligi, 2014). On the other hand, younger people may be less likely to trust VAs due to different reasons. For instance, it could be a part of the skepticism here, as it is natural for people to be suspicious about new products, especially if they have not been extensively tested or if there is a lack of information about their long-term reliability and transparency of the private data collection.

In the discussion of the results of the analysis, it is imperative to mention the "privacy paradox," the discrepancy between people's concerns about privacy and their actual behavior when it comes to the use of technology. The concept has been widely discussed in the literature on privacy and technology. The term privacy paradox was first used by Acquisti and Grossklags (2005) in their paper, where they investigated the privacy paradox in the context of online personal information disclosure. In the case of VAs, some people may express concerns about the privacy implications of using these devices, such as the possibility that they may record and transmit private conversations. However, despite these concerns, many people continue to use VAs in their daily lives. One reason for this paradox may be that people prioritize convenience over privacy. VAs can make tasks easier and more efficient, and some people may be willing to trade off some privacy in exchange for these benefits.

Alhabash et al. (2018) investigated the privacy paradox in the context of the IoT. The authors find that trust in the IoT system is an important predictor of privacy concerns and behavior, and that there is a negative relationship between trust and privacy concerns. Despite concerns about trust, many people continue to use virtual assistants. One possible reason for this is that the convenience and utilitarian benefits offered by these devices outweigh any trust issues. Trust in virtual assistants may become more important as their level of functionality increases. Consumers may be hesitant to adopt the technology if they do not feel that the perceived functionality justifies it due to trust issues. However, once the perceived functionality reaches a certain level, consumers may either start to trust the devices more (as evidenced by the positive relationship between perceived utilitarian value and trust), or they may overlook trust issues in favor of the potential benefits. Further research on the topic of trust and trustworthiness of virtual assistants could explore this idea in more detail.

6. Limitations and Implications

6.1. Managerial Implications

The current research on the factors affecting trust in VAs leads to several implications that could provide the basis for future research on the topic, as well as be applied to the design and marketing strategies of VA developers.

Based on the positive influence of brand trust on overall trust in VAs, it can be concluded that VA developers should build brand trust for their company and their VA in particular. This could be achieved through transparent practices, ethical behavior and good customer service. If a provider has a high level of trust among potential users, it could make the technology more widely adaptable in general and stand out from the competition. In addition, VA developers could increase brand trust by taking steps to protect the privacy and security of their users. This can include implementing strong privacy policies and practices, as well as providing users with control over their data and how it is used.

It is also evident from the analysis that developers should consider the hedonic value in addition to the purely utilitarian value to customers. VA developers should focus on creating pleasant and engaging user experiences to build trust. This could be done through personalization, for example, by the VA making personalized suggestions or responding according to personal preferences. Aspects such as gamification and humor could also create additional trust, as they could provide fun and entertainment and increase the hedonic value of the product. In addition to the software, aspects such as the external design and packaging of the VA could also play a role in hedonic value perception. Due to the greater importance of utilitarian value perception, it could be valuable to offer a wide range of features and capabilities. Managers can focus on developing and improving the features and capabilities of their VAs to increase their utilitarian value.

The finding that older consumers have greater trust in VAs provides two implications for marketing. On the one hand, younger consumers should be targeted for trust-building, as they tend to have greater privacy concerns. This could be achieved, for example, by specifically targeting younger consumers with trust-building marketing measures to reduce their concerns. On the other hand, marketing measures for the older audience could be expanded. Since this user group already has a comparatively high level of trust in the technology, these marketing measures would have to consist less of trust-building content but could rather focus their attention on the utilitarian aspect of VAs. This can include using age-appropriate language and imagery in marketing materials and

highlighting the benefits of VAs for older individuals. Another implication is that manufacturers of VAs can increase trust among older users by offering in-person training and support. This can include hosting workshops or training sessions where users can learn how to use the device or providing one-on-one support to help users get started with their VAs.

6.2. Limitations and Future Research

There are a few key limitations of this research. Firstly, this concerns the generalizability of the results obtained. Since the study only includes results from participants in the DACH region, the results should not be generalized to other geographic regions. Also, there are a disproportionate number of students (39.2%) and expatriates (only 75.3% currently live in the DACH region) among the participants, which affects the representativeness of the study. In order to obtain more representative results without bias, this should be taken into account when collecting the data.

Additionally, the data in the survey is self-reported and may be influenced by biases and inaccuracies due to respondents' memories, interpretations, and willingness to be truthful. It may be beneficial to use multiple methods of data collection, such as both self-report surveys and behavioral measures, in order to triangulate the results and increase the reliability and validity of the findings.

Another limitation is that the study only looked at a limited number of factors that influence trust in virtual assistants, such as age, brand trust, hedonic value perception, and utilitarian value perception. The omission of other factors, such as the user's previous experiences with technology, level of technical knowledge, cultural differences, and privacy concerns, could potentially lead to an omitted variable bias if they correlated with the examined factors. It could thus be useful to examine a wider range of factors to provide a more comprehensive understanding of what impacts trust in VAs and how this may vary across different contexts.

For future studies, it would be interesting to analyze more precisely the privacy paradox in the context of the utilitarian value perception of VAs. There is room for new findings and research in the VAs industry when it comes to the perception of a specific functionality level that creates a situation of a tradeoff of privacy for convenience. More consumer research, perhaps in real-world settings, that analyzes the level of importance of various features that affect the level of hedonic and utilitarian value perception, would be worth seeing. Conducting more case studies for different age groups would be valuable, in order to identify commonalities and differences between the

categories, to identify features that are required for each of them, and to assess the overall experience of interaction with the device.

7. Conclusion

Due to technological advances in the fields of AI, NLP, and IoT, and increasingly widespread adoption, VAs have been steadily growing in popularity for several years. In the future, VAs hold the potential to revolutionize the way humans interact with technology. One factor holding back the technology's widespread adoption is consumers' lack of trust in or skepticism toward VAs due to privacy concerns. Studies and surveys from recent years show that this makes many users wary of sharing their sensitive information with VAs. For this reason, it is elementary for VA developers to understand how to overcome this barrier. If trust issues are addressed, this could lead to wider adoption of the technology overall as well as open up the potential for an individual VA to differentiate itself from the competition.

For this reason, this thesis aimed to identify the factors that influence trust in VAs and discover possible ways to improve trust in VAs. Based on the findings of the existing academic literature and confirmed by in-depth interviews with users, the following four hypotheses were formulated to address this question:

- *H1: Brand trust has a positive impact on the overall trust level of VAs.*
- *H2: Hedonic value perception of VAs has a positive impact on the overall trust level of VAs.*
- *H2a: Hedonic value perception has a higher impact on the overall trust level of VAs compared to utilitarian value perception.*
- *H3: Older adults trust VAs more compared to the other age groups.*

The research questions were then evaluated by a quantitative analysis of a survey conducted for participants from the DACH region. The analysis confirmed the hypotheses H1, H2 and H3, while H2a had to be negated. A statistically significant influence of brand trust on overall trust in VAs was found. This is conclusive and confirms previous research that found that trust in individual brands and trust in their products and product categories are strongly positively correlated. The finding that hedonic value perception has a positive impact on trust in VAs is also not surprising, and confirms previous research that has looked at technology products in general. Hypothesis H2a had to be negated, as the analysis found that the utilitarian aspect of VAs has a stronger influence on trust in VAs than the hedonic aspect. This contrasts with a previously conducted study on this topic. Hypothesis 3 was confirmed and is logically in line with the previous academic findings that older people have fewer privacy concerns than younger people.

Various implications for practice can be derived from the results of the analysis. First of all, it is not surprising to note that VA developers should carry out marketing measures to build trust in the products. Since hedonic value perception has a significant positive impact on trust in VAs, developers should also emphasize fun and entertainment. This could be achieved through personalization, gamification and humor; however, at the same time improving the features and capabilities of their VAs to increase their utilitarian value. As older consumers have a higher level of trust in VAs, marketing efforts for younger consumers should focus on trust-building, while marketing efforts for older consumers can focus on the functional benefits of VAs.

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Appendix

Appendix 1 – In-depth interview guidelines

Introduction

Hello, X, hope you are doing great! I would like to thank you for participating in this interview.

My name is Aleksandra, and I am currently finishing my international masters in Management majoring in Marketing at Católica Lisbon School of Business and Economics. At the moment I am writing my thesis on the topic of the trustworthiness to voice assistants (VA) in the DACH region. One of its parts is a qualitative analysis (or interviews). The goal of those is to investigate the attitude and perceptions of consumers toward VAs, to identify the main issues and factors that could have a positive impact on VAs adoption and interviews will help me to gather some valuable insights on the topic.

I am going to ask you some general questions, but this is supposed to be an open conversation, so feel free to add anything important that you think is missing, and please keep in mind that there are no right or wrong answers and what matters is your true and open opinion about the subject. The interview will last, approximately, 20/30 minutes, and it will be recorded for later in-depth analysis of your answers. Moreover, all your answers will remain anonymous, and you will not be contacted further past this interview.

If there are no questions, without further do, let's start our interview!

Consumers interviewed:

T.W.: 24 years old, Male, Entrepreneur

T.H.: 58 years old, Male, Lawyer

M.E.: 32 years old, Male, Product manager

L.K.: 22 years old, Female, Master's student (Management)

J.C.: 29 years old, Female, Psychologist

T.W.: 55 years old Female, Retired

P.H.: 83 years old, Female, Retired

D.W.: 43 years old, Male, Consultant

I - General attitudes toward voice assistants:

   1)   Initial question: Are you familiar with voice assistants (for example, Siri, Google Assistant, Alexa…)?

T.W.: Yes

T.H.: Yes

M.E.: Yes

L.K.: Yes

J.C.: Yes

T.W.: Yes

P.H.: Yes

D.W.: Yes

Then, to make sure that everyone was familiar with the topic a general definition was given: "A Voice Assistant is a virtual assistant that uses speech recognition, natural language processing, and speech synthesis to perform tasks for its users. These assistants have advanced significantly and can now handle a range of complex tasks. Voice assistants are now integrated into many devices we use regularly, including smartphones, computers, and smart speakers. Some voice assistants offer a specific set of features, while others are more versatile and can assist with a variety of tasks."

2) *How often do you use VAs?*

T.W.: I would say almost every day.

T.H.: Several times a week.

M.E.: Every day, usually at home.

L.K.: So, I think with Alexa, it's like at least four or five, six times a day. Video on, off, and like a timer in the lines. And on my phone, I would say it's a bit less, so maybe once or twice.

J.C.: 5-6 times a day.

T.W.: Every day.

P.H.: Several times a day.

D.W.: Quite often, several times a day for sure.

3) *VAs on which devices do you use?*

T.W.: I usually use it on my phone but recently my parents bought a smart assistant, therefore, every time I am visiting them, I use Amazon Echo.

T.H.: On my phone and tablet.

M.E.: Smart speakers and iPhone.

L.K.: So, it's a smart speaker and phone. I don't know if you include the one in the car, but the one in the car, I just don't like it.

J.C.: Smart speaker.

T.W.: Smart speaker.

P.H.: Smart speaker.

D.W.: Phone, smart speaker, car.

4) Think about situations when you use(d) VAs?

T.W.: I have dyslexia, therefore I use it quite often. Most of the time for some small tasks like turning the music on, setting an alarm or timer, also replying to a message, to check the weather. I guess most of the typical functions.

T.H.: Usually I use it to check the news or weather, sometimes to set a timer and alarm. Also, it's useful in the car when checking traffic and routes.

M.E.: To turn on music, and radio, turn on films/series (as I have a module connecting a smart speaker to the TV), turn on lights off or on (smart house), to check the weather, to set a timer or alarm. There is a friend of mine who uses it to control radio nanny.

L.K.: In most situations where I use them, first of all, when I'm lazy, I use voice assistants for calculations. Like the daily use and the kitchen. Lights on, Spotify connect. I think it's like two of the most ones then. Radio on and alarm. As I also have a smart home system it's very useful. Also Google translator.

J.C.: To play music, to check the weather, and news, to turn on the film on the TV, and radio.

T.W.: My son has recently bought Echo for me and my husband and so far I am using it to turn on the series, and radio, and set a timer or to check the weather.

P.H.: I usually use it to turn on/off the radio, to check the weather and news. Once I collapsed and couldn't stand up, thank God there was Alexa and I asked her to call my son. No one knows what could happen if I didn't have a smart speaker.

D.W.: We have three smart speakers at home and smart bulbs, sockets, and other smart devices, therefore I communicate with Alexa very often at home. For example, to add products to the shopping list, to check traffic, to turn off/on lights, and other devices. I use my phone's VA for small tasks to set a timer, for instance. And in the car to build the route or to turn on the music/podcast.

5) How usage of VAs makes you feel?

T.W.: For me, it's like a real assistant that allows me to make things faster but I have to admit that when Echo appeared at my parents' house I was very excited to use it. It felt new and unknown, it was more of a fun thing to do. Remember how fascinated I was when could manage some things in the kitchen while staying in my room. This moment when I communicate feels nice maybe because it's still not that common, so you feel special.

T.H.: In the beginning, I was suspicious about the necessity of this technology. After a while, my son convinced me that it's very useful and saves time, he showed me what can I do and how to use it and now

I got used to it. Cannot say that I have some kind of emotional attachment, however, sometimes I feel that it is fascinating that this is possible nowadays.

M.E.: In the beginning when I just bought a smart speaker it was really fun, I was trying to make fun with it, for example, to try to make it use swear words, but her replies were really funny. At this point, it's just normal for me. Maybe additional functionality is the aesthetic satisfaction from the design.

L.K.: Yeah, that's a good question because I think it's one of the reasons why I've used it less after a certain amount of time. In the beginning, it was new, it was awesome. I was waking up having the news, the light goes on, and the music starts slowly. I even turned the music on when I was just leaving the train station, when I'm one minute later entering my doors, the music is already playing at home. But at some point, yes, feeling wise that there is literally a microphone all the time with you, with everything you do. So much information can be captured. And of course, I think nobody wants your data. Even when it's some things that you usually don't want to share. But I think I felt a bit like yeah that you feel observed.

J.C.: The first impression it was something new, I also asked her questions like "How are you?". Now it's just functional, I got used to it very fast.

T.W.: I'm shocked that it appeared to be so easy to use and convenient. In the past, I always had to wait for my husband to help me to turn on some movies but now there is Alexa. I didn't expect that it's going to be so fast to learn commands and interact with Alexa. I feel that every time I am speaking with her, I am excited, however, less and less over time.

P.H.: At first, I thought that it is not going to work as it was too complicated, but I learned how to use it in one day or so. I feel thrilled about talking to her and I'm fascinated by how clever she is.

D.W.: So, this purchase was inspired by my sons, then we talked and decided to try it out, it was around five years ago. Of course, in the beginning, it was something new, something for fun, remember laughing about some of Alexa's answers. Now it is about functionality, I don't think any more about communication in that way, however, I noticed that when I go to the Netherlands where we don't have smart speakers, I start missing it.

6) What are, in your opinion, the main advantages of VAs?

T.W.: Well, for sure the fact that I can be more effective due to the time reduction, another point is the ease of usage and personalized approach, as it memorizes what I liked or disliked, talking about music, for example.

T.H.: Convenience, easy to use when you are busy doing something or in the car especially.

M.E.: It's a great solution for people who organize their space with contemporary technologies as a smart home is something that can radically make your life easier and you get used to it very fast. For fun

as well, you can watch films and listen to music more of an emotional experience. Another thing is the first tactile sensation from the packaging of smart speakers.

L.K.: Functionality: smart objects. I think it's nice, especially when you just can say turn the kitchen on, and then the kitchen lightens up without you searching for switches. Otherwise, it's good for spontaneous stuff. For example, when you have (for me it's maybe three times a week or so) question or so, and you have someone that you can ask directly. I mean, of course, you can Google it, but you can just ask that.

J.C.: She's helpful for routine tasks, I don't have to think about what music to turn on or where to search for it

T.W.: She saves so much time and energy! Super convenient and fast, I cannot imagine not having her anymore.

P.H.: I don't know, she just makes your life so much easier. Even though it feels that there is nothing complicated I couldn't do by myself, you get used to it super-fast, when you don't even have to move to turn something on/off.

D.W.: Obviously functions, especially if you are a curious and innovative person like me, it's interesting how you can create different functions personalized and optimized only for you.

7)   And what are the main disadvantages?

T.W.: I think that the biggest problem for me is that it doesn't understand sometimes or doesn't react when I am calling.

T.H.: I was thinking about purchasing a smart speaker but what stops me is the privacy issues, as I have no clue what is done to my personal data and who can use it.

M.E.: They push users to purchase many additional products to create an ecosystem, so you have additional expenses (for example, you need to buy a special remote for the TV), customer support also sometimes doesn't help much. For other voice assistants, there is a problem with voice recognition (Siri, Google assistant).

L.K.: They just don't understand sometimes. I have a funny story because yesterday I was talking to an assistant on the telephone, and it got me mad because the assistant just didn't understand the word yes. So, in Germany, I was saying ja. She was always like, so sorry, I can't understand. A microphone is the biggest disadvantage. Of course, you have your phone, which is a microphone as well, and you take it everywhere. I don't know why I have this perception, but it feels that smart speakers are even more dangerous.

J.C.: It's more about future improvements, so far there are no big issues.

T.W.: Hmm, cannot highlight big disadvantages, maybe just in the beginning I had to get used to certain commands, but it was very fast.

P.H.: Honestly, I don't have any problems.

D.W.: I think that for me personally, it would be nice if there would be one voice assistant every-where. So, imagine having Alexa both at home, in the car, and on the phone.

8)   What is the biggest issue or worry related to a VA?

T.W.: I am quite concerned about active listening.

T.H.: The biggest issue for me has been awareness, like understanding what I'm able to do with these devices.

M.E.: No big issues, it's more related to bad internet, therefore bad experience with VAs.

L.K.: It should be data, as I have no clue what they do with the collected data. You know, it's probably true when you sometimes talk about something and then you get advertisements, right for what you have talked about and it's a bit yeah, and I mean, when it's just advertisement, it's not so bad. But what if they put you in a category based on what you like and so on? I don't want to believe in all those conspiracy theories but there is so much data collected on basically every topic of your personal life…just imagine the data is not safe and later on, they take the data and, I don't know, blame you for something. This is super hypothetical, but the data is saved somewhere, and you don't know what happens with it.

J.C.: There are no worries or issues.

T.W.: I think that maybe one issue is that I feel the support from my son if I want to use other additional functions because it feels too complicated for me. For example, he wants to buy us smart bulbs and without him, I would have never thought about this.

P.H.: Well, for me for example it's hard to check new functions and commands by myself because sometimes I can't imagine what is it capable off. Therefore, I need some help from my son or grandchildren to show me and explain everything.

D.W.: There are no big worries to be honest.

II - Trust-related questions

Now, we will move to the second part of the interview where we will talk about trust in VAs.

9)   Do you trust VAs? Why?

T.W.: Well, it became such a routine for me that I don't really notice that I use it, so it's a bit hard to answer this question. In general, I believe that it's not that safe because of the active listening, and also, I'm not sure about the data collection but I still continue using it.

T.H.: As I use it mostly for simple tasks, I don't feel insecure about it.

M.E.: I trust the information which I get from the VA. About active listening - I don't care because we are actively listened every day on our phones and laptops. Moreover, as a person who works in a telecom company and understand that even if you turn off your microphone manually, nothing is going to change.

L.K.: Trust is a hard work, so of course, I have some kind of misbelief in it. But as I mentioned in the beginning, I don't think that my data is so valuable that anyone would analyze it in such a deep way.

J.C.: I think, yes. In a way, I don't share a lot of personal information. If you mean active listening, I don't think that it's an issue as nowadays we are sharing our personal information everywhere.

T.W.: Yes, for sure. There is no need to recheck the information. And I haven't thought about active listening from the speaker before you mentioned it.

P.H.: Yes, I trust her.

D.W.: Yes, I've never questioned whether to trust it or not.

If, no. At which point of interaction with VA do you feel the most vulnerable?

T.W.: I think that when I'm speaking with someone and there is a smart assistant close, I feel that it can listen to my dialogue. Also, what makes me extremely nervous is when I speak with someone about a certain product and then I have all those recommendations on my social media or search.

L.K.: The most vulnerable moment for me when using voice assistant is basically not when using it, but everything apart from the communicating point. So, like when you don't use it and you know that it's still here and you're continuing talking to someone and everything. But it's ironic because you have a phone which does the exact same, but somehow, it's a bit more but, it's just a small, you know, such a bad just a little thing that is.

10)   In your opinion, VAs are utilitarian (functional) or hedonic (emotional) products? Why?

T.W.: I would say that in the beginning, it was very special for me, I felt excited when I was using it, so probably it was emotional but after a while more functional I would say.

T.H.: In my opinion, it's functional, however in the beginning it was more of an experience every time I communicated with it.

M.E.: In the beginning, it was for sure an emotional purchase out of curiosity. However, after time you learn more and more commands and it gets extremely useful and necessary for life. It's so easy that you don't have to move/stand up to turn something on or off. Also, as you learn more every time it starts surrounding you everywhere. And yes, to sum up maybe, in the beginning, you buy it out of curiosity and fun but then it becomes an indispensable part of your life.

L.K.: For me, it's the functional part. In the beginning, I wanted to have innovative stuff. This is just so it was new. I think it was like a bit of passion just to try it, test it out.

J.C.: For me, it's about functional features. However, in the beginning, it was more interesting for me rather than necessary.

T.W.: Well, I think that she for sure brings me a lot of positive emotions but on the other hand I feel that it has almost become a part of my life as it integrated so easily and fast.

P.H.: I believe that it is more of a functional product that helps me to facilitate day-to-day tasks.

D.W.: Totally functional but also, I feel that having the pack + smart home makes me a bit special compared to some of my friends, I feel more open-minded and explorative.

11) VAs from which brands do you use?

T.W.: I use Siri (on my phone) and Alexa (smart assistant).

T.H.: Siri and Google Assistant.

M.E.: Amazon, Apple.

L.K.: Amazon, Apple, Google.

J.C.: Amazon.

T.W.: Amazon.

P.H.: Amazon.

D.W.: Amazon, Siri.

12) Do you think that your attitude towards the brand has an influence on your trust in the VA?

T.W.: I've never thought about this in this way but probably. Honestly, I prefer to have Amazon smart speakers rather than Apple's or Google's as there are so many privacy issues and scandals related to them. I feel that I don't want to use their VAs except for Siri on my phone as I'm too used to it.

T.H.: I don't think so, for me they are all plus or minus the same.

M.E.: I chose Amazon because they have the best technology for voice recognition, it is less expensive than Apple (as there you must purchase everything from the brand), in general, the technology is much better at Amazon and they learn faster, they are also integrated into more devices.

L.K.: It's just how it ended up for reason. Because Amazon speakers at the time when we got them were the only ones that had a connection system for music (around five years ago). So there was no ML speaker and not even Google, I think. So, we just wanted to have those. Amazon speakers. We were shopping on Amazon. We got the advertisement for Amazon speakers. And so, like this, we got the Amazon speaker, and they were the Amazon speaker, and it would connect with Spotify. So that's why we ended up with Spotify. We had Google Phones before, so we had to switch to Apple later. I think that can have an

impact because I don't know, it had a little impact on me as well on Apple because if it's thrown out, I don't know. But they just play everywhere, those safety things. And I was like, oh, yeah. Nice. At least my information is a bit safe. Not that it's like the major one. I would say it can help them.

J.C.: Well, it's more because one thing is more convenient for me at home use amazon as they appeared earlier. There is a probability that I liked Amazon first and that's why bought Echo.

T.W.: Not in my case, because this purchase was made by my son, but I think he mentioned that it's convenient that Alexa is integrated into many devices and also cooperates with many platforms that we use.

P.H.: I don't know many brands. It was a present from my children and I didn't even know about the existence of smart speakers before. So, it was a surprise for me.

D.W.: I would say yes because Amazon was a pioneering company with their smart speakers and I know that it's in their core strategy, therefore the technology is the best on the market. I see how they constantly transform and evolve and I trust Amazon more compared to other brands as they weren't included in that many scandals about privacy issues.

13) What could make you trust VAs more?

T.W.: If I could be sure that my data is not used somewhere else, that it doesn't manipulate me when purchasing something, for example.

T.H.: If I would know how the technology work, as for me it's still hard to understand what is behind it.

M.E.: Honestly, I think people just don't know how to use it and how convenient is it. If Amazon could let people test smart speakers for a short time, I'm pretty sure, that no one would bring them back.

L.K.: I don't have a solution for that, but it would be nice if there's a technical way to solve the problem with confidential data. For example, if the whole data would be stored only in my smart speaker without sharing it with the main server. Then the program answers locally without ever directly uploading your data or processing it in the cloud. Maybe this could be a solution to trust it or not. Another point is the marketing of course.

J.C.: Maybe it's natural, so there is nothing you can do now except marketing that could show many different functions and capabilities Another point is to integrate it into as many devices as possible, as it feels that when people realize the convenience of VAs, they will use it without doubts (like it was with smartphones).

T.W.: It is hard for me to say, as I don't have any problems with it.

P.H.: I think people don't even know this product exists and don't know how to use it. Therefore, there is a lack of trust in every new technology. Probably companies should try to show also old people the

advantages of these systems may be opening offline shops where you can check how everything works and ask for help, in case.

Appendix 2 – Online questionnaire

Voice assistants

Introduction

Hello there!

My name is Sasha and I would really appreciate if you could participate in this short 7 minutes survey. (Sie können die Sprache der Umfrage in der oberen rechten Ecke ändern)

As part of my master's thesis, this study is being conducted to explore factors that could have a positive impact on the level of trust to voice assistants in the DACH region.

(1) The survey is fully anonymous.

(2) The collected data will be kept strictly confidential.

(3) Only aggregated results will be used in any report on the survey.

(4) Participation in the survey is voluntary.

For any questions regarding this survey, you can reach out to me at s-aapkanieva@ucp.pt

Thanks in advance for your help :)!

Best Sasha

Q1 Do you live in the DACH region (Germany, Austria, Switzerland) or used to live there in the last 10 years?

○ Yes

○ No

Q2 How often do you use voice assistants (Siri, Google Assistant, Alexa etc.)?

○ Once a month

○ Everyday

○ Less than once a month

○ Every week

○ Never used it

○ Every two weeks

Q3 Choose the device(s) you use most often to communicate with the voice assistant

- ☐ Smartphone
- ☐ Smart speaker
- ☐ Laptop / desktop computer
- ☐ Tablet
- ☐ TV remote (Smart TV)
- ☐ Car
- ☐ Wearable (e.g. e-watch)
- ☐ Other

_____

Q4 What do you usually use voice assistants for? (Multiple answers can be selected)

- ☐ Ask a quick question
- ☐ Check weather/news
- ☐ Play music
- ☐ Set a timer or a reminder
- ☐ Send a text or an email
- ☐ Check traffic/navigation
- ☐ Add notes
- ☐ Buy/order something
- ☐ Control other smart devices
- ☐ Make a phone call
- ☐ General web searches
- ☐ Other

_____

Q5 In your opinion, what are the doubts/problems about the use of voice assistants? (Name at least one)
_____

Q6 Think about voice assistants in general and let me know whether you agree or disagree with the statements below:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I fully **trust voice** assistants.	○	○	○	○	○
I am sure that my **personal information is safe** when I use voice-assistants.	○	○	○	○	○
I can **rely on** voice assistants in my daily tasks.	○	○	○	○	○

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I am **satisfied with** the voice assistant's performance.	○	○	○	○	○

Q7 Rank voice assistants' brands based on the frequency of use:
_____ Apple
_____ Google
_____ Amazon
_____ Other

Q8 Think about Siri and let me know whether you agree or disagree with the statements below:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I **fully trust** Siri.	○	○	○	○	○
I am sure that my **personal information is safe** when I use Siri.	○	○	○	○	○
I can **rely on** Siri in my daily tasks.	○	○	○	○	○
I am **satisfied with** Siri's performance.	○	○	○	○	○

Q8 Think about Google Assistant and let me know whether you agree or disagree with the statements below:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I **fully trust** Google Assistant.	○	○	○	○	○
I am sure that my **personal information is safe** when I use Google Assistant.	○	○	○	○	○
I can **rely on** Google Assistant in my daily tasks.	○	○	○	○	○
I am satisfied with Google Assistant's performance.	○	○	○	○	○

Q8 Think about Alexa and let me know whether you agree or disagree with the statements below:

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I **fully trust** Alexa.	○	○	○	○	○
I am sure that my **personal information is safe** when I use Alexa.	○	○	○	○	○
I can **rely on** Alexa in my daily tasks.	○	○	○	○	○
I am **satisfied** with Alexa's performance.	○	○	○	○	○

Q8 Think about your assistant and let me know whether you agree or disagree with the statements below:

		Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	**Strongly agree**
I **fully trust** my assistant.	○	○	○	○	○	○
I am sure that my **personal information is safe** when I use my assistant.	○	○	○	○	○	○
I can **rely** on my assistant in my daily tasks.	○	○	○	○	○	○
I am **satisfied** with my assistant's performance.	○	○	○	○	○	○

Q9 Think about your interaction with voice assistants. How does it make you feel?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
It **is interesting to** communicate with the voice assistant.	○	○	○	○	○
Talking to a voice assistant **is fun.**	○	○	○	○	○
I feel **excited when** talking to the voice assistant.	○	○	○	○	○

In my opinion, using the voice **assistant increased** my task effectiveness.	○	○	○	○	○
Using the voice assistant enabled **me to** find the needed information **faster.**	○	○	○	○	○
The voice **assistant makes** my life **easier.**	○	○	○	○	○
I am paying attention and I will choose "Strongly agree" in this question	○	○	○	○	○

Q10 In my opinion, using voice assistant is

- ○ Fun
- ○ I don't know
- ○ Not fun

Q11

- ○ Necessary
- ○ I don't know
- ○ Unnecessary

Q12

- ○ Exciting
- ○ I don't know
- ○ Dull

Q13

- ○ Useful
- ○ I don't know
- ○ Useless

Q14

- ○ Enjoyable
- ○ I don't know
- ○ Unenjoyable

Q15

- ○ Productive
- ○ I don't know
- ○ Unproductive

Q16 What is your gender?

○ Male

○ Female

○ Non-binary / third gender

○ Prefer not to say

Q17 How old are you?

○ Less than 18

○ 18-24

○ 25-34

○ 35-44

○ 45-54

○ 55-64

○ 65 or older

Q18 In which country do you currently reside?

Q19 What is your marital status?

○ Single

○ In a relationship

○ Married

○ Divorced

○ Widowed

Q20 What is your occupation?

○ Student

○ Employed

○ Unemployed

○ Retired

○ Other

Q21 What is your highest level of education?

○ 9th grade

○ High school

○ Bachelor

○ Master

○ Doctorate

○ Other

Q22 What is your total household income?

○ Less than €10,000

○ €10,000 - €19,999

○ €20,000 - €29,999

○ €30,000 - €39,999

○ €40,000 - €49,999

○ €50,000 - €59,999   ○ €90,000 - €99,999

○ €60,000 - €69,999   ○ €100,000 - €149,999

○ €70,000 - €79,999   ○ More than €150,000

○ €80,000 - €89,999

Q23 Including yourself, how many people live in your household?

○ 1

○ 2

○ 3

○ 4

○ 5

○ 6

○ 7

○ 8

○ 9+

Appendix 3 – SPSS Descriptive statistics outputs

		Frequency	Percentage
Gender	Male	52	53,6%
	Female	45	46,4%
Age	Less than 18	1	1,0%
	18-24	26	26,8%
	25-34	18	18,6%
	35-44	12	12,4%
	45-54	14	14,4%
	55-64	14	14,4%
	65 or older	12	12,4%
Education	9th grade	2	2,1%
	High school	11	11,3%
	Bachelor	45	46,4%
	Master	27	27,8%
	Doctor	4	4,1%
	Other	8	8,2%
Occupation	Student	38	39,2%
	Employed	40	41,2%
	Unemployed	2	2,1%
	Retired	14	14,4%
	Other	3	3,1%
Total household income	Less than €10,000	20	20,6%
	€10,000 - €19,999	12	12,4%
	€20,000 - €29,999	4	4,1%
	€30,000 - €39,999	5	5,2%
	€40,000 - €49,999	6	6,2%
	€50,000 - €59,999	4	4,1%
	€60,000 - €69,999	3	3,1%
	€70,000 - €79,999	6	6,2%
	€80,000 - €89,999	4	4,1%
	€90,000 - €99,999	6	6,2%
	€100,000 - €149,999	18	18,6%
	More than €150,000	9	9,3%
Number of households	1	22	22,7%
	2	41	42,3%
	3	14	14,4%
	4	9	9,3%
	5	5	5,2%
	6	2	2,1%
	7	1	1,0%
	8+	3	3,1%
Marital status	Single	26	26,8%

	In a relationship	28	28,9%
	Married	36	37,1%
	Divorced	5	5,2%
	Widowed	2	2,1%
Country of origin	Austria	14	14,4%
	France	2	2,1%
	Germany	54	55,7%
	Mexico	1	1,0%
	Netherlands	1	1,0%
	Portugal	20	20,6%
	Switzerland	5	5,2%
	Total respondents	97	100%

Table 2: Sample characterization (N = 97)
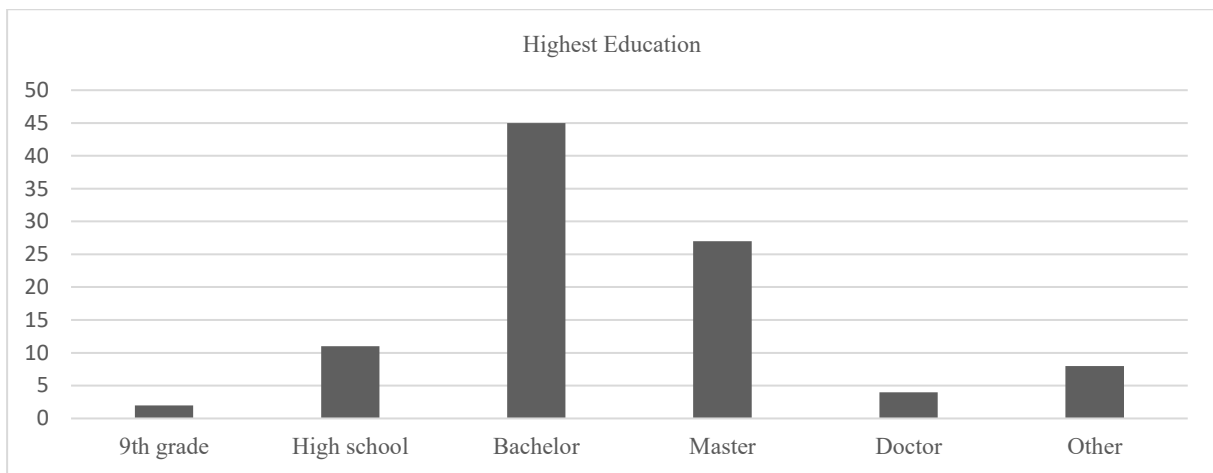
Figure 6: Distribution of the level of the highest education
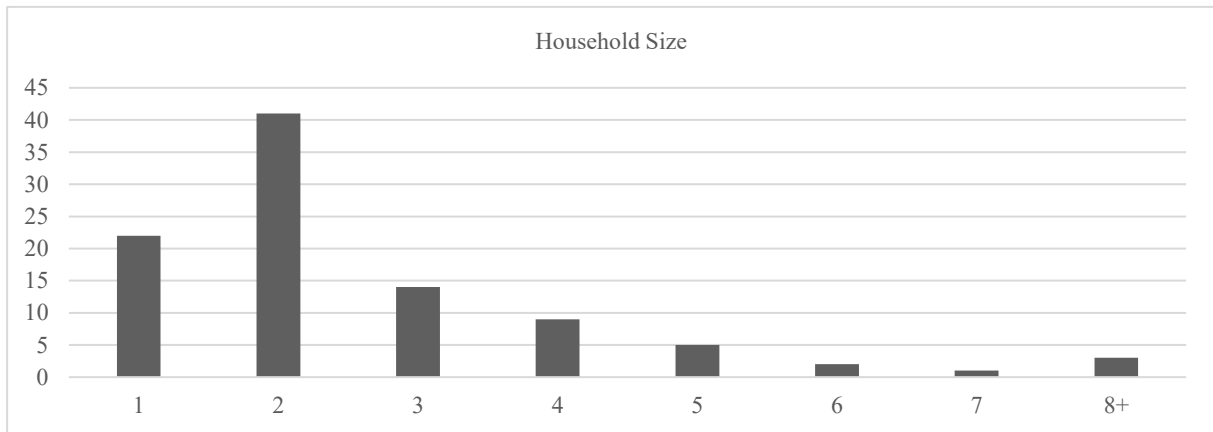
Figure 7: Household size distribution
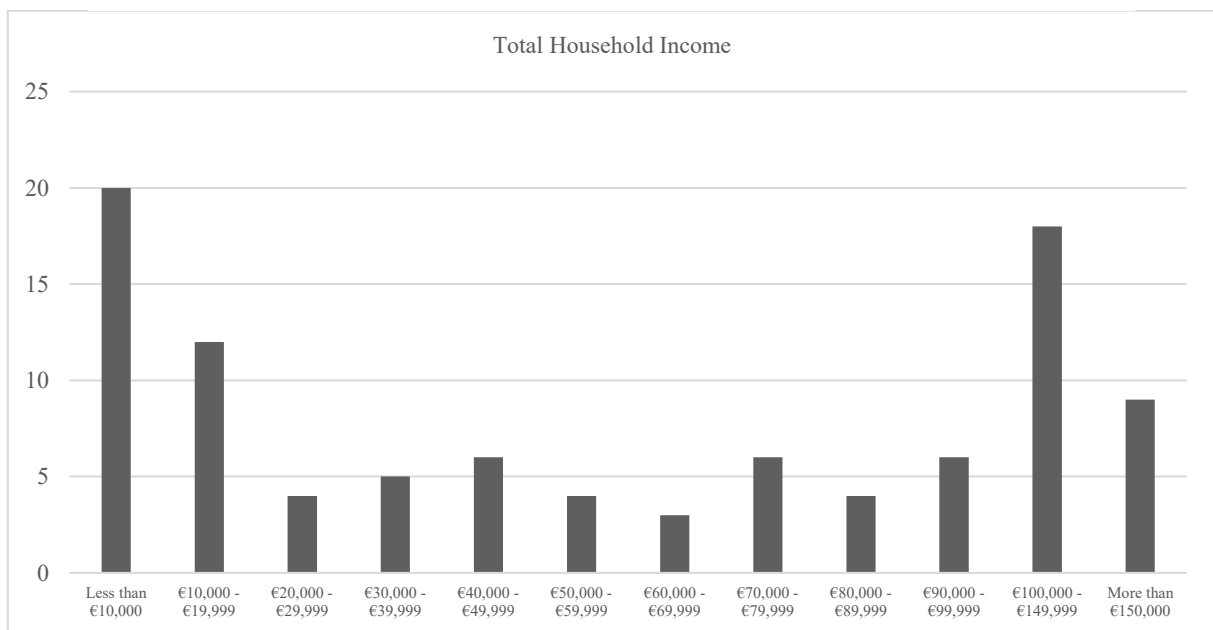
Figure 8: Household income distribution

		Frequency	*Percentage*
Devices	Smartphone	67	42,7%
	Smart speaker	40	25,5%
	Laptop/desktop computer	7	4,5%
	Tablet	6	3,8%
	TV remote	8	5,1%
	Car	19	12,1%
	Wearables	7	4,5%
	Other	3	1,9%
Usage	Ask a quick question	42	13,0%
	Check weather/news	46	14,3%
	Play music	42	13,0%
	Set a timer or a reminder	59	18,3%
	Send a text or an email	14	4,3%
	Check traffic/navigation	33	10,2%

	Add notes	9	2,8%
	Buy/order something	8	2,5%
	Control other smart devices	18	5,6%
	Make a phone call	24	7,5%
	General web search	18	5,6%
	Other	9	2,8%
Times	Everyday	40	41,2%
	Every week	16	16,5%
	Every two weeks	13	13,4%
	Once a month	9	9,3%
	Less than once a month	19	19,6%
	Total respondents	97	100%

Table 3: General knowledge about VAs

Chi-square test	p-value
Functions * How old are you?	0,306
How often do you use voice assistants? * How old are you?	0,248

Table 4: Crosstabs Chi-Square tests

	Reliability test (Cronbach's Alpha)
Overall trust	0,879
Overall brand trust (Amazon)	0,936
Overall brand trust (Apple)	0,884
Overall brand trust (Google)	0,741
Overall brand trust (All brands)	0,936
Overall hedonic	0,884
Overall functional	0,870

Table 5: Reliability tests

Hypothesis 1

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,814[a]	,663	,660	,60617

Table 6: Model Summary Hypothesis 1

ANOVAª					
Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	68,719	1	68,719	187,017	<,001ᵇ
Residual	34,907	95	,367		
Total	103,626	96			

Table 7: ANOVA Table Hypothesis 1

Coefficientsª							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	,331	,219		1,510	,134		
Brand_Trust_All	,820	,060	,814	13,675	<,001	1,000	1,000

Table 8: Coefficients Table Hypothesis 1

Hypothesis 2

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,615ª	,378	,371	,82376

Table 9: Model Summary Hypothesis 2

ANOVAª					
Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	39,162	1	39,162	57,711	<,001ᵇ
Residual	64,465	95	,679		
Total	103,626	96			

Table 10: ANOVA Table Hypothesis 2

Coefficientsª							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	1,247	,271		4,602	<,001		
Hedonic_General	,610	,080	,615	7,597	<,001	1,000	1,000

Table 11: Coefficients Table Hypothesis 2

Hypothesis 2a

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,717ª	,513	,503	,73243

Table 12: Model Summary Hypothesis 2a

ANOVAᵃ					
Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	53,199	2	26,600	49,584	<,001ᵇ
Residual	50,427	94	,536		
Total	103,626	96			

Table 13: ANOVA Table Hypothesis 2a

Coefficientsᵃ							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	,347	,298		1,164	,247		
Hedonic_General	,321	,091	,324	3,534	<,001	,616	1,624
Functional_General	,501	,098	,469	5,115	<,001	,616	1,624

Table 14: Coefficients Table Hypothesis 2a

Hypothesis 3

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,565ᵃ	,319	,274	,88536

Table 15: Model Summary Hypothesis 3

ANOVAᵃ					
Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	33,079	6	5,513	7,033	<,001ᵇ
Residual	70,547	90	,784		
Total	103,626	96			

Table 16: ANOVA Table Hypothesis 3

Coefficientsᵃ							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1 (Constant)	5,000	,885		5,647	<,001		
from18to24	-2,375	,902	-1,018	-2,632	,010	,051	19,763
from25to34	-2,361	,910	-,888	-2,596	,011	,065	15,474
from35to44	-1,688	,922	-,538	-1,831	,070	,088	11,392
from45to54	-1,589	,916	-,540	-1,734	,086	,078	12,835
from55to64	-1,107	,916	-,376	-1,208	,230	,078	12,835
more65	-,979	,922	-,312	-1,063	,291	,088	11,392

Table 17: Coefficients Table Hypothesis 3