Siri, Do I like You? Digital Voice Assistants and Their Acceptance by Consumers

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Nowadays, digital voice assistants (DVAs) such as Amazon's Alexa, Google's Assistant, or Apple's Siri provide speech-oriented human-computer interfaces that have the potential to make consumers' interaction with other consumers, firms, or devices more convenient, enjoyable, and productive. However, at least currently, DVA acceptance is limited, even among digital natives and corresponding explanations are missing. This paper seeks to close this gap by investigating which factors have an impact on DVA acceptance. Therefore, we develop a new approach that combines elements of the Technology Acceptance Model (TAM) as well as the Uses and Gratifications Approach (UGA). A sample of 283 digital natives participated in a Siri field experiment. The results demonstrate that especially enjoyment, but also social status and social influence are main DVA acceptance drivers. Nevertheless, Millennials have some privacy concerns about companies getting too much personal information while using DVAs. This study provides valuable insights into main drivers of DVA acceptance. Theoretical and practical implications are discussed.

1. Introduction

The idea to communicate with devices in spoken natural language and to control them in this way is not new. Already in 1966, Joseph Weizenbaum invented ELIZA, an early chatbot that mainly consisted of a database of keywords and contents as well as a pattern matching and substitution methodology that gave users the illusion as if the program is able to understand asked questions in natural language and to provide meaningful answers (Weizenbaum 1966). Since then (and triggered by massive advances in linguistics, data computing and storage as well as speech-to-text and text-to-speech converters) the capabilities of such chatbots have rapidly evolved (Wünderlich & Paluch 2017, Čaić et al. 2018; Wirtz et al. 2018; Ivanov 2019a). Nowadays, large, internationally operating companies such as Amazon, Apple, and Google are making their way into everyday consumers' life, providing powerful digital voice assistants (DVAs) like Alexa, Siri, or Google Assistant for everyone. Companies distribute impressing numbers of DVAs (pre-)installed on smartphones (e.g. Siri, Google Assistant) or smart speakers (e.g. Alexa). However, it is unclear, to what extent DVAs – especially their speech features – are actually used by the consumers and which are the determining factors for their acceptance.

Besides this lack of in-depth usage studies, DVA acceptance has rarely been discussed from a theoretical point of view. Our study tries to fill this gap and examines DVA acceptance based on two well-known theoretical models. We develop customized gratuities, which are tailored for DVAs – hedonic and utilitarian reasons as well as risks regarding to the DVA acceptance. By using such a wide range of probable reasons for DVA usage (or not usage),

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our results contribute towards a better understanding of their acceptance. Until now, only few research in this direction has been published (Joo and Sang 2013; Park et al. 2014). In our study we rely on a new, integrated measurement approach based on the Technology Acceptance Model (TAM) and on five gratuities derived from the Uses and Gratifications Approach (UGA). We aim to suggest a model, which can explain and even predict DVA acceptance. The main research objective is to confirm that these factors positively or negatively influence the acceptance of DVAs. In order to answer this question, we apply the approach using Siri's speech features as an example. Through our findings, future research is stimulated to recognize, define, and interpret reasons for the usage of DVAs. Not only researchers, but also practitioners may profit from the study outcomes.

The paper is structured as follows: In section 2, two approaches (TAM and UGA) for measuring technology acceptance are described in detail. Section 3 discusses DVAs and the development of the new approach. Section 4 describes the empirical study: data collection and analysis as well as the results. Sections 5 and 6 close with a discussion and implications as well as a conclusion and an outlook.

2. Approaches for measuring technology acceptance

2.1. Technology Acceptance Model (TAM)

TAM and its numerous extensions are wide-spread approaches for exploring the acceptance of new technologies. Being developed by Davis in 1986 (Davis 1986), the origin of the model can be found in behavioral psychology, especially in the Theory of Reasoned Action (TRA) by Ajzen and Fishbein (Davis et al. 1989). TRA makes the basic assumption that an individual's behavior is determined by both – behavioral intention and attitude (Joo and Sang 2013). Building on TRA's assumptions, TAM seeks to pinpoint factors, which influence an individual's behavioral intent towards the use of a technology (Park et al. 2007). Davis initially created TAM for computer-based information systems to explore the acceptance and the adoption of traditional technologies in the workplace (Davis 1986; Kim et al. 2007). Because of its flexibility, TAM has been extended as well as adopted and applied to many different contexts, e.g. in mobile commerce (Ko et al. 2007), smartphones (Joo and Sang 2013), mobile cloud services (Park and Kim 2014), mobile navigation Systems (Park et al. 2014), autonomous vehicles (Lee et al. 2019), smartwatches (Kim and Shin 2015), smart glasses (Rauschnabel and Ro 2016) and recently also in the field of DVAs (Coskun-Setirek and Mardikyan 2017; Easwara and Vu 2015).

In general, TAM assumes that potential users are influenced by external factors when they communicate with a new technology (Elmorshidy 2013). However, these external variables do not have a direct impact on the actual behavior of the potential users, but an indirect one, that can be measured using constructs like Perceived Usefulness (PU) and Perceived Ease of Use (PEOU) (Davis 1986; Venkatesh and Morris 2000). Davis defines PU as the subjective perception of an individual that the use of a particular technology improves her/his performance in the workplace (Davis 1989). PEOU, on the other hand, indicates the extent to which the individual believes that the use of a technology is not associated with physical effort. This implies an easy usage of a technology or an application (Davis 1989). Both constructs, PEOU and PU, are positively related to the user's Attitude Towards Using a technology (ATU), which determines further usage of a new technology (Park et al. 2007; Lee et al. 2015). Furthermore, PU and ATU have a positive impact on Behavioral Intention to Use (BIU) (Srite and Karahanna 2006), whereas BIU is positively related to Actual System Usage (ASU) (Wu and Wang 2005; Lee et al. 2015). Therefore, BIU is determined by PU and ATU, which in turn is determined by PU and PEOU (Davis et al., 1989). Furthermore, as a tool, which explains and predicts user behavior, TAM was optimized to include only three basic constructs: PU, PEOU and BIU. In such case a direct impact of PU and PEOU on BIU shows a strong, direct effect. Moreover, PEOU has then a small (but significant) indirect effect on BIU, even if the latter effect decreases over time (Onobhayedo 2017). Even though including ATU into the equation has a small effect on the coefficients of PU and PEOU, ATU does not fully mediate these relationships (Onobhayedo 2017). Therefore, it is not surprising that TAM will be often mentioned in the literature without ATU (Venkatesh and Bala, 2008; Venkatesh and Davis, 2000). Therefore, in our study this more parsimonious model structure is assumed.

Despite the vast and successful application of TAM in investigating the factors of technology acceptance and usage, Park et al. (2007) cannot fully explain why individuals ultimately accept and use certain technologies. Coskun-Setirek and Mardikyan (2017) also point out that the original TAM ignores external, overall context factors. Therefore, the original model should be completed with additional components in order to make it applicable for new, innovative technologies as well. Furthermore, Benbasat and Barki (2007) criticize that acceptance research puts too much emphasis on TAM without considering the approaches of other theories in acceptance research. In order to overcome these significant limitations, the study also draws on another approach – UGA – to investigate DVA acceptance.

TAM is also a precursor to many other approaches in technology acceptance research (van der Heijden 2004; Taher-

doost 2018). Accordingly, Venkatesh and Davis developed TAM2 in 2000, summing up the basic model to include social and cognitive-instrumental variables (Venkatesh and Davis 2000). In addition, TAM also forms the basis for the development of Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003 and TAM3 (Venkatesh and Bala 2008). Since UTAUT was primarily created for the organizational rather than for consumer context, Venkatesh et al. (2012) modified the model and expanded it to UTAUT2 (extended by the factors: hedonic motivations, price value and habit). On the other hand, there are also some other technology acceptance models, that will be used by researchers, e.g. the Technology Readiness Model with "people's propensity to embrace and use new technologies to accomplish goals in home life and at work" (Parasuraman 2000, p. 308) or the Hedonic-Motivation System Adoption Model (HMSAM) with factors: perceived ease of use, perceived usefulness, curiosity, joy, control, behavioral intention to use and immersion (Lowry et al. 2013).

Although TAM has proven to be useful in identifying factors that influence a person's technology acceptance and use (Lee et al. 2015), the model, as Park et al. (2007) states, does not fully explain, why individuals ultimately accept and use a technology. Bagozzi (2007) as well as Coskun-Setirek and Mardikyan (2017) point out that the original TAM ignores external, overall context factors. Consequently, the existing model should be supplemented with other factors in order to make it possible to apply it in the area of new technologies as well. Benbasat and Barki (2007) criticize that the focus in acceptance research lies too much on the technology acceptance model without considering the approaches of other theories. In order to overcome these significant limitations, this study draws on UGA in addition to the original TAM in order to investigate the acceptance of DVAs. The original TAM-items fulfill the aim of the study, namely to investigate the acceptance of DVAs, having impact on Behavioral Intention to Use DVAs and Actual Use of modern technologies, such as DVAs. The model exclusively concentrates on beliefs about the technology (here: DVAs). Moreover, instead of using already established items (e.g. in TAM2 or UTAUT), we invent, based on literature on UGA, additional constructs (see section 2.2), which are more suited for such a new technology like DVAs. Otherwise to HMSAM, we do not only want to investigate heterogeneous variables, but also utilitarian ones as well as some risks.

2.2. Uses and Gratifications Approach (UGA)

UGA has its origins in media and communication research. It tries to explain and describe, why people choose and use media for their own purposes (Rauschnabel et al. 2018). Based on first studies in gratification research from the 1940s, the American communication scientist and sociologist Elihu Katz (1959) developed UGA. His development has resulted in a thoroughly significant paradigm shift for media and communication research. In contrast to the classical media research, UGA does not ask "what the media do to people", but "what people do to the media" (Rubin 2002). The approach also examines the correlation between the consumer and the available media offer. However, UGA focuses on consciously acting consumers and their active and goal-oriented role in dealing with the media. Based on their needs and expectations, consumers decide, whether and which of the existing media will be used. According to Katz et al. (1974), UGA deals with social and psychological origins of needs, which conduct to different expectations towards media and non-media sources. These expectations however lead to different media usage patterns, resulting in a satisfaction of needs or other consequences (Katz et al. 1974).

Despite many extensions and further developments, UGA is not without criticism. Frequently mentioned limitations are:

- The approach focuses too much on the individual itself without considering other fundamental factors such as its social environment (Nabi et al. 2006).
- Assuming an omnipresent and always active audience is not sustainable, as an individuals' behavior always depends on its mood and the situation in general (Dunne et al. 2010). Schweiger (2007) adds that recipients usually turn to the media implicitly and unconsciously.
- The approach is not based on a valid theory and shows a theoretical weakness (Ruggiero 2000).

Contrary to the criticism, UGA is still a suitable approach to explain the acceptance and the use of media. Sheldon et al. (2017) suggest that the approach is suitable for both – traditional and highly innovative new technologies. *Tab. 1* presents recent studies that have used UGA to examine the acceptance of different modern technologies. In addition to the research object and the sample size, researched gratuities are shown in the overview. The literature (see *Tab. 1*) shows that UGA has diverse applicabilities and utilities. Quan-Haase and Young (2010) share this view and confirm that the approach plays an important role in the digital age in order to investigate the acceptance of such young technologies, like e.g. DVAs. While voice control cannot per se be classified in the mass media field, it can still be helpful and useful in the usage of some mass media (such as smartphones). In our study, Siri is deliberately selected based on consumer gratuities to be determined from a variety of conversational interfaces. Gratuities used in our study are written using bold fonts in *Tab. 1*.

Research object	Research study	Sample size	Selection of researched gratuities
Chatbot	Brandtzaeg and Følstad (2017)	146	Productivity, Pastime, **Social Motivations,** Entertainment
Internet	Song et al. (2004)	498	Distraction, Information Search, **Social Status**
Messaging Services	Gan and Li (2018)	297	**Enjoyment**, Attraction of the medium, Information Exchange
Mobile/Online Games	Li et al. (2015)	3919	**Enjoyment**, Reality Escapism, Social Presence, Success
	Rauschnabel et al. (2017)	642	**Enjoyment**, Image, Nostalgia, **Physical Risks, Privacy Concerns**
Mobile Phone	Leung and Wei (2000)	834	Mobility, Immediacy, Expediency
Social Networks	Malik, Dhir and Nieminen (2016)	368	Attention, **Social Impact**, Pastime
	Papacharissi and Mendelson (2010)	344	**Enjoyment**, Pastime
	Valenzuela et al. (2009)	1715	Information search, **Social Status**, Entertainment
	Xu et al. (2012)	160	Coordination (Expediency), Immediacy
Tablet	Leung and Zhang (2016)	948	Relaxation, Information Search, **Social Status**, Time Management

Tab. 1: UGA-based studies with researched gratuities

3. Digital Voice Assistants and an approach for measuring their acceptance

3.1. Digital Voice Assistants (DVAs)

DVAs are software applications based on Artificial Intelligence (AI), which communicate with people through natural, spoken language (Griol et al. 2013). They may be integrated in a smartphone (e.g. Apple's DVA Siri or Google's Assistant). In addition, DVAs are also available in form of smart speakers (e.g. Amazon's Alexa). Tasks, such as making calls, sending messages, receiving reminders, or opening an application, can be fulfilled by DVAs using voice control without any manual intervention (Bitkom 2018). In their interaction with DVAs consumers can nowadays assess a wide range of functions, which is constantly being increased by new skills (Bitkom 2018). This opens up various possibilities for users in their everyday life. According to Statista (2017), almost half of the respondents see DVAs as an obviousness in everyday life. Despite the vast application of DVAs in different fields and their function as an everyday helper, there are also doubts about the use of DVAs. According to a study by BVDW (2017), about 80 % of respondents are concerned about the use of DVAs in their daily lifes: 30 % fear misuse of their data or third-party monitoring and 29 % state that communication with a voice assistant is strange and impersonal to them. *Tab. 2* provides an overview of the most important findings of the selected studies on DVA usage which make clear that DVAs are wide-spread among consumers – especially when integrated into smartphones – but their everyday usage is up-to-now limited – among other reasons – by data security and privacy concerns.

One of the best-known DVA is Apple's Siri (Speech Interpretation and Recognition Interface). Siri learns steadily through questions or commands of its user and gains in competence in order to answering questions more purposeful. Furthermore, Siri learns about consumers' usage behavior on different devices by Apple. This allows the voice assistant to make suggestions, so-called shortcuts (Apple 2019). The entire learning process contributes to a personalization of the human-voice assistant relationship. Siri can thus become in many ways more and more useful to consumers – both at work and in private life. In addition, Apple is steadily expanding the stock of features for its DVA and is constantly working on its quality (Apple 2019).

3.2. Approach for measuring DVA acceptance

Based on the discussions above, in the following we develop an approach for measuring DVA acceptance. Our approach not only makes a use of TAM and its extensions but also integrates selected gratuities derived from UGA. Apple's Siri is used as a DVA example when formulating the items for an online survey.

As already discussed in section 2, TAM (as well as UGA) can be adapted for measuring technology acceptance in many application fields (Park 2010; Venkatesh 2000). Therefore, also, for measuring DVA acceptance, original

Source (Year)	Type of study (Country)	Sample size	Findings
Bitkom e.V. (2018)	Online survey (DE)	n = 1.007	- 13% of respondents already use a DVAs in their households; - 4% plan to purchase a DVA in a period of up to 12 months; - DVAs have a wide range of so-called actions or skills and their application area permanently increases; - More than half of non-users are concerned about data protection (58%) and their privacy (57%), while 56% of non-users say they do not need a DVA.
Deutsche TV-Plattform e.V. (2018)	Online survey (DE)	n = 1.006	- High degree of fame of DVAs; - Relatively low usage rate of DVAs (on average only 15% of respondents use a DVA); - Especially the voice control via smartphones is used (38%).
EY (2018)	Online survey (DE)	n = 1.015	- More than half of respondents (53%) use DVAs at least occasionally; - High affinity for DVAs in the younger age groups; - Large proportion of potential users (70%); - Data security and privacy concerns are essential for 80% of respondents in the context of using DVAs.
PwC (2018)	Online survey (US)	n = 1.000	- Previous usage rate of DVA is 72% among the US-population; - 57% of respondents use DVAs on their smartphones; - Young adults (18-24 year) are a driver of the adoption of DVAs; - Consistency of such technology as a crucial factor for ultimately broad adoption among consumers.
SPLENDID RESEARCH GmbH (2018)	Online survey (DE)	n = 1.024	- 37% of respondents already use DVAs; - Google Assistant and Siri are the most popular DVAs (both 15% each); - 22% of respondents are interested in the technology behind DVAs.
BVDW e.V. (2017)	Online survey (DE)	n = 1.038	- Google Assistant (29%) and Siri (22%) enjoy great popularity among DVAs; - High affinity for DVAs in the age group of 16-24-year-olds.
Capgemini S.E. (2017)	Online survey (DE, FR, UK, US)	n = 5.041	- Half of respondents (51%) have already used DVAs; - Consumers especially appreciate the ease of use and the multitasking capability of DVAs; - 65% of non-users are concerned about data protection and privacy as a reason, why they do not use DVAs.
Pew Research Center (2017)	Online survey (US)	n = 4.135	- 42% of respondents use DVAs on their smartphones; - 55% of the US-citizens sees a great advantage of such technology, especially in the voice-driven interaction; - For 23%, the fun factor is crucial in using DVA.
PwC (2017)	Online survey (DE)	n = 1.012	- High awareness of DVAs (e.g. Siri: 70%) - 20% of Germans plan to use Siri in a timely manner; - Users still have concerns about data misuse and too much transparency.
Wavestone (2017)	Online survey (US)	n = 1.000	- Technical improvements as a key factor in the continued adoption of DVAs.

Notes: DE = Germany, FR = France, UK = United Kingdom, US = United States of America.

Tab. 2: Studies on DVA usage

TAM constructs can be taken over unchanged for our approach. When building the UGA-based gratifications, in contrast to TAM, which considers PEOU and PU as primary factors influencing the final usage decision, it is obvious that UGA draws on a large number of different and freely selectable gratuities. According to Li et al. (2015), gratifications obtained through the use of a communication medium always depend on the type of the communication medium. Therefore, it is necessary to consider new gratifications for each new medium or communication technology (Li et al. 2015; Simon 2007). This approach can cover a wide range of customer needs and explore an equally wide variety of motivations (Luo et al. 2011). Gratifications used in our study come from recent research papers shown in *Tab. 1*. From a large selection of different gratifications in the literature, five of them were selected for this study. In addition to a hedonistic gratification "Enjoyment" (EN) and utilitarian gratifications "Social Status" (SS) and "Social Influence" (SI), also "Physical Risks" (PR) and "Privacy Concerns" (PC) find their place in our approach. Based on both, the original TAM and five gratuities derived from UGA, a research model is developed

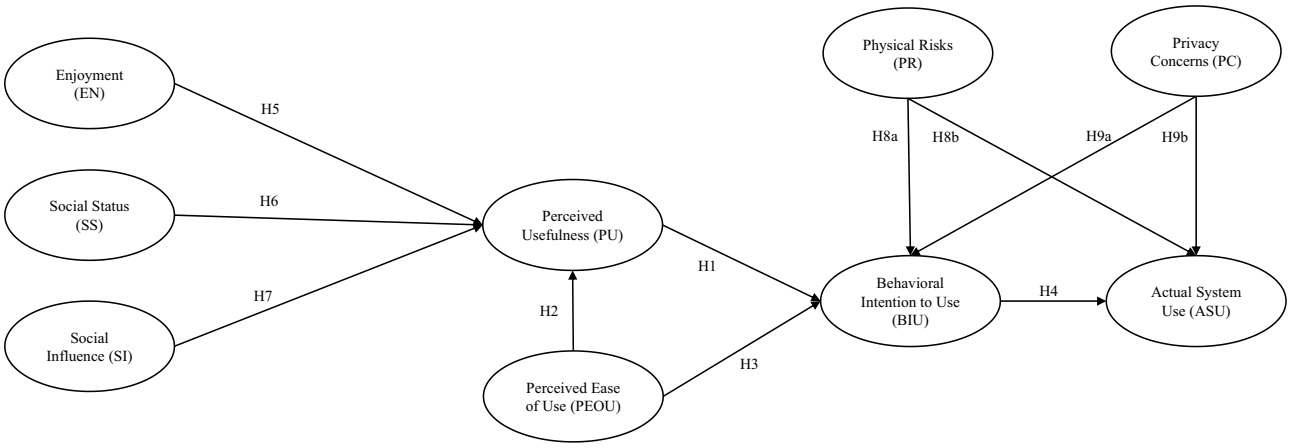


Fig. 1: Theory-based structural model – Approach for measuring DVA acceptance

(*see Fig. 1*). The integrated factors and their relationships (hypotheses) as well as the items used in the measurement model are discussed in the following.

TAM assumes that both, Perceived Usefulness (PU) and Perceived Ease of Use are of decisive relevance for the technology acceptance (Davis et al. 1989). In line with Davis (1989), PU will be here understood as the degree to which users believe that the DVA can be useful in private and professional everyday life (Davis 1989). Moreover, various studies have shown that PU not only influences Attitude Towards Using a technology (ATU), but also in further step – Behavioral Intention to Use a technology (BIU) (Park et al. 2007; Davis et al. 1989; Venkatesh 2000). Based on the following theoretical considerations with regard to the DVA Siri, we hypothesized the following:

H1: Perceived Usefulness of a DVA has a positive impact on Behavioral Intention to Use a DVA.

Based on the definition by Davis (1989), Perceived Ease of Use (PEOU) describes the extent to which the consumer believes that the use of a DVA is not associated with physical exertion for him/her. This implies that the DVA is easy to use (Davis 1989). Various studies have proved so far, that PEOU has a significant influence on Perceived Usefulness of a technology (Davis et al. 1989; Venkatesh 2000). The easier the usage of a technology, the larger the PU of the technology will be (Venkatesh and Davis 2000). In the case of the DVA Siri, this leads to the following hypothesis:

H2: Perceived Ease of Use of a DVA has a positive impact on Perceived Usefulness of a DVA.

Based on the literature, PEOU has an indirect (via Attitude Towards Using a technology) impact on the Behavioral Intention to Use a technology (Srite and Karahanna 2006). This basic attitude of an individual is ultimately decisive for whether the DVA will be used or not. Therefore, the following causal relationship can be assumed:

H3: Perceived Ease of Use a DVA has a positive impact on Behavioral Intention to Use a DVA.

In addition to the previous interdependencies, it is also assumed that the Behavioral Intention to Use has a significant influence on the Actual System Use (Wu and Wang 2005). Transferred to our study, intention to use means the decision of the consumer to use a DVA. The following hypothesis is therefore made in this context:

H4: Behavioral Intention to Use a DVA has a positive effect on the Actual Use (ASU) of a DVA.

Gan and Li (2018) attach great explanatory value to hedonistic gratuities in order to find reasons for usage behavior or usage intentions (Gan and Li 2018). Enjoyment (EN) is one of these hedonistic gratifications (Rauschnabel et al. 2017). In our study, enjoyment means the degree to which using a DVA is enjoyable and is perceived by its users as pleasant. Enjoyment has so far proven to be a significant bonus in a wide variety of studies on UGA in order to further expand the intended use of instant messaging (Gan and Li 2018), Mobile/Online Games (Li et al. 2015; Rauschnabel et al. 2017) and social networks (Papacharissi and Mendelson 2010; Valenzuela et al. 2009). Therefore, we hypothesized the following:

H5: Enjoyment has a positive effect on Perceived Usefulness of a DVA.

In addition, utilitarian gratifications can be crucial for the use of a DVA. For this reason, two gratuities: Social Status (SS) and Social Influence (SI) are also included in the research model. Social status (SS) can be defined as the extent to which the use of a DVA helps to convey a certain self-image of a person (Gan and Li 2018). Through this self-image, a person should be perceived and seen by fellows, but also by strangers in a certain, deliberated way. Previous studies have shown that people use technology and media to convey a certain self-image to the outside world (Leung and Zhang 2016; Rauschnabel et al. 2017; Song et al. 2004). Therefore, the arguments lead to the following hypothesis:

H6: Social status has a positive effect on Perceived Usefulness of a DVA.

Another gratification that could speak for the use of DVAs is Social Influence. Based on Rauschnabel et al. (2017) social influence can be understood as to the extent to which DVAs' users believe that the usage of DVAs is expected by other people (Rauschnabel et al. 2017). Rauschnabel and Ro (2016) and Venkatesh et al. (2012) believe that social influence is decisive for the intended use. The following causal relationship can therefore be proposed:

H7: Social Influence has a positive effect on Perceived Usefulness of a DVA.

In spite of the fact that media and technologies are becoming more and more personal and omnipresent, concerns of consumers are steadily increasing (Junglas et al. 2008). In addition to already mentioned motives, which have a positive influence on the use of the DVA, risks and concerns about the use of DVAs should not be neglected. Rauschnabel et al. (2017) take up consumers' concerns in their study on the intended use of Pokemon Go and integrate two constructs: Physical Risks and Privacy Concerns. A significant connection between privacy concerns and the attitude to use Pokemon Go could not be found, but a slight influence of physical risks on the attitude could be confirmed (Rauschnabel et al. 2017). Contrary to Rauschnabel et al. (2017), it is assumed with regard to DVAs that there is a causal relationship between the two types of risks and the BIU and ASU. Physical risks include all those dangers and risks that may arise from the use of a DVA, e.g. a distraction in traffic. Due to Malhotra et al. (2004) privacy concerns reflect consumer fears. They fear that the use of a technology or a medium will result in their personal and private data loss or even data breaches (Malhotra et al. 2004). Following hypotheses can therefore be derived for the two constructs:

H8a: Physical risks have a negative impact on Behavioral Intention to Use a DVA.

H8b: Physical risks have a negative impact on Actual Use (ASU) of a DVA.

H9a: Privacy concerns have a negative impact on Behavioral Intention to Use a DVA.

H9b: Privacy concerns have a negative impact on Actual Use (ASU) of a DVA.

Against the background of derived hypotheses and theoretical principles, the research model can be depicted as demonstrated in *Fig. 1.* In the following, we apply the approach for measuring DVA acceptance to estimate the technology acceptance by digital natives (Millennials) using Apple's Siri. *Fig. 1* shows our theory-based construct model. Further, *Tab. 3*, presents all hypotheses and corresponding references in the literature.

4. Empirical study

4.1. Questionnaire design, data collection and analysis

In order to operationalize the DVA acceptance measurement approach, Apple's Siri and Millennials were in the focus of the empirical study. Siri was selected as being wide-spread among German Millennials (aged between 17 and 35) which have different values, traits, behaviors and a bigger purchasing power compared to previous generations (Eastman et al. 2013; Eastman et al. 2014). Millennials can be classified as the first "high-tech"-generation (Lissitsa and Kol 2016). They grew up with smartphones in the age of mobile technologies and do not only impress with their technical knowhow, but also with their affinity for digital novelties (Karakas et al. 2015). Also,

Hypotheses		Literature
H1	PU has a positive impact on BIU.	Davis et al. 1989; Venkatesh 2000
H2	PEOU has a positive impact on PU.	Davis et al. 1989; Venkatesh 2000; Venkatesh and Davis 2000
H3	PEOU has a positive impact on BIU.	Davis 1989; Davis et al. 1989
H4	BIU has a positive impact on ASU.	Wu and Wang 2005
H5	EN has a positive impact on PU.	Gan and Li 2018; Rauschnabel et al. 2017; Li et al. 2015; Papacharissi and Mendelson 2010, Valenzuela et al. 2009
H6	SS has a positive impact on PU.	Gan and Li 2018; Leung and Zhang 2016; Rauschnabel et al. 2017; Song et al. 2004
H7	SI has a positive impact on PU.	Rauschnabel et al. 2017; Rauschnabel and Ro 2016; Venkatesh et al. 2012
H8a	PR has a negative impact on BIU.	Junglas et al. 2008; Rauschnabel et al. 2017
H8b	PR has a negative impact on ASU.	
H9a	PC has a negative impact on BIU.	Rauschnabel et al. 2017; Malhotra et al. 2004
H9b	PC has a negative impact on ASU.	

Notes: PU = Perceived Usefulness; PEOU = Perceived Ease of Use; BIU = Behavioral Intention to Use; ASU = Actual System Use; EN = Enjoyment; SS = Social Status; SI = Social Impact; PR = Physical Risks; PC = Privacy Concerns.

Tab. 3: Hypotheses and their derivation

Construct	Items	References
Perceived Usefulness (PU)	With the help of Siri, I can make my life more effective. (PU1) Siri is a great support in my everyday work. (PU2) The information I receive fully answers my questions. (PU3) The answers that Siri provides are very relevant to me. (PU4) I feel that using Siri makes my job easier. (PU5)	Venkatesh 2000; Venkatesh and Davis 1996; Davis 1989.
Perceived Ease of Use (PEOU)	The operation of Siri is easy to understand. (PEOU1) The use of Siri is intuitive and flexible. (PEOU2) Siri is user-friendly and can be used by anyone. (PEOU3)	Venkatesh 2000; Venkatesh and Davis 1996; Davis 1989.
Attitude Towards Using (ATU)	I have a positive attitude towards Siri. (ATU1) It makes sense to use Siri in certain situations. (ATU2) I like to call on Siri for information and advice. (ATU3) I enjoy using Siri at university / work. (ATU4)	Venkatesh and Davis 2000.
Behavioral Intention to Use (BIU)	I intend to use Siri in the future. (BIU1) I intend to use Siri more often in the future. (BIU2) I will recommend the use of Siri to other people. (BIU3) If I have to choose a DVA in the future, I select Siri. (BIU4)	Venkatesh et al. 2012; Moon and Kim 2001; Venkatesh 2000.
Actual System Use (ASU)	I use Siri very often (six times or more a week). (ASU1) I use Siri frequently (one to five times a week). (ASU2) I use Siri occasionally (up to once a week). (ASU3)	Moon and Kim 2001.
Enjoyment (EN)	Using Siri gives me pleasure. (EN1) I enjoy using Siri in the workplace. (EN2) Using Siri at the university is a pleasure. (EN3)	Gan and Li 2018; Rauschnabel et al. 2017; Li et al. 2015; Papacharissi and Mendelson 2010; Valenzuela et al. 2009.
Social Status (SS)	Using Siri improves my image. (SS1) Using Siri has a positive effect on my self-confidence. (SS2) I use Siri to show other people that I am following trends. (SS3)	Leung and Zhang 2016; Rauschnabel et al. 2017; Song et al. 2004.
Social Influence (SI)	In the university there are some students who use Siri. (SI1) At my workplace, Siri is used by a few colleagues. (SI2) People, whose opinion I appreciate, recommend Siri. (SI3)	Rauschnabel et al. 2017; Rauschnabel and Ro 2016; Venkatesh et al. 2012.
Physical Risks (PR)	Siri has distraction potential and represents a risk to me. (PR1) I am afraid that by using Siri is risky in everyday life. (PR2) I think using Siri can be dangerous in some situations. (PR3)	Rauschnabel et al. 2017.
Privacy Concerns (PC)	I'm concerned that Apple gets too much information. (PC1) I'm worried that Apple is abusing my data. (PC2) Unauthorized third parties could use my data. (PC3) I'm afraid of being manipulated by the use of Siri. (PC4)	BVDW e.V. 2017; PwC 2017; Rauschnabel et al. 2017; van Eeuwen 2017.

Tab. 4: Operationalization of all constructs used in the study

Millennials – especially in Germany – are the first generation with a high percentage of studying at universities (e.g., in Berlin 85 %, in Bavaria 52 %).

An online questionnaire was developed that mainly contained closed-form questions: For the TAM-constructs as well as the UGA-gratuities (as discussed in *Fig. 1* and *Tab. 3*) well-known items from the literature were adapted to the DVA/Siri context (see. *Tab. 4*). Respondents were asked to state their agreement to these items on 5-point Likert scales. The answer options ranged from 1 ("disagree"), to 3 (a neutral middle category), to 5 ("fully agree"). Due to the odd number of answer options, survey participants could take a neutral position at any time and were not forced to choose one side.

In addition to closed questions, the questionnaire also contained three open questions, which could be used to obtain additional information on the acceptance of DVAs. By combining open and closed questions, it was possible to have a comprehensive look at the topic based on quantitative (closed questions) and qualitative (open questions) data. The survey started on December 21, 2018 and ended on February 5, 2019. The interviewed sample were bachelor and master students from the University of Bayreuth, Germany.

In total, 340 people between the age of 17 and 35 participated in the survey. Corresponding to a completion rate of 83.2 %, 283 survey participants finished the questionnaire. For further empirical investigation, a sample of n=283 is used. The gender distribution in the study sample is 63.9 % women and 35.7 % men. One person did not give an indication of the gender. 27 survey participants (9.5 %) are assigned to the age group 17 to 20 years. 142 persons

Constructs	n	Mean (SD)	FL	CR	AVE	CA
PU				0.940	0.758	0.940
PU1	283	2.93 (1.24)	0.910			
PU2	283	2.39 (1.35)	0.919			
PU3	283	2.99 (1.21)	0.795			
PU4	283	2.98 (1.21)	0.862			
PU5	283	2.64 (1.35)	0.862			
PEOU				0.775	0.538	0.775
PEOU1	283	4.40 (0.68)	0.648			
PEOU2	283	4.11 (0.82)	0.847			
PEOU3	283	4.17 (0.87)	0.690			
BIU				0.928	0.765	0.925
BIU1	283	2.95 (1.38)	0.893			
BIU2	283	2.74 (1.37)	0.891			
BIU3	283	2.51 (1.38)	0.966			
BIU4	283	2.94 (1.41)	0.731			
ASU				0.860	0.672	0.855
ASU1	283	1.91 (1.42)	0.870			
ASU2	283	2.08 (1.56)	0.830			
ASU3	283	2.81 (1.72)	0.755			
EN				0.875	0.701	0.870
EN1	283	3.17 (1.14)	0.751			
EN2	283	2.35 (1.18)	0.884			
EN3	283	2.43 (1.16)	0.871			
SS				0.940	0.840	0.940
SS1	283	1.97 (1.15)	0.948			
SS2	283	1.88 (1.18)	0.932			
SS3	283	1.78 (1.20)	0.867			
SI				0.801	0.577	0.799
SI1	283	3.16 (1.06)	0.638			
SI2	283	2.57 (1.23)	0.778			
SI3	283	2.28 (1.32)	0.847			
PR				0.887	0.725	0.883
PR1	283	2.86 (1.33)	0.851			
PR2	283	2.64 (1.38)	0.950			
PR3	283	3.06 (1.34)	0.740			
PC				0.908	0.731	0.911
PC1	283	4.16 (1.08)	0.602			
PC2	283	3.83 (1.21)	0.670			
PC3	283	3.75 (1.26)	0.741			
PC4	283	3.33 (1.42)	1.251			

Tab. 5: Quality assessment of the constructs

	ASU	BIU	EN	PC	PEOU	PR	PU	SI	SS
ASU	**0.820**								
BIU	0.861	**0.875**							
EN	0.657	0.739	**0.837**						
PC	0.341	0.150	0.136	**0.855**					
PEOU	0.477	0.529	0.385	0.068	**0.734**				
PR	0.580	0.427	0.413	0.611	0.137	**0.851**			
PU	0.848	0.808	0.711	0.277	0.485	0.539	**0.871**		
SI	0.753	0.711	0.752	0.378	0.321	0.689	0.731	**0.760**	
SS	0.677	0.697	0.741	0.270	0.333	0.548	0.736	0.721	**0.917**

Notes: PU = Perceived Usefulness; PEOU = Perceived Ease of Use; BIU = Behavioral Intention to Use; ASU = Actual System Use; EN = Enjoyment; SS = Social Status; SI = Social Impact; PR = Physical Risks; PC = Privacy Concerns

Tab. 6: Fornell-Larcker-Criterion

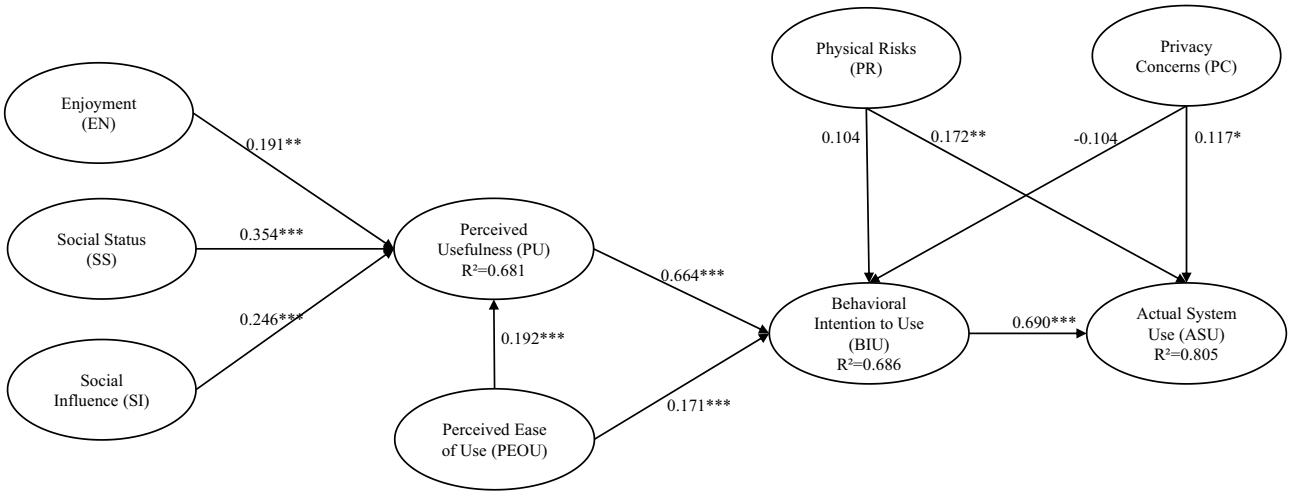
(50.2 %) were 21 to 25 years old and 99 persons (35.0 %) were between 26 and 30 years. The remaining 15 survey participants were older than 31 years and younger than 35 years.

For the study, variance-based PLS-SEM and the software SmartPLS 3 were chosen to analyze and evaluate the collected data were chosen (Sarstedt et al. 2016; Hair et al. 2016; Hair et al. 2012). In comparison to CB-SEM (e.g. AMOS), PLS-SEM (here: SmartPLS) will be used for relatively small sample sizes (here: n=283) (Hair et al. 2016; Hair et al. 2017) and when the analytical focus lies on prediction and identification of relationships between constructs (Hair et al. 2019; Chin 1998; Hair et al. 2011). Moreover, PLS-SEM is a predictive method (to predict outcomes using the chosen model) with the aim of theory development (Hair et al. 2016; Sharma et al. 2019; Shmueli et al. 2016) and it fits perfectly for the aim of this study.

Obtained data depicts reality, if not distorted too much by measurement errors (Hair et al. 2017, p. 6). Therefore, it is necessary to examine the reliability and the validity of the measurement models (Gerpott and Paukert 2011). *Tab. 5* summarizes quality assessment of the measurement models underlying the research model. Following quality criteria are used to assess the measurement models: indicator reliability, internal consistency reliability (measured by Cronbach's alpha (CA ≥ 0.7) and composite reliability (CR ≥ 0.6)), convergence validity (measured by average variance (AVE ≥ 0.5) and discriminant validity (measured by Fornell-Larcker criterion; correlations (values below the diagonal) should all be smaller than the values on the main diagonal) (Hair et al. 2011). Each of these quality criteria defines a calculated key figure (see *Tab. 5* and 6).

In order to be able to fully test the reliability and the validity of the measurement models, discriminant validity must be analyzed in addition to indicator reliability, internal consistency reliability and convergence validity (Hair et al. 2011). Discriminant validity is used to ensure the empirical autonomy of the construct (Hair et al. 2017). It is examined on the basis of the Fornell-Larcker-Criterion (Hair et al. 2016; Henseler et al. 2009; Lee et al. 2011) and will be here fulfilled (*Tab. 6*). The current measurement model provides evidence of reliability and validity. Therefore, the analysis shifts to the structural model (Shmueli et al. 2019; Hair et al. 2012).

In order to assess the quality of the structural model, relationships between the constructs, predictive capability and prognostic relevance are used as evaluation criteria (Hair et al. 2011). *Tab. 5* provides an overview of the results regarding to the quality of the structural model. The evaluation criteria used to assess the structural model's quality is in line with the approach of Ringle et al. (2012). This approach is also used by Götz et al. (2010), Hair et al. (2013) and Henseler et al. (2009). Relationships between the constructs, as well as the predictive power and predictive relevance of the model, are considered for assessing the quality of the model (Hair et al. 2011). *Fig. 2* depicts most important findings of the structural model. Overall the quality of the measurement model and structural model has been assessed. The measurement model provided evidence of reliability and validity, whereas the



Notes: * p < .05; ** p < .01; *** p < .001.

Fig. 2: Structural model – results of the quality assessment

structural model met different criteria for the assessment of a structural model.

Moreover, in order to gain additional impressions about the empirically collected data, concerning age and gender effects, a correlation analysis based on descriptive statistics was conducted. The analysis is intended to reveal group-related relationships between the moderating variables – age and gender – and the respective constructs from the research model. Against this background, correlation coefficients were calculated on the basis of the demographic data. Therefore, we used a multi-group analysis, which in this case shows that the pre-defined data groups have no significant differences in their group-specific parameter estimates (Henseler et al., 2009; Hair et al. 2016). This statement is in line with the fact, that Millennials (with no difference either between men and women or between younger (17–25 years old) and older (26–35 years old)) act in a similar way (Hartman & McCambridge 2011).

An evaluation of the open-ended question about the current use in everyday life shows that Siri represents a frequently used source of information for many of the respondents (n=211). Survey participants use Siri, for example, to get informed about the weather forecast, to query general information or to search for information in the Internet. Some of the respondents also consider Siri to be very helpful for making and receiving phone calls or messages by using only the voice input. Siri will also be used for navigation while driving. However, a quarter of the respondents stated that they do not see any use for Siri in their everyday life and do not use the DVA at all. This view is also shared by two-thirds of the respondents, who answered the question about the current use of Siri in everyday student life. In 103 out of 157 cases, Siri is not used at the university. Nonetheless, Millennials use their DVAs to quickly acquire information and search in the Internet. Finally, concerning Siri's potential applications in the future, 132 answers of the survey participants have been collected. Many interviewees consider the collection of different kind of information with the help of Siri to be an interesting feature for the future. In contrast, a quarter of respondents do not see any future applications for Siri in their everyday lifes.

5. Discussion and implications

Although there are some studies about DVAs (Coskun-Setirek and Mardikyan 2017; Joo and Sang 2013), there is no such study, which examines the acceptance of DVAs in such broad spectrum as we do. We develop a new, literature-based approach for measuring the DVA acceptance and apply it to the acceptance of a DVA – Siri.

By closely looking at the predictive power and the predictive relevance, it can be stated, that the approach suits for the acceptance measurement very well. Following Luo et al. (2011), the criterion of predictive power is used first. Variables explain here 68.6 % of the variance of Behavioral Intention to Use DVAs and 80.5 % of the Actual Use of DVAs. Overall, the forecasting performance of the model is moderate (Hair et al. 2011; Chin 1998). In terms of predictive relevance, values for Q^2 of 0.463 for Behavioral Intention to Use DVAs and 0.482 for Actual Use of DVAs have been determined for the approach for measuring DVA acceptance. The empirically collected data can be well reconstructed by the model and the PLS parameters (Chin 1998). The research model therefore does not only show moderate predictive power, but it can also be considered as relevant for the prediction of Millennials' acceptance for using DVAs. By searching for suitable gratifications, we wanted to learn more about reasons for using or not using DVAs in daily life by digital natives. Overall, the level of information content and the adjustment effort

(Luo et al. 2011) was high. We not only used original TAM-constructs but also incorporated in our model five up-to-date gratifications tailored for a such new technology like DVAs. This procedure was more effortful than using existing constructs for TAM but, on the other hand, in this way, we found out, what has an influence on Millennials using DVAs.

On the basis of the empirical results from the previous chapters, the research question set up at the beginning of the study can be answered. Overall, nine hypotheses (*H1, H2, H3, H4, H5, H6, H7, H8b, H9b*) can be accepted. With regard to the research question about the factors which positively or negatively influence the acceptance of DVAs, the following results can be compiled for the approach for measuring DVA acceptance: The results of this study suggest that enjoyment, social status and social influence play an important role in consumers' decision to use DVAs. Consumers, who enjoy talking to their mobile devices, are indeed more likely to use DVAs. Moreover, when some colleagues, friends or students use a DVA, it will be very likely, that their friends will also do so. On the other hand, some consumers are concerned about companies who can easily get too much personal information about the consumers and eventually misuse them by e.g. giving them to some unauthorized third parties. Even though DVAs are an interesting and (in some life situations, e.g. navigate a car, receive quick answers, set the timer) very useful device (189 responds), still many respondents (103 people) do not use DVAs in public, e.g. at the university. They rather do so at home, where nobody will laugh at them because of talking to their smartphones. The findings of the open questions show, that many of the respondents see no current use of Siri and will not use DVAs in the future. Similar results emerge from the consideration of the mean values for Behavioral Intention to Use DVAs (BIU) and Actual Use of DVAs (ASU): Means for BIU, 2.95, as well as those for ASU, 2.81, both below the scale mean, do not indicate acceptance of Siri in the target group. Some of the interviewees give reason for that, e.g. they do not want to control their devices by using their voice. Moreover, privacy concerns, fear of being intercepted and unexplained legal situation of DVAs are further reasons for not using such devices. Among digital natives, privacy concerns are indeed an issue (Mean=4.16; SD=1.08), but not to the extent as they would adversely affect the acceptance or the usage of Siri.

Our findings go in line with several other studies, which (at least in some way) look for reasons/gratuities for acceptance of modern technology devices. Joo and Sang (2013) found out that smartphone use is mainly affected by motivations based on goal-oriented and instrumental use. Their findings can be clearly reflected in our gratuities: enjoyment, social status and social influence, which are also goal-oriented. Moreover, Kim and Shin (2015) found out that e.g. mobility and availability of modern devices (there: smartwatches) are crucial for their acceptance. This also goes in line with our findings. We assume that DVAs are available everywhere we go – not only at home but also en route. Both studies take for granted immediate access to informations as a "technology's primary utilitarian purpose" (Kim and Shin 2015). Otherwise than by Coskun-Setirek and Mardikyan (2017), who pointed out that job relevance and output quality positively influence Actual Usage of Voice Activated Personal Assistants (like e.g. DVA Siri), we found out, that people, who use DVAs do so because they want to be entertained and look for an enjoyable activity. The difference here clearly lies in the choice of a study sample. While we focused on Millennials, only 43,7 % of the study sample from Coskun-Setirek and Mardikyan (2017) were students in such age. It shows, that different age groups have varying needs and requirement for using DVAs.

Moreover, our study has important theoretical and practical implications. No previous study examined factors that had either a positive or a negative impact on the acceptance of DVAs under digital natives (Millennials). By doing so, we filled a research gap in the area of technology acceptance. The findings suggest, that enjoyment, social status and social impact are the main drivers to use DVAs. On the other side, privacy concerns negatively influence the acceptance of DVAs. For theoreticians, it provides a new context for the application of DVAs as an innovative, modern AI-technology. Our model has proven, that also such a founded method like TAM, can still be used for modern technologies. But our findings are especially useful for practitioners. In our study we show, that not only the functions of DVAs themselves are relevant for customers but especially motivations like enjoyability, social impact and social status decide, whether DVAs will be used or not. By saying this, we strongly recommend putting more emphasis by accordingly targeting marketing campaigns of DVAs to familiarize their potential under the customers. It is also recommendable to strongly address customers' concerns (e.g. privacy concerns). Doing so can add a lot of value in the development and distribution of DVAs.

Besides (service-)robots (Wirtz et al. 2018; Ivanov & Webster 2019b; Jörling et al. 2019; Rosenthal-von der Pütten 2018) also voice-based technologies are constantly evolving and experiencing a constant change (Tuzovic and Paluch 2018). Personal DVAs are now integrated in any smartphone or smart speaker. In the meantime, the retail, automotive and healthcare sectors are also relying on voice controls to offer their customers voice-based technologies and services (see e.g. Lee et al. 2015). Time will tell how businesses can meet the needs of consumers with voice-based services and which attitude consumers will adopt towards integrating DVAs in their daily life.

6. Limitations and further research

Although the study presents helpful and crucial contributions to the literature, some caveats must be discussed. Main limitations of the study are educational level and geographic coverage of the respondents. First of all, it should be noted that students of the University of Bayreuth between the age of 17 and 35 were defined as the target group of our study and interviewed. Therefore, the results of the empirical study cannot be transferred to other students at other universities in Germany or even in the world. In order to measure the general acceptance of all Millennials or the total population in Germany, further studies would have to be carried out.

Moreover, it would be interesting to know, if cultural differences play a role in the acceptance of DVAs. Conducting a transnational study in this context might be advisable. Not only cultural differences, but also the transience of time play an important role by examining new technologies. As we can see, in our study, Actual Use of DVA was generally low. One probable reason for that can be the fact, that every new technology firstly needs some time to adapt and to be used by the mass. We therefore recommend to repeat this study in some years.

Furthermore, it cannot be ensured that gratifications chosen within UGA are only possible gratifications that influence the usage and the intention to use DVAs. Therefore, future research may focus on examining whether and, if so, which other factors influence the usage of DVAs.

It could also be interesting to reflect upon the other side of the coin and think about motives for not using DVA. This approach might illustrate the future potential of DVAs and also uncover reasons against their usage.

Ultimately, researches can use other technology acceptance models to look closer for the factors that have an impact on the adoption of DVAs.

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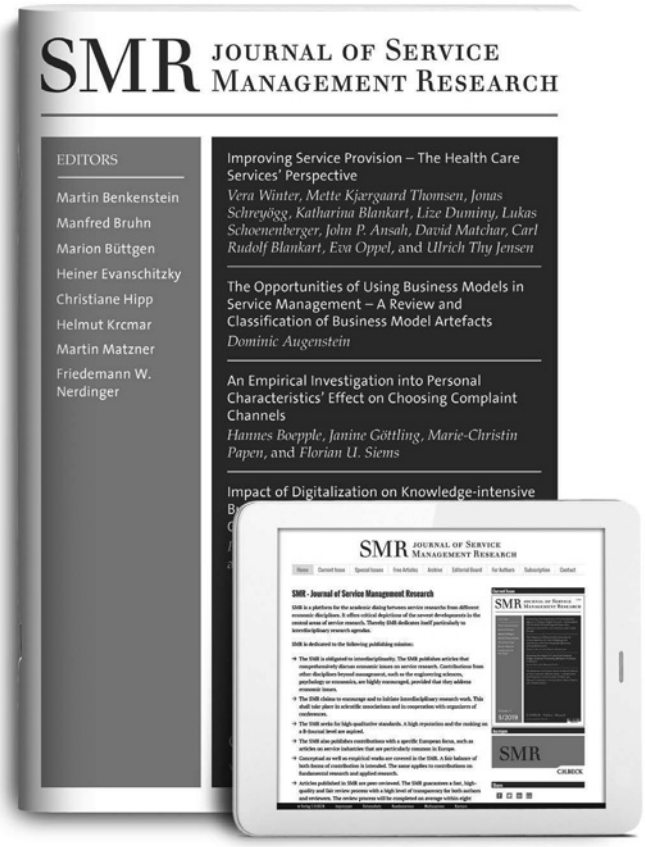

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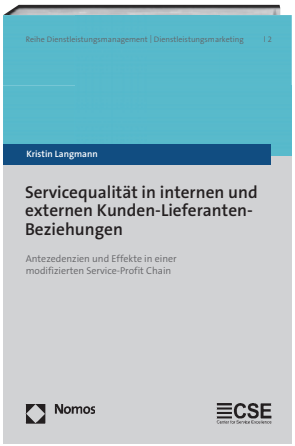

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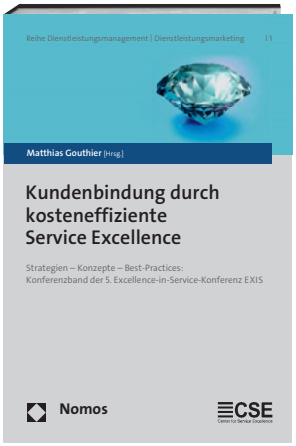

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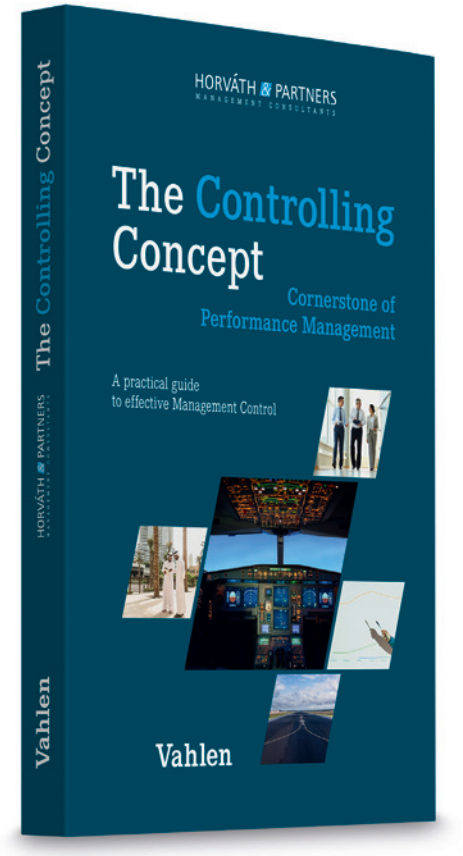

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