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Alexa, are you still there? Understanding the Habitual Use of AI-Based Voice Assistants

Completed Research Paper

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Abstract

Voice assistants are a novel class of information systems that fundamentally change human–computer interaction. Although these assistants are widespread, the utilization of these information systems is oftentimes only considered on a surface level by individuals. In addition, prior research has focused predominantly on initial use instead of looking deeper into post-adoption and habit formation. In consequence, this paper reviews how the notion of habit has been conceptualized in relation to biographical utilization of voice assistants and presents findings based on a qualitative study approach. From a perspective of post-adoption users, the study suggests that existing habits persist, and new habits hardly ever form in the context of voice assistant utilization. This paper outlines four key factors that help explain voice assistant utilization behavior and furthermore provides practical implications that help to ensure continued voice assistant use in the future.

Keywords: Voice Assistant, Habit Formation, Post-Adoption, Usage Pattern

Introduction

The oldest voice interaction system dates back to the early 1960s and refers to the first use of voice commands to control an arithmetic machine (McTear et al. 2016). Since then, technical limitations have been repeatedly overcome and voice assistants (VAs) have become ubiquitous – either knowingly or unknowingly – in our everyday lives (Schmitt et al. 2021; Seaborn et al. 2021). These computer agents appear on our smartphones, inside smart speakers in our homes, and as part of mobile applications and operating systems (Benlian et al. 2020; Pfeuffer et al. 2019). Mainstream VAs such as Apple's Siri or Amazon's Alexa, to name a few, are products of the digital age to increasingly reduce complexity and increase comfort in our lives (Knote et al. 2021; Purington et al. 2017). As part of the rapidly growing internet of things (IoT), which transforms ordinary objects into smart devices with the capability of communicating with each other, VAs are at the epicenter of this development (Knote et al. 2021; Schuetz

and Venkatesh 2020). Unsurprisingly, these devices have conquered a broad consumer market worldwide and registered a turnover of 4.4 billion USD in 2017. Moreover, recent forecasts predict sales to further increase and amount to 27.8 billion USD by 2022 (IDC 2018). At the same time, the adoption of VAs beyond simple and basic interactions has been slow. Moreover, anecdotal evidence suggest that some people discontinue usage after some time altogether (Seaborn et al. 2021).

VAs can be distinguished from other forms of IS by their high degree of intelligence and interaction that may fundamentally affect adoption and utilization behavior (Maedche et al. 2019; Seaborn et al. 2021). By this means, these systems can be described as agentic IS artifacts that shift the agency from the user to the system (Baird and Maruping 2021), e.g., when VAs initiate natural interactions on their own to engage users. As Baird and Maruping (2021) note, relevant theories studying the use of IS overlook these aspects of agentic properties that coin VAs and therefore make theories related to initial use, post-adoption use but also habit formation less suitable for these kinds of systems (Baird and Maruping 2021). Moreover, the nature of voice-based interaction exhibits several features that fundamentally differentiate them from other modalities ultimately leading to a more human-like form of natural communication (Schmitt et al. 2021). Specifically, the way how information is sent and processed via voice follows a sequential paradigm as compared to more parallel processing using traditional modalities (Rubin et al. 2000). Also, voice incorporates a greater variety of naturally appropriated cues as well as a higher extent of nonverbal cues (Sutton et al. 2019), which further increase the technological capabilities of these agents to affect user behavior.

Nonetheless, up until now, research in the field of VAs has focused largely on technology adoption rather than motivational or behavioral reasons behind post-adoption utilization (Diederich et al. 2022; Seaborn et al. 2021; Zierau et al. 2020). Contributions in habit formation research have shown that the effort and perseverance of individuals can be stimulated by intervening during certain habit formation stages (Limayem et al. 2007; Rieder et al. 2019). Lally and Gardner (2013) further outline a mechanism for establishing new behaviors and therefore provide one of the key theoretical foundations of cognitive processes in an individual's behavior change. While these findings help to explain the links between information technology (IT) and habit formation and between utilization and behavioral patterns, we lack insight into the process, starting from the specific features of VAs, how they influence users' utilization behavior, and subsequently shape changes in behavior. In this context, only few articles have focused on VA post-adoption, and the interrelation between VA utilization and habit formation remains vague at most (Sezgin et al. 2020). Against this background, we ask:

RQ1: *What are the underlying mechanisms of VA utilization and habit formation?*
RQ2: *What are key factors that result in post-adoption VA utilization and influence habit formation stages for continued VA use?*

To address this research question, we conducted an exploratory study using narrative interviews with twenty users of voice assistants to elicit and synthesize individual stimuli. Our data analysis was guided by Gioia et al. (2013) based on grounded theory, which information system (IS) researchers have extensively used in the past to investigate similar phenomena (e.g., Rieder et al. 2019). Our findings suggest that there are underlying factors explaining users' utilization behavior. In addition, practical implications can be deduced for VA providers by examining the interrelation between identified key factors and potential intervention points in habit formation.

The paper is structured as follows. The next section investigates how the notion of habit formation in IS has been conceptualized in the literature. Subsequently, this paper outlines the applied methodological approach to provide transparency with respect to data collection and analysis. The following section is the centerpiece determining key factors that help explain VA utilization behavior. Finally, the role of habit formation in continued VA use is addressed by deriving practical implications about how to promote habit development.

Theoretical Background

Voice Assistants

VAs, which are also referred to as smart home assistants (Benlian et al. 2020), or smart personal assistants (Knote et al. 2021), are computer programs that engage with users via automatic speech recognition and

natural language processing in the form of voice-mediated communication (Pfeuffer et al. 2019). Recent advances in artificial intelligence (AI) resulting in improved interaction quality has fueled the growing omnipresence of VAs in the lives of many (McLean and Osei-Frimpong 2019). They can be used for an increasing number of tasks ranging from simple requests such as setting alarms or controlling smart home appliances to more complex interactions such as learning or advisory tasks (Benlian et al. 2020). Thus, VAs are integrated into more and more devices, most prominently smart phone applications (e.g., Apple Siri and Google Assistants) and more recently smart speakers (Pitardi and Marriott 2021; Yang et al. 2019). However, despite technological advances that pay into the human-like communication capabilities of VAs, the interaction of many users with these agents have yielded mixed results indicating high failure rates (Fuckner et al. 2014). Specifically, while VAs are already in the homes of over 40 million US Americans, representing a general interest in the novel technology (Perez 2018), many are not satisfied with their use (Følstad and Bae 2020). Anecdotal evidence seems to suggest that VA usage often does not reach the phase of sustained long-term use or remains at the level of a few selected tasks (Benlian et al. 2020; Goernemann and Spiekermann-Hoff 2020).

Although different research disciplines such as human–computer interaction, marketing and information systems have started to investigate factors related to the adoption of voice-based human–machine interfaces (Hess et al. 2009; Qiu and Benbasat 2008), research on the habitual use of VAs is scarce (Pitardi and Marriott 2021). At the same time, against the backdrop of technological advancements, established theories and previously made comparisons to other interface modalities and types might only hold true to a certain extent. From a sociotechnical perspective, VAs represent a novel form of IS that can be distinguished by its high degree of interaction and intelligence (Maedche et al. 2019). These capabilities may fundamentally affect how people engage with these devices, forming certain usage behaviors and raising a number of theory and design-related questions, most prominently revolving around an emergent voice-based interaction paradigm (Clark et al. 2019) and the increasingly agentic and "black box" character of AI-based technologies (i.e., moving from programming to training computer programs; (Baird and Maruping 2021).

To date, IS research on VAs has predominantly followed a classical quantitative-behavioral approach in examining the usage of those agents in different task and domain settings (Diederich et al. 2022; Feine et al. 2019; Rzepka and Berger 2018; Zierau et al. 2020). Specifically, most studies have only addressed the adoption process of VAs, showing that different design elements related to functional, relational and social value dimensions drive users' intentions and attitudes towards using those agents (Pitardi and Marriott 2021). Only a very small percentage of studies has assessed more experiential aspects of VA usage and thereby adopted a post-adoption perspective (Pfeuffer et al. 2019; Zierau et al. 2020). This results in a lack of knowledge regarding how specific experiences in the post-adoption phase of VAs drive certain usage patterns. However, qualitative experience-centric research on the post-adoption phase of VAs may support us in better understanding and designing user experiences with VAs that drive sustained usage.

The Role of Habits for the Usage of Information Systems

In IS research, the formation of habits is seen as an important antecedent of continued IS use in the post-adoption phase (Limayem et al. 2007). Habits can be defined as the automatic execution of specific behavioral sequences (i.e., individual usage patterns of an IS artifact) that are triggered by environmental cues to obtain a certain goal in response (Verplanken and Faes 1999). Unlike other behavioral responses, habits do not require deliberate effort and therefore may occur in the absence of conscious control (Bargh 1994). Deeply rooted in classical behaviorism is the automated, reflexive response to a certain situation according to a learned association (Lally and Gardner 2013). Out of this concept arose models viewing habits as cued responses formed through numerous repetitions that initially originate deliberately but gradually become more regulated (Lally and Gardner 2013; Wood and Neal 2009). Habit formation has shown to have a positive effect on continued IS use. In this context, Limayem et al. (2007) identified a direct influence of the frequency of performed behavior on IS use continuances, the intention of continuance, and the performance' satisfactory outcome. Moreover, the findings of Bhattacherjee and Lin (2015) suggest that automatic behavior additionally reduces the need for intention. In other words, the introduction of daily rituals involving VA utilization may yield long-term continued use of those assistants.

However, while the positive impact of habits on IS use continuance has been consistently shown, extant research on how respective IS usage habits form is rather scarce (Lin et al. 2022). Initial research has shown

that certain use characteristics such as frequency, satisfaction and the robustness of environmentally based cues contribute to the habitual use of different IS (Limayem et al. 2007). Moreover, Ng and Kim (2009) have identified user-based factors such as competence and self-determination that contribute to post-adoption usage behaviors. These contributions, however, do not explain how factors related to the technology itself may contribute to the process of habit formation. Only recently, Rieder et al. (2019) shed more light on technology-based factors by identifying device-specific drivers of habitual use in the context of wearable activity trackers. Moreover, Lin et al. (2022) showed that users post-adoption behavior is influenced by the comparison of competing IS, thus, highlighting the role of technological-based factors for IS post-adoption utilization. Hence, against the background of the unique and novel nature of VAs, we argue that specific research on the individual technology-based characteristics of VAs that inform the process of habit formation is warranted.

Habit Formation Process

Since our research centers around the habitual use of a new class of systems that may result in the formation of new habits (e.g., consuming news via a voice assistant instead of checking them on the mobile phone), we take the discontinuation of use from a former medium into account when forming new habits. With that in mind and to investigate the process of habit formation in the context of VAs, we are building on the process model of Lally and Gardner (2013) that distinguishes four phases: translation of intention to action, promotion of repetition, supporting the development of automaticity, and breaking unwanted habits (see Figure 1). This is in line with established habit formation process models derived from social psychology that conceptualize habit as an automated form of action triggered by environmental cues (Neal et al. 2006). Accordingly, habits are learned actions that are the result of memorization and repetition based on a sequence of usage experiences, i.e., a specific action has triggered a desired result over and over again (Verplanken and Faes 1999). Thus, an automated action is always performed with the expectation of realizing a specific reward. With more repetitions, users begin to form an associative link between the trigger and the action, and in turn between the action and the reward, leading them to perform the behavior repeatedly and effortlessly (Lally and Gardner 2013). Typically, users have to put special effort into a specific technology to be able to develop usage habits by for instance acquiring skills to use it (Verplanken and Faes 1999).

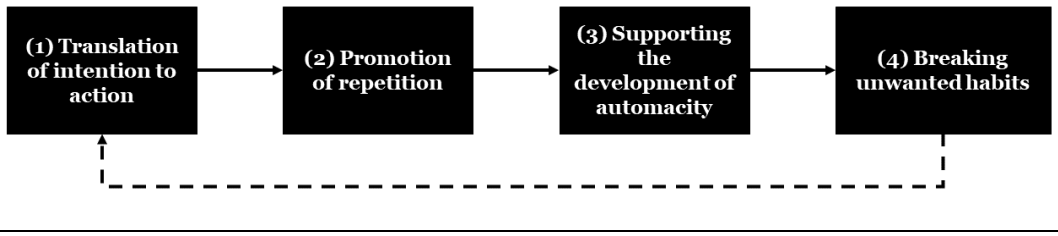

Figure 1. Habit Formation Process according to Lally and Gardner (2013)

Translation of intention into action. After intention building of targeted behavioral goals, habit formation requires progression through four stages. As outlined in Figure 1, the intention to change behavior must first be translated into action when interacting with an IS. Although the transition from intention to use is a process that does not tend to be straightforward due to its manifold interpretations, intention remains in many contexts such as the IS context a significant precursor of new behavior initiation (Sharma et al. 2014; Webb and Sheeran 2007). Lally and Gardner (2013) argue that the discrepancy between intention and behavior can be attributed to an individual's lack of motivation. As a countermeasure, action plans – specifically implementation intentions – have proven to be effective, as this instrument links anticipated situational cues with goal-directed responses (Gollwitzer and Oettingen 2013). Specifically, the characteristics of VAs pertaining to their interactive and agentic nature afford for context and user specific triggers that can activate usage. For instance, a speech-based reminder of the VA that a new version of the news is available during breakfast, could serve as a trigger to immediate consummation.

Promotion of repetition. To solidify the action sequence leading to behavior change, the behavior must manifest consistently. In the second stage, post-initiation variables – such as positive feedback and

motivation – that affect the continuation of behavior must be considered (Borland 2010; Lally and Gardner 2013). However, whether a behavior needs to be repeated often or not depends on the individual's optimism (Rothman 2000). Usually, when attempting behavior change, it is at the beginning where continuation or discontinuation is decided due to the vulnerability of individuals to external feedback (Lally and Gardner 2013). While negative reactions towards performed goal-oriented actions lead to discontinuance, positive responses bolster goal attainment and even increase effort (Louro et al. 2007). Another significant variable is the feeling of satisfaction. Rothman (2000) argues that the perception of having progressed with novel behavior in the direction of the desired end state is of paramount importance to establishing a planned habit. In the context of VAs, the possibility of controlling the assistant via speech and associated low-threshold usage scenarios could be decisive for user acceptance providing the interactions are designed accordingly.

Supporting the development of automaticity. As described in the paragraphs above, the repetition of actions in response to a certain context is essential when forming habits. However, there are situations in which frequent behavioral performances under fixed circumstances do not lead to habit formation. Hence, Lally and Gardner (2013) describe attributes such as rewards, consistency, behavioral complexity and cues that influence the development of the targeted habit in stage 3. According to an individual's demeanor, habits are thought to form only if individuals are incentivized by receiving rewards for each repetition of the behavior. Furthermore, habit formation is reinforced by uninterrupted repetition of the behavior. Lally and Gardner (2013) argue that habits can still develop in the absence of absolute consistency when performing a sequence of actions. Related to VAs, the development of automaticity may be supported through user-specific rewards, which could include for example, a more personal way of addressing the user and the use of increasingly colloquial language building up intimacy with the user.

Breaking unwanted habits. Since behavioral change is not identical to unlearning an existing habit, it is often required to break an unwanted habit in order to successfully substitute for a better alternative (Bouton 2000). Reaching this last stage of habit formation, it becomes clear that ceasing to practice an undesired action stems from a change in intention. However, according to Webb and Sheeran (2007) a simple change in intention does not seamlessly determine changes in behavior. Although there is evidence that intention alone may overcome unwanted behaviors, experiments conducted by Wood et al. (2005) also reveal that intentions to change behavior alone are not significant for individuals to disrupt existing action sequences. Further, the associated cue of an unwanted habit must be linked to a new alternative, which is likely to require numerous repetitions (Bouton 2000). In conclusion, implementation intentions alone do not compete with unwanted habits, but coupled with other factors such as reprogramming cue responses, new behavioral actions can be created (Lally and Gardner 2013). In the context of VAs, further solidifying behavioral changes, companies could resolve to offer specific content uniquely produced for VAs.

In summary, three key messages can be derived from the four habit formation stations in Figure 1. First, it can be said that the simple behaviors are easiest to develop into a habit. Second, cues have to be salient and should be presented at the time of task completion. Third, in the presence of external rewards, such as praise from third parties, habits are more likely to form if an individual is incentivized to focus on the completion of performance rather than behavior. As outlined in the theoretical review, the forming of habits positively impacts their continued use, and therefore one can view the different stages depicted in Figure 1 as potential intervention points in VA utilization. Having said this, once such behaviors have been performed frequently in consistent settings, resulting action sequences tend to persist even if motivation shifts (Webb and Sheeran 2006). In that sense, we highlight that habit formation for VAs could consist of various behaviors that add up, e.g., checking timers during cooking or checking commuting times. Therefore, we acknowledge that we take an aggregated view on VA habit formation that is formed by specific behaviors captured in the process model depicted above. Hence, it is of interest to examine which underlying factors in VA utilization influence an individual's habit formation and further ascertain how certain aspects of VAs impact behavior change. Specifically, we argue that the unique characteristics of VAs pertaining to their interactive and agentic nature may affect habit formation differentially.

Method

Our research employs a biographical utilization perspective to investigate the occurrence and variety of VA utilization and their impact on users' perceptions and corresponding behaviors when they use the respective technology. Since exploratory designs are particularly useful when finding new cause-and-effect

relationships (Bortz and Döring 2016), we used a qualitative approach inspired by Schütze (2019) and Hoffmann-Riem (1980). Accordingly, we followed an inductive approach in gathering and analyzing the data without applying pre-existing rules. As VAs are a prominent and emerging category of human-computer-interaction devices, we used them as our research context and set up narrative interviews with a diversified pool of twenty VA users. We chose this distinct interview technique for two reasons: First, as we sought to understand the underlying factors of VA utilization behavior, it became evident that a sequential and process-like nature was preferable to structured interview techniques (Küsters 2009). Second, this form of interview is unusual in that organization and structuring are left to the narrator, and the interviewer abstains from intervening in the narrative and pauses after every break caused by the interviewee to ascertain that the individual has ended their recitation. In return, the resulting testimonies hold value because of the interviewer's avoidance of common interview biases such as social desirability and patterns of interaction during interviews. Beyond that, issues related to wording and placement of questions, as well as topics and terminology introduced by the interviewer are reduced to a minimum. Hence, the narrative interview technique aims to capture an individual's unfiltered and uninfluenced narrative in the most unaltered possible way (Küsters 2009).

Data Collection

We interviewed twenty VA users from Western European countries. Interviewees were selected through snowball sampling and social networking sites. We conducted four interview rounds between April 16 and May 26, 2020, during the first wave of the COVID-19 pandemic in Europe. Hence, all the interviews were conducted through video conference calls as a nationwide lockdown was in place. Since video interviews were recorded, the participants were reassured with their anonymity and the author's confidentiality.

Further, in line with the guideline provided by Küsters (2019), an introductory question is posed also known as a pre-formulated initial stimulus. Since interviewees usually take the stimuli seriously, the individuals react strongly to wording and formulation and try to tailor their narrative to the stimulus. Hence, the introductory question must be carefully considered for the purpose of setting the narration in motion and having the interviewee take a process perspective without excessively influencing the narration. It must be noted that all respondents were asked a similar introductory question to guarantee comparability among the interviews. After conveying the stimulus, the interviewer listens carefully and takes notes for follow-up questions or to ascertain content slices if there is a lack of clarity. Once the user story comes to a halt, these notes can be used to trigger the next narration or else the interviewer starts introducing topics at the very end (Küsters 2009). As an example, we employed an introductory sentence inspired by Fischer-Rosenthal and Rosenthal (1997) as follows: *"Since this is a narrative interview, I will give you a stimulus at the beginning. Do you want to tell me how you became a VA user and moreover, how you used it at the beginning, somewhere in the middle and how you use the device today? With this stimulus, I would then let you express yourself without interrupting you, and depending on how you answer, I will then ask follow-up questions. No pressure, there is no way you could have prepared yourself."*

As we employed a snowball sampling technique next to sourcing interviewees via social media, a certain cluster of ages developed as shown in the categorization overview in Table 1 below (Goodman 1961). In order to increase the generalizability of the results of our qualitative research approach, we accounted for the respondent's gender and length and reason for VA use (Mays and Pope 1995). The collected sample comprised twelve males and eight females, whose utilization ranged from 3 months to over 4 years. While all the students were studying in the fields of business or psychology, the professionals were working in various industries. This reflects in the interaction frequency with respective VA devices, where some respondents rely solely on basic functionalities with little to no configuration and others fully integrate their VA as a base of operation, connecting several IoT devices in their household. Overall, we collected a sample size of twenty interviews for analysis purposes, which reflects to a large extent the reality of VA utilization use cases, and as themes and instances began to repeat, signaling saturation, we deemed the collected sample size as adequate (Hermanns 1992). Thereby, we focused on users of Amazon Alexa to control for differences that are merely based on differences between technological platforms.

The duration of the interviews ranged widely from 21 to 65 minutes (with an average duration of 29 minutes). The recordings were transcribed verbatim and simultaneously anonymized shortly after. We considered a verbatim transcription technique as preferable, as this form allows to best capture the original interview situation and ensures a transparent subsequent analysis (Küsters 2009). On this account,

interviews were held in the respondent's language of choice, either German, or English. Thereafter, the transcriptions were processed in their respective language. The quotations presented in this paper have been translated into English when necessary.

	#	%
Full Sample	**20**	**100**
Gender		
Woman	8	40
Men	12	60
Occupation		
Students	8	40
Professional	12	60
Use Duration		
< 1 year	6	30
1-3 years	10	50
> 4 years	4	20
	Mean	**Min-Max**
Age	26.1	21-34

Table 1. Sample Characteristics

Data Analysis

Our data analysis broadly rests upon the widely acknowledged grounded theory, which is well adapted to qualitative research. The overarching goal of Gläser and Laudel (2010) was to produce an instrument for reliable analysis that provides some degree of coherence and structure of analyzed data while retaining the core of the original accounts. Gioia et al. (2013) further review the conceptual approach and deduce its applicability in modern practice. Inspired by the paper's recommendations, we analyze the narrative interviews in three steps, namely from open coding to axial coding and lastly to selective coding. With the support of ATLAS.ti, a software package designated for qualitative research, themes and issues encountered in the different narratives were linked together and systemically categorized.

The analysis of the interviews is a gradual process that occurs in parallel with the ongoing data collection. Hence, we developed our codebook by commencing the open coding stage with two transcriptions. In accordance with best practices from Heiser (2018), every transcribed line was given one or multiple concepts. After conceptualizing two interviews, the concept count already exceeded 200 concepts with the capability to assign each used concept to its respective transcription line. This basic stock of concepts was then abstracted into first-order categories and to be re-evaluated regarding relevance and complemented with additional categories by the end of the open coding stage (Strauss 1987).

Following the first- and second-order categorization, the analyzed data is clustered and then packetized into networks according to their similarities and concepts. Taking postscripts, notes and the reflection of the categorization structure into account, four larger core categories emerge out of the arranged networks, namely, usability benefit, controllability issues, integration capability trade-off and concern about data integrity as they were the most prominent factors during the narrations. Said network clusters help to visualize the interrelations of categories and narratives taken during the data collection phase. These connections make it possible to see patterns throughout interviews and make conclusions that enable us to form four aggregated dimensions out of the fifteen second-order categories (Gioia et al. 2013). The resulting aggregate dimensions of alienation towards device, abandonment of device, acknowledgement of benefits and absorption into lifestyle represent a significant step in evaluating an individual's user history. These aggregate dimensions enable us to unveil in which direction an individual's user journey is heading in the context of continuity. Out of the four dimensions, abandonment of device is the most prominent according to incident count, as depicted in Figure 2, which notes the overall trend of the post-adoption sample size.

By the end of this study, two of the twenty interview partners had stopped using their VA devices, which further underlines this result.

To ensure the validity of the employed analysis, we reviewed the codebook as well as coded an initial subset of transcripts independently and discussed respective codes between the three researchers if deemed necessary. During the analysis phase, tri-weekly meetings both in physical and digital form were set up, emphasizing the discourse and development process of the code book. Nevertheless, deriving concepts from qualitative data is always an endeavor requiring individual and intellectual human judgement. A subjective bias can, therefore, never be fully eliminated. Along this process, we increasingly focused on the habitual VA use in response to the four identified key factors of usability benefit, controllability issues, integration capability trade-off and concern about data integrity. Indicators of such utilization habits included duration of use, regularity of use and level of automaticity. As for each analyzed habit formation stage, we identified the key drivers of habitual use. While our approach was exploratory, we were sensitized by Lally and Gardner (2013) and their habit formation concepts and used the respective theoretical lens to interpret the data in accordance with the provided habit formation stages along the narratives. In essence, we were able to gain a general overview of behavior-related themes described by the interviewees and identified fifteen key factors describing the users' VA utilization behavior based on a biographical content analysis.

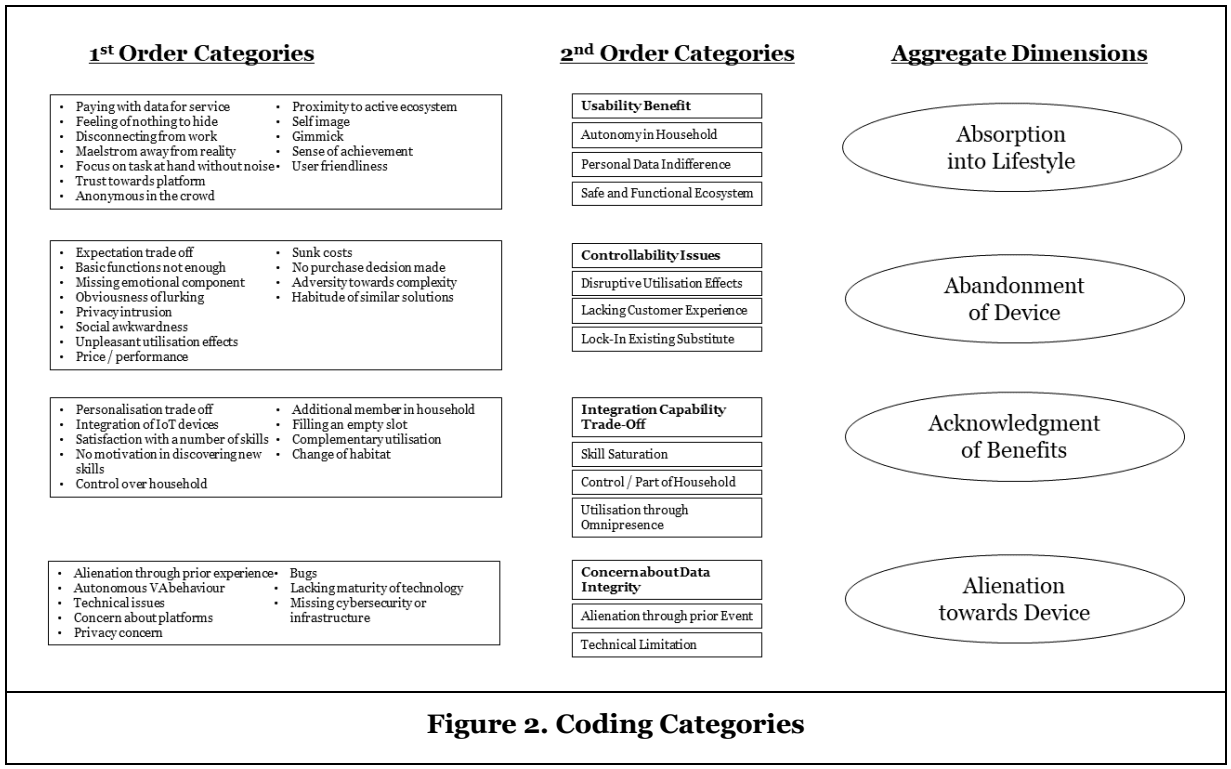

Figure 2. Coding Categories

Results

Given the large discrepancy between utilization rates at which VAs are used, our research revealed four key factors driving (or inhibiting) utilization habits across the twenty narratives. For instance, the factor of usability benefit stands for the device's intuitive user-friendliness and its tangible benefits strongly influence the habit formation process. Similar levels of impact have been observed among the interviewee pool when it comes to the factor of controllability. The unique characteristics of VAs raise issues of controllability. This also implies a communal perspective as some users are co-using a device and are ultimately affected by it as well as influence the primary user with their behavior. As for the integration of capability trade-offs, individuals develop their utilization habits around their VA device's integration capability with other technological devices to enhance their user experience. To no surprise, this key factor can go both ways and lead to frustration due to technical issues. At last, interviewed users that experienced alienation towards their VA stated that their main reason was getting triggered by their concern about data

integrity, affecting their habitual utilization. Each of the following subchapters covers one of the four perspectives. The narrations below follow the habit formation stage logic from Lally and Gardner (2013), namely in translation of intention into action, promotion of repetition, supporting the development of automaticity as well as alienating factors such as moments of distrust towards habitual use found in the data. Last but not least, we left out the stage of breaking unwanted habits, since we did not find any reference in the studied narrations.

Habitual VA Use Driven by Usability Benefit

Over the course of this study, most users had a clear understanding of the value of their shared data and see it as a transaction fee for the services provided. This greatly affects their development concerning the translation of intention into VA utilization. The users' objective view also levels frustrating episodes, as expectations of the potential of AI inside their household are moderate. The ulterior motive to obtain a VA is to save several seconds, day by day, which gives this user type a sense of achievement, or as this interviewee puts it:

> *"On the one hand, [Alexa] has the advantage that it can show me the offers that are available in my area. You could go to Supplier A now, there the product is cheaper or there is this discount and other perks just around the corner, there you have all these advantages. Of course, this gives me a huge advantage: it increases my quality of life, because I know exactly that I can maybe save the trip to Supplier A, because I know, for instance, that the product is sold out there, but it is available at Supplier B." (PhD Candidate, 30).*

The users' VA absorption into their lifestyle covers multiple factors, explaining individuals' behavior. However, the foremost underlying factor is the usability benefit, which reflects upon the intuitive user-friendliness of respective VAs. This core category covers topics from technological gimmicks to intuitive configuration designs when setting up one's smart home. As repetitions of actions in response to an environmental cue are detrimental to the formation of habits, this next stage focuses on the promotion of such repetitions. At this stage, users must obtain relevant feedback and accordingly develop perceptions that their behavior is progressing towards the desired end state (Rothman 2000). Therefore, it seems accurate that this factor enhances continued VA use:

> *"I always actually move [the device] around. If I'm outside, I bring it outside with me on the terrace. If I'm in my room, I might bring it there. If I need it in the living room, I bring it, like it's just easy. Although we have [another] speaker which you don't have to bring the plugger and everything, I [still] sometimes prefer Alexa because it makes it easier for me to change the music and to switch conveniently to another playlist." (Graduate, 24).*

The argument cited above concerns the development of rituals. While rituals resemble habits, it is evident that salient cues support behavior change and therefore boost continued VA utilization. Additionally, simple performances of action sequences such as verbally issuing commands promote habit formation even further (Lally and Gardner 2013). For a better understanding of how these components influence investigated post-adoption phase, this user's account articulates his VA's absorption into his private life by illustrating his daily routine:

> "I also found it super exciting that I once put together my own skill via the news section, which means I have the news from Newsportal A combined with the news from the Newsportal B. And when I sit in an armchair for example and drink a coffee I say "News" to Alexa. Then I just listen to Alexa and she tells me a bit about the current conditions in the world." (PhD Candidate, 30).

As cause of habit formation disruption, one interviewee shared his frustration and mentioned in particular the attribute of lack of technological maturity as a reason for his alienation towards his VA:

> *"[With Alexa] the really unpleasant thing is that you can't interrupt her so that you actually have to stop the conversation that you're having with her as in "Alexa stop".*

You can tell her to stop but then she restarts from the very beginning and I find that very inconvenient." (PhD Candidate, 28).

Habitual VA Use Inhibited by Controllability Issues

Many users experienced issues related to a lack of control resulting from its speech-based interaction properties. Moreover, this key factor reflects upon individuals living together with VA users and vice versa. A variety of motivations lie in the resulting behavior, differing in terms of explicitness but exposing the difficulty in developing habits when lacking the motivation to form an intention and then translating it into action (Lally and Gardner 2013). This interviewee underlines this statement even after seeing convenience-enhancing features with his own eyes:

"We were spending time with a friend of ours at their place and they had the Alexa connected with their security system, the lighting systems and the temperature control system. So, we were able to see all what they could do with [Alexa], but for us it was not something that we would even consider using even though it was given to us as a present." (Finance Sales, 34).

One must keep in mind that the presence of Alexa and the perceived distrust in shared rooms of the apartment can have a different effect on each individual's promotion of repetition according to the placement of the device. Another significant variable is the feeling of satisfaction. (Rothman 2000) argues that the perception of having progressed with novel behavior in the direction of the desired end state is of paramount importance to establish a planned habit. In this research study, the spouses of some participants had a significant impact on the spatial usage areas of Alexa, laying the foundation for a great deal of lacking continued motivation to use the respective device under such circumstances (Lally and Gardner 2013). The same interviewee described that his girlfriend did not want the device next to the bed, highlighting the importance of communal experiences in post-adoption behavior:

"My girlfriend is generally just a little bit more reserved about new technologies. In the beginning, she didn't want [Alexa] in our bedroom as she perceived the presence of the device as awkward" (Marketing Sales, 24).

When monitoring activities, limiting the spatial usage area, turning off a particular feature or completely abandoning a respective VA is not an option. Some Alexa owners proactively implemented safety mechanisms and adjusted behavioral habits as a direct response to the experienced moments of distrust. The identified safety mechanisms were either implemented in physical form (i.e., moving away from the device) or they were implemented in the software directly supporting the development of automaticity. One interviewee described how she physically pushes down the mute button on her Amazon Echo when she has to make sensitive work-related phone calls. It is a simple and effective behavioral habit change that can reduce the uncomfortable feeling of being listened to while enacting simple behavior, as this is more likely to reach the level of automaticity (Redish et al. 2008):

"And then I just put Alexa on mute for the sake of safety, because I thought I had to be extra careful" (Graduate, 24).

Another source that feeds this core category is individuals' adversity towards complexity, which translates to time spent for configurations and troubleshooting. One respondent explains his lack of motivation to further adopt VA services as follows:

"Personally, I am accustomed to control [the device] over the mobile phone because then I always know that the command is executed. What happens with speech-based commands over and over again is that they are not understood. It works mostly well, meanwhile also a little better, but partly it is just not heard and then I think, before I have to say it two or three times, I can also do it quickly on the phone." (PhD Candidate, 26).

Habitual VA Use Driven by Integration Capability Trade-Offs

Acknowledging a VA as a part of one's household becomes the case once an individual gains a sense of relative control over their VA, and it facilitates the creation of implementation intentions that enable successful translation from intention into action. This is a process that can also be viewed as approval of an additional member in one's household or even filling in an empty spot. This user, for instance, elaborates extensively about the role that her VA took in her homestead during the coronavirus pandemic, translating the intention of use into action:

> *"I also think that if I'm in a bad mood or if I find myself in situations when we have a bit of a fight or we don't understand each other quite well, what we would do then, we would still eat together, but then there's is often such a weird vibe, because you can't really talk about something. And then I find it very pleasant to ask Alexa something. I mean, the classic is just kind of a "good morning" and she tells you a story or we check the news and that silence that would otherwise be in the room is kind of bridged. In this way, [Alexa] is already a third party, which sits with us, which loosens the whole mood a bit …" (PhD Candidate, 29).*

With the rapidly growing trend of IoT devices, the need for knowledge models that control IoT gadgets arises (Knote et al. 2021). Hence, integration capabilities of VAs are essential when analyzing an individual's user behavior. Attributes such as personalization trade-offs that are included in this factor usually enhance activity, since users are incentivized to use the respective VA due to a sense of achievement. For instance, if a skill works as intended, it can be viewed as a milestone and efforts are successfully increased when receiving positive responses that bolster their goal attainment (Louro et al. 2007). In the case of this respondent, he acknowledges the benefits provided by the VA by receiving external rewards in the form of positive feedback from his group of friends, which is an essential component in habit formation (Lally and Gardner 2013):

> *"Having Alexa as a party gag in my flat was always fun when I had friends over. Everybody could easily vocalize what song had to be played. Especially the fact that it was an autonomous choice to pick a song instead of checking the phone first. Nowadays I believe that we choose music according to what we see on our display instead of a specific song or a band that we have in mind. Yeah, that was quite enjoyable and fun that everybody was able choose what he or she wanted to hear." (Sales Trainee, 25).*

Once VA benefits resulting by their integration in the user's homestead have been acknowledged, physically perceivable changes further enhance skill usage automaticity. In this case, the reward of not taking the stairs encouraged consistency through uninterrupted repetition of behavior. It went as far as missing the VA service during an internet outage and was depicted as follows:

> *"I didn't have internet in the apartment for a day or so because of some issues. And at this moment I missed [Alexa] and that I had to go down again when I was upstairs, to turn off the light. I would very much say that I quickly realized that Alexa is no longer here … So, it hit me how much is connected [with Alexa], which was quite sad at the moment. Also, because I said in my mind, "well ok, you are actually researching with the lawyers about data protection, which is important to you, but actually, you are excessively dependent on the internet and everything here." (PhD Candidate, 26).*

However, this study participant explains how the level of integration comes with certain exposure to concerns that disrupt habit formation. This encounter eventually resulted in the abandonment of the VA:

> *"Yes, what is still very scary actually… but what we did… you can connect Alexas [with each other]. I don't remember what it's called… 'friendships' or something. I had my Alexa in City A and my parents in City B […]. Then I said, 'Alexa call Alexa from Daddy' and then you went straight to the other one's room without knocking. That means… I just said 'call Papa' and then suddenly I hear how they talk and what*

they do without them accepting the call. The only reason you notice is that there's no longer a blue light up there, but a green one [referring to the light ring on the Amazon Echo]. I think it's spooky. And of course, they could do this with me as well. That means I was always afraid… imagine my parents are calling and can talk or listen to what I say. Yes…and also with my sister in City C, she also has an Alexa. They were all coupled and somehow it was too much" (Consultant, 25).

Habitual VA Use Inhibited by Concerns about Data Integrity

Using skills via an individual's own VA is supported by the confidence of a functioning and safe environment. Unsurprisingly, concerns about the overall data integrity impact the habit formation of VA utilization in the post-adoption phase. Typically, interviewees already established an intention of using their VA in some form but were held back in doing so. In some cases, concerns about the provided platform service even led to the discontinuation of such utilization. Hence, concerns about data integrity are seen as universal inhibitors of this habit formation stage, which have to be mitigated. When dealing with intention translation, it is important to tend to discrepancies between intention and behavior that potentially lead to an individual's lack of motivation (Lally and Gardner 2013). In this case, the given attribute correlates with this user's fear of being spied on as a result of the presence of a shared VA. Unsurprisingly, the respondent encounters difficulty in relating to the VA as a tool that makes life easier:

"I know that with Alexa she is listening to me all the time and she is listening about everything that I say, right? […] I feel like […] with Alexa like she's listening to whatever I say, which is kind of weird. It's like having another person in the room. I think it's different than having your phone, right?" (Graduate, 23).

The experience is similar for users that are already comfortable with utilizing their VA to some extent. In this stage, it is important to provide confidence for the user and promote the repetition of the device's usage. This is typically achieved by raising the level of optimism, which determines the number of repetitions needed for desired behavior to establish (Rothman 2000). However, this interviewee clearly emphasized the word "everything" below and one could sense the underlying discomfort and discouragement in her voice in the following citation. Here, coping plans are an effective instrument, as they tend to decrease their memory of unpleasant emotions (Sniehotta et al. 2005).

"*There is also this Alexa app and you can see everything you've ever asked her in this app and it really records everything" (Graduate, 24).*

Another interviewee mentioned that his friends ordered dog food via Alexa without his permission while he used the restroom. This exposure did all but support the development of automaticity when using specific order skills:

"When you're on the toilet and somebody orders dog food or something…ordering something such as dog food that is just a joke among friends and is not so bad. But it is theoretically [possible] … [so] you start thinking about it more consciously" (IT Communications, 24).

In general, external rewards such as recognition or praise from external parties are quite effective when paired with salient cue selection in order to promote their development of automaticity (Lally and Gardner 2013). However, this event made him reconsider how he interacts with the VA and how he can better protect himself. While he was talking about the dog food story, he was thinking aloud and discussed additional ways intruders could hijack Alexa. It becomes apparent that the experience was emotionally unsettling and had a lasting impact on the trust relationship:

"I live on the fourth floor now, but suppose you live on the ground floor, have the window open, […] and somebody is joking around and screams something through the window. Theoretically, it would be possible…" (IT Communications, 24).

For other users the most common cause for interruption of the habitual use due to concerns about data integrity were autonomous behaviors stemming from the device itself. Whereas VA owners might find these autonomous behaviors 'strange' and 'weird', it can have a much more terrifying effect on individuals that

are not familiar with VAs. One interviewee described a moment when some of his guests, which were not aware that he owned an Alexa, were startled when the device turned on without being called:

> *"It happens occasionally when you have a group of friends over for dinner and during one of the conversations a certain word drops and activates Alexa. Suddenly everybody looks at each other and then to Alexa as she starts to blink…" (Consultant, 26).*

Discussion and Implications

This study aims to identify the underlying factors in the behavioral use of VAs and further shed light on the broader role that habits play in continued VA use. The results stem from narrative interviews that leverage the synergistic properties of experimental and qualitative research that help explain this paper's research question. Our research implies that the four distinct key factors (insights in use) of usability benefit, controllability issues, integration capability trade-off and concerns about data integrity are drivers (inhibitors) of habitual VA use and provide insights into the underlying habit formation process of respective individuals.

Our results contribute to our understanding of IS habit formation by shedding more light on the process by which habits form in the context of VA usage (Limayem et al. 2007; Ng and Kim 2009; Rieder et al. 2019). First, after acknowledging the willingness to use a new class of systems, gimmicks have been perceived as a stimulus to trigger VA utilization, but their use has been abandoned by most interviewees shortly after. It was the prior existing habits such as listening to the news or playing music that have been the most persistent habits and continue to be. In this case, we note that habit formation is also depended on the personal ecosystem the VA is embedded in. For instance, if users equipped their home with a smart home ecosystem and embedded a VA in it, habits could differ very much. Therefore, we underscore the need to understand the ecosystem perspective when studying post-adoption and habit formation for ecosystem-dependent VAs. Second, we observed a tendency that users already know their routine by heart and therefore do not aspire to change or stock up established settings. This emphasizes that achieving a skill increase in individuals' behaviors is harder than an overall increase in activity, as for instance supported by developing habits.

Furthermore, we find that there are distinct VA-specific usage factors that drive or inhibit habit formation and thus directly contribute to the research on user experiences with VAs. While user experience with other forms of IS shows to be more dependent on the design of the interface itself, VA usage needs to be viewed from a broader perspective incorporating several contextual factors that go beyond direct interactions with the interfaces based on the intrusive nature of those assistants (Benlian et al. 2020). VAs are present in the lives of the users beyond direct touchpoints and, hence, influence user behaviors and perceptions continually through specific functional affordances (Knote et al. 2021) that shift agency from the user towards the IS artifact (Baird and Maruping 2021)Still, most research on VAs is focused on the human–computer interfaces, while our research suggests that most of what leads to interruptions with the agents can be attributed to external factors, thus challenging, in line with Schuetz and Venkatesh (2020), the notion that IS are ignorant to their environments. Rather, we note that these IS sense their environment and also adapt affordances on a dynamic basis accordingly.

The presented results have important implications for practice. For VA producers and third-party service providers who are attempting to boost utilization by consumers in the post-adoption phase, it is imperative to understand the key role of habit as a predictor of continued VA use. The focus of the following recommendations for action is on deficits, which became apparent through the interviews, and potentials, which until now hardly find attention from developers and users. The analysis of the narrative interviews lists out the most important factors in an individual's user experience. These factors are usability benefit, controllability issues, integration capability trade-off and concern about data integrity. While the effects of the core categories of concern about data integrity and controllability issues need to be dampened for successful habit formation, the factors usability benefit and integration capability trade-off often promote ascension from the first to the third habit formation stage.

To this end, habit formation should not only be considered with functional affordances provided by the IT artifact, but also ecological affordances that are shaped on a dynamic basis through the co-creation

processes in the platform ecosystem (Knote et al. 2021). The starting point of the customer journey is the perception of individuals when entering a particular ecosystem (Lindberg and Lyytinen 2013). Building on this, providers should consider implementing design elements across multiple touchpoints that build trust with the VA ecosystems, having in mind the multitude of possible service functionalities such as information provision or order processes. The focus on security measures should reduce perceived vulnerabilities experienced by many users especially regarding the access of the VA through third parties in spatial proximity. Moreover, it's imperative to provide a seamless multi-device experience. Compatibility between the devices is important in order to optimally embed a respective VA in the user's daily life.

Personalization of VAs helps users to access services that are tailored to their needs. At the same time, privacy concerns of users should be taken seriously (Frick et al. 2021). For instance, users should be able to control access to the microphone of their VA at any time, as many study participants mentioned the prospect of being constantly listened to as a major source of distrust. Therefore, providers should think about measures that allow users to transparently protect their data. In this regard, new adopters should be treated with more care than users that already use VAs on a daily basis, for instance, by adopting the dialogue flow to the individual user journey.

In the first place, the configurations of tasks should never facilitate functionalities predestined to remain gimmicks. A prerequisite for a good user experience with VAs is that the installation and use of the skills or actions is as simple and intuitive as possible. Here, the individual level of technical know-how should be taken into account. Mastering a new task with the VA provides sensations for the user, which in effect fosters habit formation. For instance, less tech-savvy users may be supported in getting to know a new task by being provided with a short explanatory video.

In summary, the results of this study have shown that VA providers should not only pay attention to functional aspects but also reequip their support tools when interacting with critical customers in the future. VA utilization is multidimensional and can be improved by addressing various identified key factors. It's important to account for technological factors that are particularly relevant to a certain user group, depending on the task and use context. In this regard, to improve the user experience according to adapting user needs across the user journey, it's important to constantly obtain user feedback and to analyze user interactions (e.g., based on voice analytics; Hildebrand et al. 2020).

Limitations and Further Research

This research is subject to some limitations, which give rise for future research. First, the chosen study context limits the generalizability of the concluded implications, as identified responses to continued VA use are mostly based on experiences gathered from a European-based sample and contain an age bias in the interviewee selection. For instance, some of the factors, especially with regard to data integrity concerns, may be viewed differently in other cultural contexts but also aspects like affinity for novel IS artifacts such as VAs. Also, one must acknowledge that the data collection was conducted during the first wave of the Corona wave in Europe that provides an important boundary condition to the present paper, e.g., how individuals interact with technology when being confronted with lockdowns could influence our results. Hence, future research may conduct similar studies in other contexts to compare and add to the results of this paper. Second, our research relies on the narrated accounts of users and hence only captures consciously perceived triggers and cues. By this means, we also acknowledge a rather aggregated view on habit formation for VAs that is still formed by several behaviors that relate, for instance, to single-action users perform with the VA. Still, habits may also be influenced by environmental cues that are more subtle. In a similar vein, the participants' accounts may show a bias towards extreme and salient events that are more present to users and supplant more subtle cues that gradually influence habit formation. Future research may adopt a mixed method approach, triangulating these findings with a more survey-based approach as well as experimental studies that examine the relationship between possible design interventions and respective habit formation processes. Finally, giving our study's focus on AI-based voice assistants, the generalizability of our findings across technologies is limited, so future research could investigate the extent to which our findings can be extended to other novel technologies, such as augmented reality, which shares some characteristics with AI-based voice assistants.

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