Acceptance of Digital Voice Assistants for Grocery Shopping

Carsten Schultz
University of Hagen
Philipp Brüggemann
University of Hagen

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Abstract:

Following the technology acceptance model, the present study analyzes the acceptance of digital voice assistants. We specifically address the use of these assistants for habitual purchases in the case of grocery shopping. Beyond extending insights into digital shopping behavior, this study contributes to the literature by including privacy concerns and technology anxiety in this context. We are particularly interested in how privacy concerns affect consumers' decision process. The empirical findings suggest that privacy concerns directly influence consumers' behavioral intention. Further, this effect is predominantly triggered by concerns regarding the (unknown) data collection process and the (unknown) data storage situation whereas the device and, surprisingly, the secondary use of data are two dimensions that have weaker effects in this situation. Additionally, the results demonstrate that technology anxiety also negatively anchors consumers' perceptions of digital voice assistants.

Keywords: Digital Voice Assistant, Grocery Shopping, Privacy.

Track: Retailing & Omni-Channel Management

1. Introduction

Digital voice assistants establish themselves as another mode of operation in the era of digitalization (Klaus & Zaichkowsky, 2020). Such assistants allow interactions via voice commands, therefore constantly scanning the (audible) environment for keyword activation. By using the keyword, users can articulate commands or pose questions. After processing, responses and confirmations are emitted through the associated loudspeaker (Hoy, 2018).

Klaus and Zaichkowsky (2020) identify three key reasons for the use of digital voice assistants: "[a] convenience and ease of use with voice, [b] feelings of control with voice, and [c] positive emotion with voice" (Klaus & Zaichkowsky, 2020, p. 393). Digital voice assistants are already successfully implemented in smartphones, smart home devices, connected cars, virtual reality headsets, and smart clothes (Novak & Hoffmann, 2019). Even though such assistants are accepted and used for straightforward tasks in everyday life (Jones, 2018; Moriuchi, 2019; Novak & Hoffmann, 2019). More complex situations, such as voice shopping, are still developing.

The present study contributes towards this question and specifically addresses the acceptance of digital voice assistants for grocery shopping. As grocery shopping is a laborious form of shopping (Aylott & Mitchell, 1998), digital voice assistants provide opportunities for such habitual purchases (Moriuchi, 2019). These assistants can increase the convenience and ease of use, especially in grocery shopping. In food retailing, this technology is further encouraged by delivery services and click-and-collect services. Consumers acceptance consequently drives the success of such innovative technologies. Based on the technology acceptance model (TAM) (Davis, 1989; Venkatesh & Bala, 2008), the empirical study explains prospects' and consumers' attitudes, behavioral intention, and actual use of digital voice assistants in food retailing. We extend this approach by including technology anxiety and privacy concerns. Privacy concerns include the four dimensions of data collection, internet of things-device, data storing, and secondary data use. Beyond explaining the behavioral intention to use digital voice assistants for grocery shopping, this study identifies the challenges of both privacy concerns and technology anxiety in this context.

2. Theoretical Background

2.1 Digital Voice Assistants

Following their emergence, some previous studies provide initial insights on the use of digital voice assistants (e.g., Hoy, 2018; Moriuchi, 2019). Based on consumers' online

reviews, Purington, Taft, Sannon, Bazarova, and Taylor (2017) find a mixed degree of device personification between users influenced by the sociability of interactions and size of household. The degree of personification predicts overall user satisfaction. The level of anthropomorphism of digital voice assistants is the subject of another stream of research (Moussawi, Koufaris, and Benbunan-Fich, 2020; Wagner & Schramm-Klein, 2019).

After considerable media backlash, privacy issues and technology trustworthiness have received some research attention in the case of digital voice assistants (e.g., Chung, Iorga, Voas, and Lee, 2017; Easwara Moorthy & Vu, 2015; Foehr & Germelmann, 2020; Schultz, 2020). Non-users and users of smart speakers are divided. Users swap privacy for convenience. (Lau, Zimmerman, and Schaub, 2018; Liao, Vitak, Kumar, Zimmer, and Kritikos, 2019). Further, current privacy controls are rarely used and not well aligned with users' needs (Lau et al., 2018), and users trust the service providers to abide by the regulations and assure data privacy and security (Liao et al., 2019). Interpersonal communication cues, such as gaze direction and voice volume level, are subsequently suggested and found practical to regulate voice recognition and, thus, control privacy (Mhaidli, Venkatesh, Zou, and Schaub, 2020). Interestingly, Campagna, Xu, Ramesh, Fischer, and Lam (2018) propose that voice assistants enable their users to steer their privacy needs with fine granularity of control.

In contrast, research on using digital voice assistants for shopping purposes is considerably scarce. Localization, that is understanding varieties in language, is particularly relevant when interacting with digital voice assistants for transaction purposes (Moriuchi, 2019). For product recommendations, consumers perceive websites to be more humanlike (and more successful) than voice assistants (Whang, 2018). The present study specifically adds to this line of research providing insights into the factors that influence the use of voice assistants in grocery shopping.

2.2 Research Model and Hypotheses

Figure 1 presents the research model and related hypotheses. We focus our discussion to the challenges associated with privacy concerns and technology anxiety. For the general structure following the TAM, we refer to Davis (1989) and Venkatesh and Bala (2008).

Beyond the media attention, some studies also indicate the importance of privacy concerns before adopting and using digital voice assistants (e.g., Easwara Moorthy & Vu, 2015; Foehr & Germelmann, 2020). The effect of privacy concerns on users' perception and behavior however is still up to date. Whereas Liao et al. (2019) find that data concerns have a

significant negative effect on the adoption of voice assistants in home situations, Schultz (2020) indicates that privacy concerns affect trustworthiness and users' attitudes towards digital voice assistants. Moreover, no previous study considers relevant dimensions of privacy concerns, such as data collection, device usage, data storage, and secondary data use. Consequently, we study whether these dimensions of privacy concerns negatively affect (a) the perceived ease of using digital voice assistants, (b) their attitude towards using digital voice assistants, and (c) their behavioral intent using digital voice assistants.

We also consider the possibility that perceived ease of use is determined not only by privacy concerns but also by technology anxiety. Technology anxiety refers to the degree of users apprehension and potentially fear when faced with the opportunity of using technology. Following the reasoning as a potential anchor effect (Venkatesh & Bala, 2008), this study analyzes whether the technology anxiety of consumers negatively affects the perceived ease of using digital voice assistants in grocery shopping.

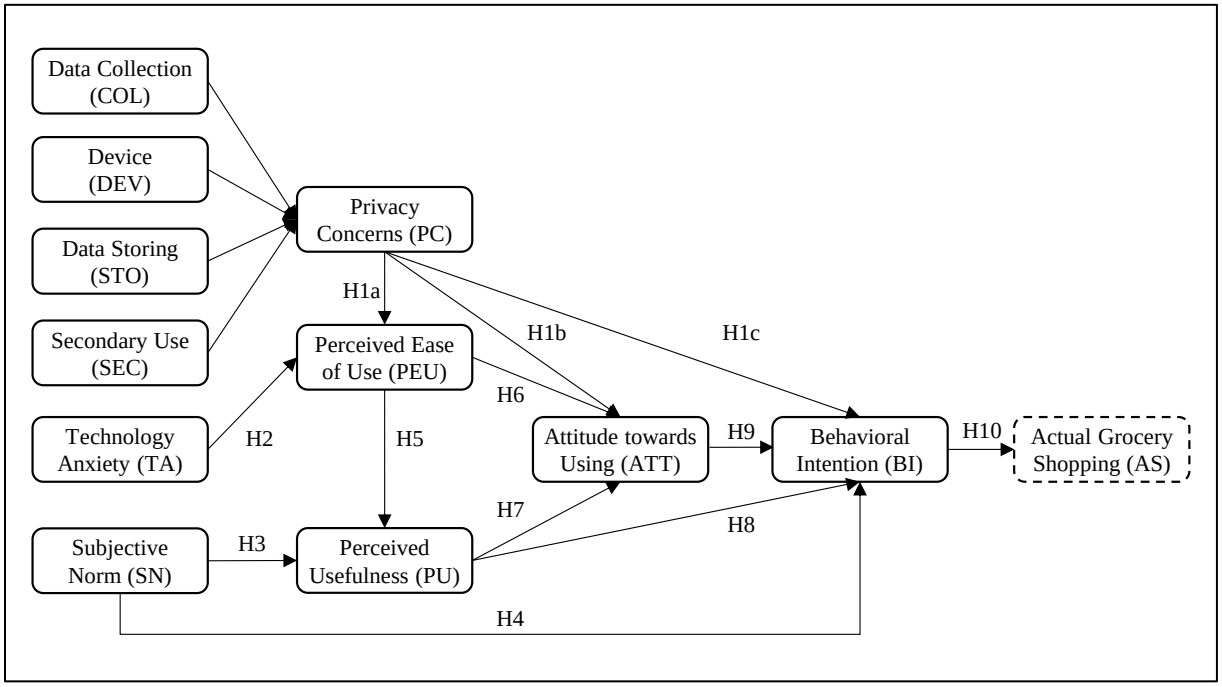

Figure 1: Research Model

3. Empirical Study

3.1 Data Measurement

All measurement scales are based on previous research modified to the context of digital voice assistants. All items were measured on a 7-point rating scale, ranging from 1 ("strongly disagree") to 7 ("strongly agree"). Based on the original TAM scales (Davis, 1989), Moriuchi

(2019) provides the foundation of the 3, 4, 8, and 5 items measurement scales for subjective norm (SN), perceived ease of use (PEU), perceived usefulness (PU), and attitude (ATT) respectively. The behavioral intention towards digital voice assistants (BI) is based on a 3 item measures adopted from Park, Cho, Han, and Kwon (2017). Whether subjects have used digital voice assistants for grocery shopping, is surveyed by a polar question. The second-order construct privacy concerns (PC) includes the four dimensions data collection (COL), internet of things-device (DEV), data storing (STO), and secondary data use (SEC) measured on a 4, 3, 4, and 3 item scale, respectively, adopted from Padyab and Ståhlbröst (2018). The study also controls for demographic data on age, gender, education, and experience with digital voice assistants.

3.2 Data Collection and Sample

Subjects were recruited via social media through personal networks. The online questionnaire ran for two weeks (November, 26th to December, 9th 2019). The questionnaire yielded 157 instances. However, 23 were incomplete and subsequently discarded resulting in a final sample of 134 questionnaires.

The sample is predominantly female (74.6 %) and on average 36 years old. 32.8 % possess a digital voice assistant. Educational level is divers with 0.7 % student, 41.0 % school graduations, 19.4 % completed apprenticeship, and 38.8 % higher education degree. Considering their experience, only 2 % have actually used digital voice assistants for grocery shopping. Consequently, variance in the data regarding actual grocery shopping falls below a relevant statistical variance.

3.3 Data Analysis

A variance-based structural equation analysis tests the presented research model (see Figure 1). The R package plspm (Sanchez, Trinchera, and Russolillo, 2015) for partial least square modeling is used for data analysis. Following Sanchez (2013), the two-step approach is employed for the second order construct of privacy concerns (PC) including data collection (COL), device (DEV), data storage (STO), and secondary data use (SEC). The measurement models are assessed by inspecting the individual item reliability, composite reliability, and discriminant validity.

All but one item loading (ANX1) exceed the 0.70 level for indicator reliability. ANX1 is consequently dropped from further analysis. The measurement items also lead to composite

reliability with Cronbach's Alpha and Dillon-Goldstein's Rho above the 0.70 level. Also, average variance extracted is at least 0.50 for all constructs establishing convergent validity. The quality measures suggests that the measurements models represent reliable and valid constructs, see Table 1.

Latent Variable	Item	Loading	Alpha	Rho	AVE
Subjective Norm (SN)	SN1	0.907	0.824	0.896	0.738
	SN2	0.764			
	SN3	0.899			
Technology Anxiety (ANX)	ANX1*	0.655	0.824	0.896	0.689
	ANX2	0.832			
	ANX3	0.897			
	ANX4	0.912			
Data Collection (COL)	COL1	0.935	0.953	0.966	0.877
	COL2	0.946			
	COL3	0.957			
	COL4	0.907			
Device (DEV)	DEV1	0.922	0.900	0.938	0.834
	DEV2	0.897			
	DEV3	0.920			
Data Storage (STO)	STO1	0.934	0.953	0.966	0.878
	STO2	0.913			
	STO3	0.958			
	STO4	0.941			
Secondary Use (SEC)	SEC1	0.973	0.961	0.975	0.928
	SEC2	0.978			
	SEC3	0.939			
Perceived Ease of Use (PEU)	PEU1	0.863	0.891	0.925	0.754
	PEU2	0.837			
	PEU3	0.921			
	PEU4	0.851			
Perceived Usefulness (PU)	PU1	0.796	0.907	0.927	0.644
	PU2	0.852			
	PU3	0.734			
	PU4	0.866			
	PU5	*0.591*			
	PU6	0.706			
	PU7	0.825			
	PU8	0.824			
Attitude towards Using (ATT)	ATT1	0.787	0.864	0.903	0.645
	ATT2	0.732			
	ATT3	0.840			
	ATT4	0.803			
	ATT5	0.848			
Behavioral Intention (BI)	BI1	0.948	0.919	0.949	0.861
	BI2	0.945			
	BI3	0.890			

Notes: * scale reversed; items in italics dropped, other values after item reduction.
Table 1: Overview of Measurement Results

The discriminant validity is evaluated using Fornell-Larcker criteria. All construct correlations are below the corresponding diagonal value (see Table 2).

	SN	ANX	COL	DEV	STO	SEC	PEU	PU	ATT	BI
SN	**0.859**									
ANX	-0.107	**0.830**								
COL	-0.047	0.487	**0.936**							
DEV	-0.064	0.550	0.759	**0.913**						
STO	-0.024	0.535	0.808	0.824	**0.973**					
SEC	-0.013	0.497	0.786	0.819	0.948	**0.963**				
PEU	0.156	-0.228	-0.009	-0.053	-0.061	-0.045	**0.868**			
PU	0.275	-0.130	-0.185	-0.175	-0.185	-0.150	0.299	**0.802**		
ATT	0.230	-0.226	-0.042	0.017	-0.033	0.006	0.482	0.657	**0.803**	
BI	0.335	-0.179	-0.297	-0.221	-0.155	-0.166	0.179	0.696	0.556	**0.928**

Notes: The bold number on the diagonal is the square root of the AVE. Off-diagonal numbers are correlations among latent constructs.

Table 2: Latent Correlation Matrix and Discriminant Validity

Independent	Dependent	Hypothesis	Path Estimate	p-value
Privacy Concern	Perceived Ease of Use	H1a (–)	0.124	0.226
Privacy Concern	Attitude	H1b (–)	0.102	0.096
Privacy Concern	Behavioral Intention	H1c (–)	–0.129	0.038
Anxiety	Perceived Ease of Use	H2 (–)	–0.297	0.004
Subjective Norm	Perceived Usefulness	H3 (+)	0.235	0.005
Subjective Norm	Behavioral Intention	H4 (+)	0.160	0.011
Perceived Ease of Use	Perceived Usefulness	H5 (+)	0.270	0.001
Perceived Ease of Use	Attitude	H6 (+)	0.310	< 0.001
Perceived Usefulness	Attitude	H7 (+)	0.590	< 0.001
Perceived Usefulness	Behavioral Intention	H8 (+)	0.497	< 0.001
Attitude	Behavioral Intention	H9 (+)	0.194	0.018

Table 3: Standardized Path Estimates and Hypotheses Summary

After establishing the reliability and validity of the measurement models, we evaluate the structural model. The empirical results confirm the negative effect of privacy concerns on behavioral attention (H1c: $\beta = –0.129$, $p = 0.038$) but not on perceived ease of use (H1a: $\beta = 0.124$, $p = 0.226$) and attitude (H1b: $\beta = 0.102$, $p = 0.096$). Perceived ease of use is however negatively influenced by technology anxiety (H2: $\beta = –0.297$, $p = 0.004$). Subjective norm positively affects both perceived usefulness (H3: $\beta = 0.235$, $p = 0.005$) and behavioral intention (H4: $\beta = 0.160$, $p = 0.011$). Perceived ease of use has a positive impact on perceived usefulness (H5: $\beta = 0.270$, $p = 0.001$) and attitude towards using digital voice assistants (H6: $\beta = 0.310$, $p < 0.001$). Attitude also increases when perceived usefulness increases (H7: $\beta = 0.590$, $p < 0.001$). Subsequently, perceived usefulness (H8: $\beta = 0.497$, $p < 0.001$) and attitude (H9: $\beta = 0.194$, $p = 0.018$) positively determine consumers behavioral intention.

Finally, the positive effect of behavioral intention on the actual use is not empirically tested as only 2 % have actually used digital voice assistants for grocery shopping. In summary, the empirical results do not support H1a and H1b but confirm all other hypotheses.

4. Discussion

In contrast to previous findings (Schultz, 2020), the empirical results suggest that privacy concerns regarding digital voice assistants directly affect consumers' behavioral intention. This result is similar to findings in the context of smart home applications (Liao et al., 2019). We also controlled the effect without including technology anxiety, yielding the same result. We conclude that both privacy concerns and technology anxiety are indeed distinct and pronounced in digital voice assistants. These concerns primarily relate to individual data collection (0.347, $p < 0.001$) and data storage (0.309, $p < 0.001$), whereas the device (0.268, $p < 0.001$) and secondary data use (0.134, $p = 0.009$) have weaker effects. Especially the result regarding the secondary data use is surprising as this primarily constitutes consumers' fears. Consequently, privacy concerns are prevalent in the context of digital voice assistants. These assistants thus need to transparently establish trustworthiness and reduce privacy concerns (Campagna et al., 2018; Mhaidli et al., 2020) in order to increase the adaptation of this technology for grocery shopping.

Similarly, technology anxiety is particularly present and challenges the perceived ease of use of digital voice assistants. Consumers feel a certain degree of apprehension regarding these assistants. Part of this anxiety may be based on the uncertainty regarding the inner workings of this technology potentially leading to fear of the unknown. Service providers thus have to create transparency and counterbalance technology anxiety before digital voice assistants are considered for more complex tasks, such as online shopping.

The general acceptance and adaptation of digital voice assistants follow established routes. Consumers' subjective norm and their knowledge positively affect consumers' perception of the technology leading to corresponding positive attitudes and behavioral intention to use digital voice assistants for grocery shopping. Beyond creating a transparent and trustworthy understanding of the technology, service providers should communicate the benefits and use cases of these assistants.

We plan to extend the present research towards the underlying transactional processes in the retail industry. Further research can also go beyond the current approach that focused on

predominantly habitual shopping behavior and studies how digital voice assistants affect more extensive shopping processes.

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