Scan&Go: Understanding Adoption and Design of Smartphone-Based Self-Checkout

Dennis Lawo[1,2][a], Thomas Neifer[1,2][b], Margarita Esau[1,2][c], Philip Engelbutzeder[1] and Gunnar Stevens[1,2]

[1]*Information Systems, University of Siegen, Siegen, Germany*
{*surname.lastname*}*@uni-siegen.de*

[2]*Institut für Verbraucherinformatik, University of Applied Sciences Bonn-Rhein-Sieg, Sankt Augustin, Germany*
{*surname.lastname*}*@h-brs.de*

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Abstract: Since stationary self-checkout is widely introduced and well understood, previous research barely examined newer generations of smartphone-based Scan&Go. Especially from a design perspective, we know little about the factors contributing to the adoption of Scan&Go solutions and how design enables consumers to take full advantage of this development rather than being burdened with using complex and unenjoyable systems. To understand the influencing factors and the design from a consumer perspective, we conducted a mixed-methods study where we triangulated data of an online survey with 103 participants and a qualitative study with 20 participants. Based on the results, our study presents a refined and nuanced understanding of technology as well as infrastructure-related factors that influence adoption. Moreover, we present several implications for designing and implementing of Scan&Go in retail environments.

1 INTRODUCTION

To streamline processes and reduce operational costs, the first self-checkout technologies (SCT) were introduced by retailers in the 90s (Johnson et al., 2019; Lee et al., 2010). Those systems promised to reduce floor space by replacing large checkout desks (Collier and Kimes, 2013) and bring advantages to the customers, e.g. the skipping of waiting lines and thus an increased satisfaction and convenience (Anitsal and Flint, 2006; Demirci Orel and Kara, 2014). However, those stationary systems "enjoyed little success" (Johnson et al., 2019). With the emergence of new mobile solutions that make use of the bring-your-own-device (BYOD) principle, self-checkout (SC) and mobile payment are becoming increasingly popular (Andriulo et al., 2015; Siah et al., 2018).

Current research on SC mainly focuses on service quality (Demirci Orel and Kara, 2014; Siah et al., 2018), social impact (Beck and Hopkins, 2017), changing customer practices (Bulmer et al., 2018), and the technical design (Bobbit et al., 2011; Günther and Spiekermann, 2005). Where studies on adoption exist, they usually do not distinguish between mobile systems provided by retailers, and BYOD solutions that require costumers to install a SC app on their smartphone. Inman and Nikolova (2017), who call BYOD solutions 'Scan&Go', are one of the few studies, that make such a differentiation.

Resulting from this, our knowledge about the factors influencing the adoption of Scan&Go, the impact on the shopping experience as well as the app design to make it easier and more valuable for customers is rather unspecific. Therefore, our work addresses two related research questions:

1. Which factors influence the adoption of Scan&Go SC and related to this,
2. how can we improve the design of such solutions?

We utilized a mixed-methods approach by triangulating the results of an online survey with 103 participants on the intention to use Scan&Go and qualitative research, where we observed 8 customers using a Scan&Go app in a do-it-yourself (DIY) store and 12 customers in a grocery store. The study was completed with semi-structured interviews afterwards.

[a] https://orcid.org/0000-0003-2848-4409
[b] https://orcid.org/0000-0002-7146-9450
[c] https://orcid.org/0000-0001-5179-7361

Our findings propose a broader understanding of Scan&Go, by differentiating between drivers influencing the shopping experience, inhibitors arising from the exploitation of the personal device for SC and technology- and infrastructure-related hygiene factors (according to Herzberg's Two Factor Theory 2017) which were formerly considered important drivers. Thereby, our research contributes to to the understanding of self-service technologies (SST), in particular Scan&Go, by providing app and infrastructure design-relevant knowledge.

2 RELATED WORK

2.1 Self-Checkout

Retailers facing the challenge of competing with new online shopping alternatives (Garaus and Wagner, 2016), increasingly substitute or enlarge channels of service provision with technology (Colby and Parasuraman, 2003; Lee and Yang, 2013). Those SSTs are nowadays ubiquitous in the form of ATMs, online banking, or app-based airline check-ins (Wang et al., 2013). Retailers introduce a variety of those SSTs, ranging from kiosks to provide information, to SC (Inman and Nikolova, 2017). This promises to streamline processes and reduce operational costs (Johnson et al., 2019; Lee et al., 2010). The first SC, that "enables shoppers to scan, bag, and pay for their purchases without the need for a cashier", was proposed by Price Chopper Supermarkets in 1992 (Inman and Nikolova, 2017). These stations reduce floor space by replacing conventional checkouts (Collier and Kimes, 2013) and bring benefits to customers, e.g., increased satisfaction and convenience by skipping waiting queues (Anitsal and Flint, 2006; Demirci Orel and Kara, 2014). A study of the NCR (2014) showed that 90% of their 2,800 respondents use SC in retails stores. Newer generations of SC use mobile devices provided by the retailer. Those are picked up by the customer after a process of identification needed for seamless payment. During the shopping, the customers are able to self-scan the products and pay their baskets before leaving. However, the high investment and maintenance costs for the provided devices limit this approach (Andriulo et al., 2015).

Recently, retailers started to introduce Scan&Go (Aloysius et al., 2016; Inman and Nikolova, 2017). Here, customers use an app provided by the retailer to scan and pay the products with their own smartphones. In addition to retailers, also startups such as Roqqio (ROQQIO Commerce Solutions GmbH, 2021) and Snabble (snabble GmbH, 2021) develop such apps as white label and single-checkout channel solutions. In principle, Scan&Go bears the potential to improve convenience and service quality of SC, although Walmart reported customers having difficulties using it (Inman and Nikolova, 2017). As our qualitative study uses the Snabble App as a design probe, we briefly introduce its features: The app allows scanning products with the smartphone's camera. Afterwards, users can see the price of the product and adjust its quantity. The confirmation of the scan closes the dialog, and the product is added to the basket. The app is then ready for the next product. To finish shopping, users need to switch to the basket. Depending on the store, it offers either to use mobile payment or, as in our case, payment via stationary checkout desks that need to scan a QR-Code on the phone's screen.

2.2 Self-Checkout Adoption

Prior studies on SC adoption are rather general, focusing on adoption alone without differentiating between device types and services models. Nonetheless, previous research brought insights about adopting factors that may be useful in understanding the newer generation of Scan&Go solutions. Most research on SC adoption uses the Technology Acceptance Model (TAM) (Davis, 1989) or adaptations of it (Cebeci et al., 2020). TAM's main dependent variable is intention to use, a construct to measure the intended adoption. According to Fishbein and Ajzen (1977), it presents "the strength of one's intention to perform a specific behavior". Kaushik and Rahman (2015) adapt the TAM and add subjective norm and trust to build an alternative model to measure the intention to use. Although TAM has been used in the context of SSTs, there is no widely accepted adaptation of it (Kelly et al., 2016).

Our research adapts the pre-prototype version of TAM as this model enables to even interview inexperienced consumers (Davis and Venkatesh, 2004). Therefore, the basic suggestion is that perceived usefulness positively influences intention to use. Ease of use is not measured in the quantitative study as this cannot be interviewed without actual usage (Davis and Venkatesh, 2004). In line with prior research (Dabholkar, 1996; Meuter et al., 2005), we further differentiate between the three most-mentioned categories: technology-related, personality-related, and demographic factors.

2.2.1 Technology-related Factors

The usefulness of an ICT artifact is influenced by external factors (Davis and Venkatesh, 2004). Some

studies (Dabholkar et al., 2003; Elliott et al., 2013; Marzocchi and Zammit, 2006; Weijters et al., 2007) suggest related items that have proven to influence usefulness of SC in the retail context. Dabholkar et al. (2003) found reliability, enjoyment and control (over the outcome of the process) to be factors positively influencing the usage of SCT. Besides, also speed (or time-saving) was investigated as an adoption factor. However, due to the year of publication, Dabholkar et al. (2003) were not able to differentiate between different schemes of SC. Nonetheless, SC was perceived to be the fastest option (Dabholkar et al., 2003). Similarly, Marzocchi and Zammit (2006) considered control to be one of the factors, influencing satisfaction and repurchase. Elliott et al. (2013) mention reliability to have a positive influence on the attitude towards SC. Moreover, they found that enjoyment positively influences the attitude. Fernandes and Pedroso (2017) work supports those factors, finding that reliability is most important for the adoption of SC.

On this basis, we hypothesize:

H1: Usefulness positively influences the intention to use.

H2: (a) reliability, (b) enjoyment, (c) control and (d) time-Saving are external factors to positively influence usefulness.

2.2.2 Personality-related Factors

Dabholkar et al. (2003) suggest the need for personal interaction with the Salesperson to be an essential factor influencing adoption. This factor has been widely adopted in other studies (Meuter et al., 2003, 2000). Meuter et al. (2000) describe that their participants wanted to avoid service personnel because "they could provide the service more effectively than firm employees". In line with this, Collier and Kimes (2013) notes that users with a low need for interaction are more likely to use SSTs .

Other studies showed that technology anxiety is negatively related to the intention to use (Elliott et al., 2013). Aloysius et al. (2016) found out that technology anxiety negatively influences the intention to use, independent of the device category, either mobile or stationary. Self-efficacy has proven to be a determinant of technology acceptance (Dabholkar, 1996). Aloysius et al. (2016) found similar concerning mobile scanning and payment technologies.

Privacy concerns were identified by Meuter et al. (2005) as factors that hinder the SST adoption in the context of medical treatment. Inman and Nikolova (2017) found that SC, in general, has the lowest privacy concerns related to other retail technologies. However, Scan&Go is associated with slightly higher privacy concerns (Inman and Nikolova, 2017). In contrast, Smith (2005) found privacy not to be linked to SC usage.

Based on prior research and especially the controversial discussion around Privacy, we hypothesize:

H3: Self-efficacy has a significant positive influence on the intention to use.

H4: (a) technology anxiety, (b) need for personal interaction, and (c) privacy concerns have a negative influence on the intention to use.

2.2.3 Demographic Factors

Regarding demographics, Dabholkar (1996) and Blut et al. (2016) spotted age to have only little influence on the intention to use SSTs. However, some researchers claim that especially older people need more personal interaction than younger people, causing a lower intention to use SCTs (Dean, 2008; Lee et al., 2010). McWilliams et al. (2016) also show that young males are more likely to use SC in grocery stores. While some studies, such as McWilliams et al. (2016), argue that education and income influence adoption of SC, a majority of studies claim that it is not linked to SC usage (Dabholkar et al., 2003; Larson, 2019; Leng and Wee, 2017). Lee et al. (2010) found income to have a negative relationship with technology anxiety, however, newer studies reject this influence (Larson, 2019). The gender difference, as addressed by McWilliams et al. (2016) and Grewal et al. (2003), claim that males are more likely to adopt SC, is similarly proven to not affect SC adoption (Dabholkar et al., 2003; Larson, 2019; Leng and Wee, 2017). However, Lee et al. (2010) note that women have a higher technology anxiety, which is negatively influencing intention to use. Weijters et al. (2007) found out that gender affects the rating of technology features, such as usefulness.

Based on the prior work, we do not include education and income into our model. But given the mixed and somehow controversial discussions about the influence of gender and age, we hypothesize:

H5: Younger people are more willing to use Scan&Go. So there is a negative relationship between age and the intention to use.

H6: Gender is a factor that has an impact on the intention to use.

3 MIXED-METHODS APPROACH

To gain multiple perspectives on Scan&Go, we engaged in two, complementary methods: First, we analyzed the influencing factors based on an online sur-

vey with 103 participants. Second, we observed and interviewed the shopping experience of 20 participants in two stores.

3.1 Online Survey

To collect the quantitative data, we created an online survey on Google Forms and distributed it among social media as well as the university's email distribution list. Participation was voluntary with no financial compensation provided.

Table 1: Overview of the Quantitative Sample

Demographic Variables	Category	Percentage
Age	< 25	39.81%
	25-34	36.89%
	35-44	6.8%
	45-54	7.77%
	55-64	2.91%
	≥ 65	5.82%
Gender	Male	43.81%
	Female	56.19%

By this convenience sampling approach (Etikan, 2016), we collected 103 answers, with a sample age ranging from 18 to 84 (Ø: 31). Our sample includes slightly more female (56.19%) than males (43.81%).

To validate our hypothesis, we adapted items from studies on SC, in line with Collier and Kimes (2013) to ensure that inexperienced consumer can answer the statements (the statements were framed by the phrase "doing the checkout with my smartphone"): Usefulness (*...would be useful for me.* (Davis and Venkatesh, 2004)), self-efficacy (*I would feel confident...* (Meuter et al., 2003)), technology anxiety (*...would make me feel apprehensive.* (Meuter et al., 2003)), need for personal interaction (*I would prefer personal contact, rather than...* (Collier and Kimes, 2013)), privacy concerns (*...could infringe my privacy* (Meuter et al., 2005)), reliability (*...would be reliable.* (Dabholkar et al., 2003)), enjoyment (*I would enjoy...* (Dabholkar et al., 2003)), control (*...I would be in charge.*) (Dabholkar et al., 2003), time-saving (*...I could save time.* (Dabholkar et al., 2003)), age, and gender. All items, despite the demographics ones, were rated using a 5-point Likert-scale ranging from "I totally disagree" to "I totally agree". The first two questions address demographic details, followed by questions about Scan&Go. We ensured anonymity to reduce evaluation apprehension (Podsakoff et al., 2003). The questionnaire was shortly introduced by a written explanation of the Scan&Go concept, without providing any specific scenarios (e.g. a DIY Store).

The data analysis was performed with R. We first conducted a multiple linear regression analysis to evaluate the influence on intention to use (see Table 3 (1)). In a second analysis, we examined the influence of external factors on usefulness (see Table 3 (2)). The results are shortly presented in section 4.1 focusing on our hypothesized research model. However, we triangulate the results in section 4.2 together with the results from the field study.

3.2 Field Study

We recruited a qualitative sample of 20 shoppers through an opportunistic sampling method. We asked 8 customers entering a DIY store and 12 customers in a grocery store in Germany to participate in the study. We explained that we are going to observe their shopping trip, including the usage of the Scan&Go app and conduct a semi-structured interview afterwards. Moreover, we encouraged them to think-a-loud during the usage of the app. Participants were compensated with a voucher for an online shop. However, participation was voluntary and not previously triggered by the promise of compensation.

We provided a smartphone with the Snabble-app installed, as most of the participants did not know the app before. Equipped with the smartphone, participants were asked to do their shopping as usual but use the app for the checkout of their goods. During this, researchers observed them and took notes on any issues arising during the usage. Semi-structured interviews were conducted after completion of the shopping trip. The interview guideline included the topics of stationary SC usage, experienced and perceived downsides and benefits of Scan&Go, app design in general and desired changes, as well as the discussion of observed usage problems.

The interviews took approx. five to ten minutes and were transcribed and coded with MaxQDA. The interviews and observational data were analyzed using the principles of thematic analysis (Braun and Clarke, 2006), working with the identified factors influencing intention to use as an initial template of codes (King et al., 2004). During our inductive analysis, we focused primarily on factors influencing intention to use. Those already used in the quantitative analysis as well as emerging ones. After each iteration, we discussed the codes and developed themes together after the final coding. In section 4.2 we present the results of the field study and triangulate them with the results of the online survey.

Table 2: Field-Study Participants (G=Grocery Store, D=DIY Store)

ID	Age	Gender	Profession
D1	52	male	Engineer
D2	51	female	Housewife
D3	69	female	Pensioner
D4	50	female	Pharma. Expert
D5	55	female	Hotel Consultant
D6	15	female	Student
D7	20	female	Student
D8	39	male	Banker
G1	57	female	Pensioner
G2	31	male	Consultant
G3	26	male	Dietitian
G4	57	female	Manager
G5	32	female	Employee
G6	25	female	Student
G7	51	male	Pensioner
G8	28	female	Clerk
G9	41	female	Shop Assistant
G10	29	female	Admin. Assistant
G11	30	male	IT Manager
G12	29	male	Police Officer

4 RESULTS

4.1 Online Survey

Table 3 shows the results of the multiple linear regression of the various models we investigated. Model (1) describes the influence on intention to use and model (2) the influence of the technological factors on usefulness.

Regarding H1, we can reject the null-hypothesis and observe a significant influence of usefulness on intention to use. Similarly, for H2 we can observe that (a) reliability, (b) enjoyment, (c) control and (d) time-saving all have significant positive influence on usefulness.

In contrast, personality-related factors seem to have only little influence on intention to use. Here we can observe that only technology anxiety H4 (a) has a significant negative influence on intention to use. The other hypothesis (H3 and H4 (b),(c) and (d)) need to be rejected as they are not significant.

Similarly, the demographic variables have no significant influence on intention to use. Therefore, H5 and H6 are not supported. However, the results for H5 must be interpreted cautiously as our sample was comparatively young.

4.2 Field Study

4.2.1 Usefulness

As already indicated by the data analysis, usefulness is a rather generic construct presenting a latent variable that is influenced by several factors. This finding is supported by our qualitative results. For example, G3 stated: "In general, I think that's practical." Similarly, G4, G6, and D6 agreed. More detailed insights emerge from themes related to time-saving, control, and enjoyment. Regarding time-saving, 19 participants initially stated that SC is faster than the usual checkout process.

Time-Saving. A closer look reveals two main themes : First, participants praise no need to wait in front of the cash register and, second, no need to (un-) pack products for the checkout.

> "You don't have to queue up, you can just pass it, and there is no person in front of you, who is looking for the change." [G8]

Additionally, 7 other participants stated that Scan&Go saves time, mainly by eliminating the need to wait in line at the checkout, as well as waiting until everything is scanned and the payment is processed. Overall, the time advantage seems to rise from greater independence from the store and its current load of customers.

> "When it is integrated into everyday life, and you can get through the checkout faster without having to pack and unpack the product again." [G4]

Further, D2, G3, and G5 described how the checkout-process benefits from not having to unpack everything from the basket or shopping cart. However, 5 participants also slightly doubted that the app always allows for faster checkout. D3, a retired woman, stated that she has no time pressure, thus the app does not need to make her shopping any faster. G3, G9, and G10 noted that some practice is needed to get fully accustomed to the handling of the app to receive the full benefits. Further, G4 suspects the time used for scanning while shopping might offset the faster checkout.

Control. Regarding control, we have to distinguish between different perspectives. Firstly, controllability is one of the dialogue principles defined by the ISO 9241-110 (DIN, 2006), saying that users should always be in control of their interaction with the system. In addition to this micro-level of control, our results reveal that also the broader level, the increased control over the shopping process should be taken into

Table 3: Results of the Linear Regression Analysis ($*p < 0.1; **p < 0.05; ***p < 0.01$)

Model 1		**Model 2**	
Independent variables	**Intention to Use (1)**	**Independent variables**	**Usefulness (2)**
Usefulness	0.606*** (0.092)	Enjoyment	0.481*** (0.073)
Technology Anxiety	-0.188** (0.076)	Reliability	0.162** (0.077)
Self Efficacy	0.041 (0.109)	Control	0.248*** (0.076)
Privacy Concerns	-0.070 (0.079)	Time-Saving	0.346*** (0.076)
Need for Personal Interaction	-0.002 (0.079)		
Age	0.001 (0.006)		
Gender	0.122 (0.184)		
Constant	2.176*** (0.784)		-1.052*** (0.360)
Observations	103		103
R2	0.619		0.652
Adjusted R2	0.591		0.638
Residual Std. Error	0.849 (df = 95)		0.799 (df = 98)
F Statistic	22.071*** (df = 7; 95)		45.996*** (df = 4; 98)

account. In particular, we uncover that Scan&Go does not only affect the checkout process but several control issues that shape the shopping experience.

> "While I'm shopping, I can see what value my shopping cart has." [G3]

Thus, 7 participants regarded the overview and control over the prices of single products as well as the overview of the total cost of the shopping cart as a benefit.

> "I had the feeling since I had already scanned this, I had the feeling now I have to buy it" [D7]

However, D7 made aware of a potential unwanted nudging effect, the higher tendency to buy once scanned goods. This effect would reduce the control to change decisions at any time rather than encouraging it. The overview of already bought products is described as a further advantage of improving the shopping control experience. G1, G6, G7, and D6 explained how they like to get feedback about the products in the shopping cart and its prices as this helps them to control the expenditure. Simultaneously, G7 and G10 promoted the idea of including a shopping list that is automatically checked.

> "That you can see what the product contains, a nutritional value or offer prices. Whether a product is vegan would also be quite good because it's not always written on it." [G8]

Another aspect of control is detailed product information. Here the information on the packaging can be deceptive at first sight. Hence, G2 and G8 explicitly stated that receiving feedback whether the scanned product is vegan or not would be beneficial. Another 5 participants note that general information about ingredients, nutritional values, and the supply-chain would be interesting. 6 of 20 participants also want to see offers of similar products, always getting the best price.

> "Another cool feature would be if you could search for a keyword, and it shows you where the product is located in the store. Like with Google Maps. Keyword: 'wall color' and then it guides you." [D6]

Furthermore, control also covers efficient in-store navigation. Especially in large DIY and grocery stores, the search for desired products can be quite complex. Hence, indoor navigation was frequently mentioned (7 participants) as an added value that a Scan&Go solution should provide.

Enjoyment. Regarding enjoyment, opinions range from not enjoying handling their smartphone during the whole shopping process (e.g. expressed by G1 and G7), to enjoying direct feedback on scanning and perceived self-efficacy of usage, as stated by D3.

> "I enjoy the usage. When it beeps and vibrates, I'm happy." [D3]

Other participants described the usage as "interesting" (D5 and G7), "relaxed" (G12), "fun" (D4 and D7) or "cool" (D6). In general, it is rather perceived as something positive, exciting, and new. However, all participants used the app for the first time. Therefore we cannot conclude how these qualities will evolve in the long-term appropriation.

Reliability. In our study, we observed that problems in using the app were frequently due to breakdowns in infrastructure. An important cause was, for instance, inconsistent or missing labeling with barcodes. For instance, D1 stated, that the occurrence of such problems would prevent him from using such an option again.

> "I don't think there's anything to improve on the app, but I think it's more about products that aren't properly labeled or something like this" [D3]

This infrastructure perspective was especially emphasized by D3 stressing that the important problems are not within the app. Similarly, 5 other participants pinpointed not to use the system when it is not reliable for all products. Hence, reliable preparation of the infrastructure is considered necessary but does not present an added value improving the user experience. Therefore, reliability has characteristics of a hygiene factor.

4.2.2 Ease of Use

Despite some minor issues, the majority of participants perceived the handling of the application as rather easy and quick to learn. Minor issues arose from unlabeled products or uncertainties about the checkout process, as already mentioned earlier.

> "I think that such an app must always have a simple design anyways." [G1]

Our participants reported frequent smartphone usage and that it became a second nature, where usually no problems occur. This competency was certainly one of the reasons why all participants had the confidence to use the app and found it easy to use. In this sense, the ease of use seems to be a hygiene factor that does not influence the intention to use positively but negatively when usability is lousy.

4.2.3 Personality-related Factors

Lack of Personnel Help. None of our participants indicated to fear a loss of personal interaction with the salespersons through the introduction of Scan&Go. Instead, participant D7 mentioned, Scan&Go might be useful to avoid personal interaction when she is not in the mood for it.

> "Sometimes, you don't feel like wanting to interact with people so much. If you have a day like this where you just want to go alone through the store and get out quickly, that's good." [D7]

This statement shows that there is a time for interaction as well as independent shopping. In particular, D7 also mentioned that the app should provide the means to call for the help of the store's personnel. This desire shows that H7 does not want to replace personal assistance digitally, but sees potential in the integration of both.

> "I would have approached a salesperson; they are probably informed about what I am doing here. And then I would have asked her if she could help me." [G1]

The quote of G1 refers to a situation where she did not know how to checkout her basket within the app. Besides, it shows how she expects to have a salesperson around to help with such issues. Additionally, 7 participants explained to need help in situations of uncertainty. These do not always result from an unfamiliarity with the application, but also from infrastructure breakdowns. For example, G3 was not sure how to proceed with the unpacked red radish and needed the advice of a salesperson or D2 had issues with a scratched barcode that was not easy to scan. Further situations that still need personal interaction are product specific questions or the need of age verification due to legal demand, as it was the case for G2.

Process Anxiety. Some participants, e.g. D2 and D3, stated the fear to make a mistake and get sued for not having scanned the products properly. Notably, they were less afraid of paying too much than they were of accidentally taking an item they had not paid for.

> "I'm afraid to do something wrong, and afterward someone is suing me that I didn't pay for something. So, for me, it's just risky because I don't feel safe." [D3]

This anxiety shows an unwanted side-effect when the checkout process is shifted to the customer. While a mistake made by the cashier can be evaluated in favor of the customer, the same type of mistake in the SC is latent under suspicion that the customer tries to cheat and might commit shoplifting. A fault-tolerant app design must, therefore, be accompanied by a corresponding fault-tolerant process design to relieve SC shoppers of such fears.

Privacy and Security Concerns. Overall, 3 participants mentioned privacy and data security concerns. While D1 fears that somebody could use his smartphone to go shopping and thereby debit his account, G5 and D5 did not trust such app from a broader perspective.

> "Because in the end, we don't have one hundred percent security with any online payment system, and I never know where my data will end up. Does everything work correctly? I never have the control compared to payment with my debit card or cash." [D5]

D5 explained that unauthorized people might use his shopping data as well as his stored payment data. Especially, the usage of the smartphone in combination

with online-payment leads to more trackability of his behavior than the cash or debit card payment.

Installation Concerns. The qualitative interviews reveal an issue not mentioned in the self-service literature so far, which we call Installation Concerns. In contrast to other SC solutions, Scan&Go requires the user to install an app on his smartphone. This prerequisite allows the customer to use a familiar device, but gives the retailer access to the private IT resources, too. In addition to privacy concerns, we have discovered other reservations about this approach. The additional effort arose from the installation of the app, additional memory used and the smartphone already filled with a myriad of apps. The example of H5 shows that these costs are set in relation to the added value created by the app.

> "That I already have so many apps on my smartphone and think: 'not another app'. Then the question arises, how often do I actually shop here? [...] In the grocery store where I go shopping every week and buy several articles, I could imagine myself using the app, rather than here, where I come once a month." [D5]

Similarly, D3 explained that she would not download an app for the seldom visits of the DIY store and the procurement of a few articles only.

4.2.4 Demographics

In line with the quantitative results, demographics did not arise as a theme in the qualitative analysis. Meaning this, we did not find evidence for age, gender or educational differences within the interview data. Nonetheless, a certain inclusiveness of the design became important for the older participants who were not always able to use the application as intended, because of small font sizes.

> "So if you ask me personally, make the font larger. Because if I don't have reading glasses on, it would of course be much easier if it were even bigger. Then I can at least recognize it. Especially with the start screen, [...] then there were three symbols at the bottom, and if they were significantly larger, that would be significantly easier." [D5]

5 DISCUSSION

Coming back to our two research questions that guided our study, we aim to discuss and triangulate the influencing factors on the adoption of these mobile SC solutions and secondly derive design implications from the empirical data (Dourish, 2006; Glaser and Strauss, 2017) to foster adoption.

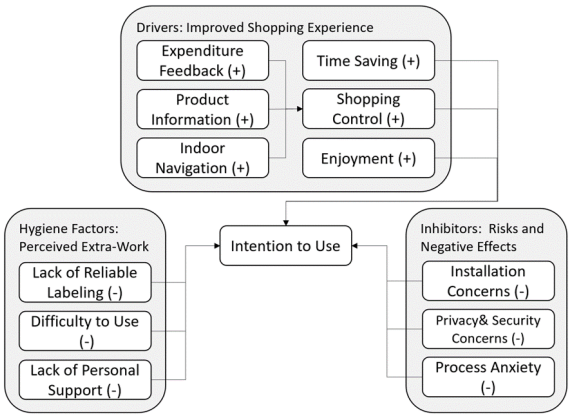

Figure 1: Summary of Findings

We have argued the importance of understanding the influencing factors of Scan&Go to provide full benefits to the customers, rather than burdening them with the workload of salespersons. However, as our results show, the factors proposed by prior research do not fully match with the new checkout scheme, where participants *bring their own devices* instead using those provided by the retailer. Based on the triangulation of our quantitative and qualitative results, we summarize our results as visualized in Figure 1.

This perspective on our findings draws on Kleemann et al.'s (2008) view that self-services present a kind of outsourcing of tasks to (unpaid) costumers: Such an outsourcing, however, will only be accepted if it comes along with an added value and, at the same time, the additional expense is kept low and does not harm the customer. This view gives an orientation, to understand drivers, hygiene factors, and inhibitors making use of Scan&Go SC solution: The drivers mainly improve the shopping experience, while hygiene factors refer to making the checkout work comfortable and reliable, and finally the inhibitors that are caused when the checkout work is outsourced to the consumers and their personal IT.

5.1 Drivers: Improved Shopping Experience

TAM (Davis, 1989) and related work (Aloysius et al., 2016) shows that *usefulness* is one of the essential adoption factors. This finding was confirmed by our survey. However, *usefulness* presents a quite general factor that results from several experiences, so it is more informative to focus on the domain-specific factors. Regarding this, our results are in line with prior

work (Dabholkar et al., 2003; Elliott et al., 2013) that found *time-saving* and in particular *enjoyment* to be essential factors of (mobile) SC. Table 3 shows that *time-saving* and *enjoyment* contribute to the perceived usefulness of Scan&Go and, thus, support the intention to use.

Regarding *enjoyment*, our qualitative study reveals that most participants described their experience as rather positive and interesting. D3, for instance, pinpointed the enjoyment of getting feedback when scanning correctly. These reactions, however, might be caused by the novelty of the app, so long-term studies are needed to confirm this finding. Although Scan&Go at first sight should have pragmatic qualities, the impact of the hedonic qualities such as *enjoyment* should not be underestimated. Gamification strategies such as collecting points on every scan or providing fun facts about the scanned products might help to establish long-term enjoyment.

Besides these factors, our survey shows that *control* contributes to the perceived usefulness. Moreover, our qualitative study reveals a broader perspective on control, which was defined in preliminary work as control over the device only (Dabholkar et al., 2003; Marzocchi and Zammit, 2006). However, our research shows that one added value of Scan&Go is the improvement of control over the entire purchasing process. First, such control arises from the direct feedback on the price of a single product as well as the total expenditure. We summarize this benefit with the factor *expenditure feedback*. Second, information about products in the shopping cart improves the control, e.g. by displaying nutritional information or warnings when scanning non-vegan products. We summarize this added value by the factor *product information*. Our findings also suggest that *indoor navigation* as an additional feature has a positive effect by improving customers' navigation control. Therefore, Scan&Go designers might use such added values on top of the scanning to increase customer experience.

Our study suggests that these driving factors contribute to the perceived *usefulness*, and, hence, increase the *intention to use* Scan&Go systems.

5.2 Hygiene Factors: Perceived Extra-Work

A factor that has yet not been considered in previous research is the perceived *lack of reliable labeling*, meaning that all products can be scanned with the application, such that the shopping routine is not disrupted or a change to another mode of checkout is needed. Due to the expectations to find a prepared store, as well as claimed non-usage if they cannot reliably use the application, we see *lack of reliable labeling* as a critical hygiene factor that needs to be fulfilled or otherwise negatively influences *intention to use*. Accordingly, it is not just the technology, but also the stores infrastructure that needs to be prepared and designed for Scan&Go.

While *ease of use* cannot be observed in the quantitative data (Davis and Venkatesh, 2004), the qualitative data shows statements how our participants expect such application to be easy to use by anybody. Therefore, it can be seen as a hygiene factor that does not positively contribute, but negatively influence adoption when not fulfilled. This means *difficulty of use* has a negative impact on *intention to use*. Since a vast majority of our participants owns a smartphone that is well-integrated in their daily life, the influence of *smartphone self-efficacy* is rather marginal. From this self-evident handling of smartphones, the expectation of installing "yet another user-friendly app" arises. Nonetheless, this issue should not be neglected, as some participants, especially elders, might need a more extended learning period. In particular, the design should minimize the additional expense of doing the checkout work. As a hygiene factor, however, good usability does not motivate people to do SC, but lousy usability keeps them away.

Previous literature points out the *need for personal interaction* to change towards a *lack of personal support*. Our quantitative results show that there is no significant influence of the *need for personal interaction* on the *intention to use*. Furthermore, the participants interviewed do not seek interaction with store personnel to have a pleasant conversation, but very pragmatically approach the salespersons when they need help. This still applies to situations where uncertainty arises from SC or product-related questions. From today's perspective, the participants assume the personnel to be merely available. Here, we propose that participants who expect to need frequent help with shopping or generally enjoy the service of asking a salesperson, if they perceive that personnel availability will shrink due to the system's introduction. Therefore, stores should not reduce personnel and introduce Scan&Go at the same time. Instead, they should ensure employees to be trained with the app to provide support, although this might be counterintuitive from a financial perspective.

5.3 Inhibitors: Risks and Negative Effects

Along with the additional effort Scan&Go creates, our study also uncovers perceived risks and negative effects. In particular, our mixed-methods approach sup-

ports a more precise understanding of what these risks mean for consumers (qualitatively) and to what extent they affect usage intentions (quantitatively).

A good example thereof is *technology anxiety*. Our quantitative model indicates that this factor has a significant (p ¡ 0.05) adverse effect on the *intention to use*. Our qualitative results help us to understand the Anxiety from the broader context of the shopping process. Our participants showed no general fear regarding the smartphone app, but a fear of doing something wrong, e.g. not finishing the payment process correctly or failing to scan a product and then getting sued by the store. Given this observation, we propose an influence of *process anxiety* that relates to the entire checkout and payment process, not just the technology. This view broadens the perspective on SC by taking the process and legal context of shopping into account. Hence, stores should create an atmosphere of trust and ensure not to raise the anxiety of customers through harsh controls of their baskets or other more aggressive safety mechanisms.

Another example are the concerns to install a Scan&Go App. This theme did not arise in the grocery store, where participants shop more often, but in the DIY store. Two of the eight participants mentioned that they would not install the app for their rare visits. Such concerns have yet not been considered in the literature, due to the missing focus on the Scan&Go approach. However, generalizing our qualitative insights, we assume that *installation concerns*, arising from rare visits in the store and non-applicability of the app in other stores, negatively influences *intention to use*. Besides, the more complicated the installation and the more resources (in terms of memory, computing power, and battery consumption) the app uses, the more significant these concerns are. Thus, instead of developing own solutions, stores should provide consumers the option to use multi-store Scan&Go solutions.

Privacy & security concerns are not confirmed by the quantitative study, which is in contrast to findings of prior research (Inman and Nikolova, 2017) The interviews, however, raise the awareness that *privacy concerns* of Scan&Go differs from the concerns of other SCT, where privacy issues are mostly related to shopping surveillance, for instance "if retailers use technologies that invade shoppers' privacy, such as video cameras hidden in mannequins" (Inman and Nikolova, 2017). This seems to uncover an instance of the privacy-paradox (Kokolakis, 2017), which usually comes with personalization privacy trade-offs. In our study, *privacy and security concerns* we observe the fear of personalized shopping data and online-shopping account misuse, but still consumers to not get any personalized shopping experience, but rather generic benefits. This is quite different from loyalty cards, which provide a unique identifier for the consumer but also often comes with personalized coupons. On the one hand, one could argue that most consumers are not aware about the data that is collected, as they do not experience any surprisingly and frightening accurate personalized service. On the other, the results hint towards a paradox that comes with generic service quality, where personalization is not even required. Assuming such unawareness about the data collection, it seems to be necessary that future design should allow for a transparent overview about the collected data including the GDPR guaranteed rights (Alizadeh et al., 2019) or even provide such data to the consumers such that personalized (third-party) services could be enabled (Stevens et al., 2017). Otherwise, the retailer is the only one who makes use from the data, that is collected by the consumer in a self-service manner.

6 CONCLUSION

Based on a mixed-methods approach, our study proposes a broader understanding of Scan&Go, by distinguishing between drivers influencing the shopping experience, inhibitors arising from the exploitation of the personal device for SC, and technology- and infrastructure-related hygiene factors (according to Herzberg's Two Factor Theory (2017)), which were previously considered important drivers. Thereby, our research contributes to to the understanding of SSTs in particular Scan&Go by providing app and infrastructure design-relevant knowledge.

However, our work is limited by the small and young sample that has been recruited by a convenience sampling approach. This sampling approach as well as the reliance on just one item per variable limits the reliability and generalizability of our study. Still, the triangulation helps to validate the results and opens a space for broader discussion. Nonetheless, it is unclear to what extent our findings based on German customers are transferable to other countries due to cultural differences in shopping. Based on these limitations, future research should operationalize the findings in a new research model to further understand the adoption of Scan&Go. Furthermore, design studies are needed to prove if the proposed added value services improve the shopping experience in the predicted way.

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