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EXPLOITING BIG DATA FOR CUSTOMER AND RETAILER BENEFITS: A STUDY OF EMERGING MOBILE CHECKOUT SCENARIOS

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ABSTRACT

Mobile checkout in the retail store has the promise to be a rich source of big data. It is also a means to increase the rate at which big data flows into an organization as well as the potential to integrate product recommendations and promotions in real time. However, despite efforts by retailers to implement this retail innovation, adoption by customers has been slow. Based on interviews and focus groups with leading retailers, technology providers and service providers, we identified several emerging in-store mobile scenarios; and based on customer focus groups, we identified potential drivers and inhibitors of use. A first departure from the traditional customer checkout process flow is that a mobile checkout involves two processes: scanning and payment, and that checkout scenarios with respect to each of these processes varied across two dimensions: (a) location—whether they were fixed by location or mobile and (b) autonomy—whether they were assisted by store employees or unassisted. We found no evidence that individuals found mobile scanning to be either enjoyable or to have utilitarian benefit. We also did not find greater privacy concerns with mobile payments scenarios. We did, however, in our post-hoc analysis find that mobile unassisted scanning was preferred to mobile assisted scanning. We also found that mobile unassisted scanning with fixed unassisted checkout was a preferred service mode, while there was evidence that mobile assisted scanning with mobile assisted payment was the least preferred checkout mode. Finally, we found that individual differences including computer self-efficacy, personal innovativeness, and technology anxiety were strong predictors of adoption of mobile scanning and payment scenarios.

Keywords: Customer Analytics; Mobile Checkout Processes; Emerging Technologies; Intended Use; Perceived Experience; Perceived Benefit; Privacy Concerns;

INTRODUCTION

With the proliferation of mobile devices and ubiquitous technologies, the retail industry can and seeks to collect data in greater volumes, from a greater variety of sources, and with increased velocity (Brown et al., 2011; Kiron and Shockley, 2011; McAfee and Brynjolfsson, 2012). The term Analytics 3.0 has been coined (Davenport et al. 2013) to describe embedding the results of analytics in customer offerings (Barton and Court, 2012; Bughin et al., 2010; Chen et al., 2012; Forbes, 2012; Fosso Wamba et al., 2012). This requires increased velocity in the sense that these offerings can be made, for example, in real-time during a shopping trip. Data volume, variety, and velocity characterize big data, and the retail industry has provided remarkable anecdotal evidence for the value that can be created for both the customer and retailer (e.g., Davenport, 2006; Davenport et al., 2011; Davenport et al., 2013; The Wall Street Journal, 2014; LaValle et al., 2011). The academic literature has provided evidence that retailers can exploit real-time information about customer preferences in order to offer customized product recommendations and pricing (Aloysius et al., 2013a). Part of the lure has been the promise of mobile technologies broadly defined to enable electronically mediated interaction between customers and the retailer while shopping in brick-and-mortar stores. However, despite considerable ongoing efforts to introduce mobile-based innovations, many retailers have not been able to realize the expected benefits that were anticipated due to the low adoption rates (e.g., The Wall Street Journal, 2014; McKinsey Global Institute, 2011; SAS Institute, 2012). One reason for these failures has been a lack of understanding of how mobile technologies interact with and disrupt service processes in the retail store, and therefore an understanding of the behavioral drivers and inhibitors of customer adoption is vital (Sheu et al., 2003). We define a situation in which mobile technologies and devices are used to enable checkout processes within the physical store as mobile checkout.[1] The current research investigates factors that may influence customer adoption of mobile checkout in the retail store.

Our literature review suggested that much research has focused on the adoption and use of technologies in retail environments and how new technologies can be leveraged to streamline existing customer-facing

[1] We thus exclude mobile shopping outside of the physical store from our definition of mobile checkout and consequently exclude it from our study.

service processes (Globerson and Maggard, 1991; Heineke and Davis, 2007; McLaughlin et al., 1991; Roth and Menor, 2003; Schmenner, 1986; 2004). Many studies in this area have leveraged well-established technology adoption models (e.g., Brito et al., 2007; Hu et al., 2009; Venkatesh et al., 2003) to investigate customers' intentions to use technologies and technologically mediated service processes, such as Apple Pay (Wakabayashi, 2014), in retail settings (see Ngai and Gunasekaran, 2007; Hoehle et al., 2012; Thong et al., 2002).

Despite the large amount of published research in this space, we found several key gaps in the literature focusing on omni-channel environments in retail settings. We found that most of the emerging literature on business analytics has focused on how firms can exploit big data to improve service operations and achieve a competitive advantage by leveraging existing datasets (see Shmueli and Koppius, 2011). Yet, little research has been undertaken to address our first research question: How can firms design technologically mediated service processes to collect large volumes of customer data? We found that many studies purely focused on technology adoption (e.g., e-commerce platforms) instead of developing a nuanced understanding of our second research question: How can ubiquitious technologies, (e.g., mobile devices) alter existing service processes to benefit retailers and customers at the same time (Voss, 2013)? This is particularly true if considering emerging service scenarios including cutting-edge technologies, such as Apple's new mobile payment services (The Wall Street Journal, 2014; RIS Research, 2012a). Our literature review suggests that most work has focused on customers' reactions to a single technology or service process, such as selling products via e-commerce shopping platforms, instead of aiming to understand our third research question: How can technologies be seamlessly woven into retail service processes (see Bonomi-Santos and Spring, 2013; Davenport et al., 2011; Schmenner, 2004)? To, it is critical to carefully analyze the steps involved to provide high quality services throughout the sales process to customers and evaluate in which scenarios customers would welcome the latest technologies, such as Apple Pay. To address these questions, we pursue the following objectives:

1) *Design-and-identify* technologically mediated service processes that help retailers to effectively capture customer data and serve customers more effectively in stores using mobile point-of-sale (POS) technologies.
2) *Evaluate* emerging service processes and understand customers' reactions to emerging and ubiquitous technologies in retail settings.

BACKGROUND

In this section, we describe the background for our research setting, with a brief history of the evolution of service processes in the retail store and a high-level description of the essential components of those processes. People's shopping behaviors are governed by processes that we have come to accept but the history of the way we shop is comparatively short. It was as recent as 1917 (Saunders, 1917) that the concept of self-service grocery shopping in which a customer picks available products and puts them in a shopping basket or shopping cart (as opposed to asking a store employee to pick the chosen products from behind a counter). With the advent of bar codes in 1974 (Fox, 2011), the process of recording these transactions was semi-automated with the POS scanning process. In the context of our work, the POS scanning process involves a mobile (e.g., hand-held scanner) or fixed (e.g., POS terminal) input device used to capture product data contained in a barcode. In order to capture the product data, the scanning device requires the user to have optical line-of-sight to the barcode on the product and, therefore, the scanning device has to be aligned with the code for the data capture to occur (see Venkatesh et al., forthcoming). The product data contained in a barcode consists of the product sku which enables the retailer to record the customer's intent to purchase the product—the transaction will be completed with the subsequent payment for the product. When a customer uses a smartphone or dedicated store device to scan, this will also potentially enable the display of descriptive product information. Therefore, it is possible that a customer may scan a product to obtain this product information but subsequently decide not to to purchase, so that they are also able to remove the product from the purchase record. Once the retailer has a record of the items in a basket that the customer would like to purchase, the transaction is completed with a payment process by transferring tender in return for the items in the basket. These two components—scanning and payment—are the integral components of the POS process, i.e., the time and place where a retail transaction is completed. POS data from cash registers were the fuel for inventory management systems, sales forecasting systems, and customer insight systems.

In the last few years, we have seen the emergence of smartphones that are used by customers as well as other mobile technologies/devices that can be used by customers and retailers (Hoehle and Venkatesh, 2015; Venkatesh et al., forthcoming). We will define a situation in which mobile technologies and devices are used to enable checkout processes within the physical store, as mobile checkout.[2] The velocity, volume, and variety of the data that can be captured by mobile devices is potentially far greater than can be captured at the POS. For example, while POS may provide data on actual purchases, the volume of data from mobile devices could also indicate to retailers a variety of information, such as the products the customer was considering for purchase, if they either scanned or looked up the products on a website.[3] This information is also available before they have made their purchase decision, while they are still shopping. The velocity of these data allows the retailer to potentially influence purchases by recommendations, coupons, promotional messages, and other marketing devices. However, the availability of the data and the ability to influence shoppers depends on their willingness to use mobile shopping processes.

Emerging Mobile checkout solutions

In this section, we describe the methodologies we used to identify service processes, and present the findings that we use to inform our research design. Our literature review suggested that little, if any, work has rigorously investigated how firms could leverage mobile POS technologies to collect customer data on a large scale and provide a superior service to customers at the same time. Therefore, in order to inform our study design, we followed a use case approach (Behrens, 2004) in order to accurately capture the POS process requirements in a retail context. A use case approach can be helpful in situations in which application or

[2] We thus exclude mobile shopping outside of the physical store from our definition of mobile checkout and from our study.
[3] Note that tracking customer browsing behavior requires the customer to be using store wireless.

business process designers need to identify system requirements and specify preliminary designs in organizations (Behrens, 2004; Jacobson et al., 2011). Use case approaches can also be helpful in determining if system users, i.e., customers, intend to use a given system or business process (Behrens, 2004; Jacobson et al., 2011). In order to identify POS processes that are feasible to implement for retailers and acceptable to customers, we conducted an exploratory study to investigate practitioners' and consumers' perceptions toward emerging technologies that firms could leverage in the context of mobile POS (Rosemann and Vessey, 2008).

Exploratory study involving retail experts. To identify feasible mobile POS processes for retailers, we organized two focus group discussions involving retail experts who were involved with the strategic planning, maintenance or development of mobile POS technologies within their organization. To solicit participation, managers from several retail organizations were contacted through email or phone. The participants were selected through a convenience sampling strategy (Hufnagel and Conca, 1994). The first focus group probed for mobile POS scenarios that emerged from practitioner reports (e.g., RFID Journal, 2012; RIS Research, 2012a) or which might emerge in the near future (RIS Research, 2012b). The second focus group investigated the impact of the emerging mobile POS technologies on retail service operations and also elicited opinions on possible preventative measures that could ameliorate risks associated with the technology implementation. Second, we conducted several in-person or phone interviews with 19 POS experts from 16 retail firms. These interviews varied in length, with an average time of 30 minutes. We also interviewed 8 experts from 3 consulting companies experienced with retail and/or payment solutions. Each interview took a little over an hour. We also discussed our emerging mobile POS technologies with 7 experts from 2 electronic article surveillance (EAS) device providers. EAS is a technological method for preventing shoplifting in retail stores. EAS solutions include radio-frequency based tags that are fixed to merchandise and removed or deactivated by clerks before customers exit the store. These discussions took approximately 3-4 hours each. Finally, we interviewed 16 hardware and software experts working for POS technology manufacturers. Each interview lasted between 30 and 90 minutes. We also attended three retail industry conferences, two of which also included technology exhibits by providers. We were also given in-depth explanations as we inspected onsite displays of equipment and technology at several of the providers as well as at the Metro future store in Duesseldorf, Germany.

Overall, our interviews revealed that it is critical to understand the point-of-sale process at the most elemental level so as to be able to understand what parts of existing checkout processes may need to be re-engineered to accommodate mobile checkout. When examining a customer who goes through a traditional employee assisted transaction in the store, although there can be many variations and added components end-to-end in the process, there are two major components: (1) scanning process and (2) payment process. First, the scanning process involves a data capture that identifies the items that the customer wants to purchase. This is usually accomplished electronically by means of an optical sca n (e.g., a barcode scan) of an identification label (e.g., a barcode) on the package of the product. There are, however, product types/retailers that are exceptions to this typical scenario. For example, some products, such as bulk grocery, need to be weighed, some products, such as loose bakery, do not have barcodes. Second, the payment process involves a transfer of tender from the customer to the retailer for the value of the products that were scanned. This is usually but not always[4] accomplished by means of cash or electronic funds transfer, such as debit/credit cards, store cards and third party payment systems. These two processes were recurrently mentioned during our interviews. For example, in the second focus group discussion, one of the participants mentioned: "I think we need to look at scanning and paying… but we need to know what is customers' perception of the technology, more specifically, does it feel more 'big brother' to them? I think they think we [retailer] can do more than we can. What is their level of understanding? We don't know if they are comfortable and how do we communicate effectively with them." In addition to these two major process components, the interviewees suggested that retailers consider various mobile shopping scenarios that would help them to collect customer data and simultaneously provide better service. The principal idea is to leverage customers' mobile devices and use their personal devices for the scanning or payment process when checking out of a store. For example, a customer may scan items using a mobile phone when browsing for products in the store. They may then use

[4] For example, part or all of the payment could be with store or manufacturer coupons.

their phone to make an electronic payment at an NFC terminal. Alternatively, they may walk up to a store employee who has a mobile device capable of processing an electronic payment.

Based on the interviews we conducted with the industry experts, we developed four scanning scenarios and four payment scenarios. Table 1 lists these service scenarios and includes descriptions of these scenarios that help explain how they are or may be operational in stores.

Table 1. Emerging Service Scenarios

		Scanning		Payment	
		Autonomy			
		Assisted	**Unassisted**	**Assisted**	**Unassisted**
Location	**Mobile**	A store employee uses a mobile device to scan items for customers on the sales floor.	A customer uses either a store mobile device or his/her own mobile phone to scan items as they shop on the sales floor.	A store employee uses a mobile device to process credit/debit card payments for customers on the sales floor.	A customer uses their mobile phone for virtual credit card or mobile wallet payments using WIFI/3G or NFC terminals.
	Fixed	A store employee scans products at a fixed point of sale.	A customer uses a fixed self-scan terminal.	A store employee accepts cash or credit/ debit cards at a fixed POS.	A customer uses a fixed self-service register to pay using cash or credit/debit cards.

It is also important to note that the interviewees' suggested that retailers disregarded some technology/service operation combinations. For example, customers' fixed payment and mobile location scanning would not make sense logically according to the participants. This would be due to the fact that the store employee needs to assist customers in the payment process anyway and they could, therefore, also handle the scanning process for customers. The next phase of our use case approach involved focus groups with retail customers. We conducted these focus group discussions to better understand potential customer reactions toward the identified emerging mobile POS scenarios.

Exploratory study involving customers. To explore customers' perceptions toward the emerging mobile POS scenarios, we conducted two focus group sessions. All participants were contacted via email or face-to-face conversations. One prerequisite for participation in the focus groups was that the participant had used mobile technologies, such as smartphones, and was familiar with mobile payment procedures (e.g., sqareup.com) that are used in retail environments. We felt this was useful because it would enable them to respond to our questions easily due to their familiarity with the associated technologies. Likewise, it was ensured that all participants were highly familiar with a range of retail stores and the associated purchase procedures. Based on the focus groups with customers, two major categories, i.e., technology drivers and inhibitors, emerged that could influence adoption of mobile checkout processes by customers based on the variability on the two dimensions of location (mobile versus fixed service location), and autonomy (assisted versus unassisted service).

First, most customers viewed perceived benefits and perceived enjoyment in the context of the mobile POS checkout process as drivers of use. For example, we received mixed input as to the perceived benefits from mobile location scanning using smartphones or store devices in retail settings. Some customers thought that scanning while shopping could be beneficial as it was integrated into the shopping (search, browsing process) and could save time at a checkout line, and also perhaps aid in the decision process because of the ability to look up details about new or unfamiliar products (e.g., a new brand). Some functionality, such as the ability to keep a running total so as to monitor the cost of the basket of goods, was also viewed as a potential benefit. In contrast, some customers could foresee additional mechanical processes necessary every time they picked up a product before putting it into the basket. Thus, they indicated that they would perceive mobile location scanning as being less beneficial and/or more time consuming due to the time and effort involved in aligning the mobile scanning device to scan the barcode due to the need for direct line of sight (Venkatesh et al., forthcoming). Further, several in the focus group were intrigued by the novelty of mobile scanning, over and above the utilitarian benefits, and expressed that they would probably enjoy the experience of using the technology. Among the reasons cited was the ability to explore features of new and unfamiliar products to discover facts about these products (such as the source, potential uses, customer opinion).

Second, many customers identified inhibiting factors that would negatively influence their intentions to use the mobile POS technologies in retail environments. For example, many respondents were wary of the potential for invasion of their privacy as a result of using mobile checkout processes. These privacy concerns were fueled by the respondents' desire to control or have some influence over their personal data. Although the retail industry seeks to collect data on their customers that can easily be collected, stored, processed and used by multiple parties with e-commerce (Belanger and Crossler, 2011; Smith et al., 2011), the focus group discussions suggested that this behavior results in increasing privacy concerns on the part of customers. Others referred to the additional tasks, such as for example self-scanning with a mobile phone, that would be part of the service and expressed concern about the additional effort involved.

Finally, many of the reasons given for why customers may or may not use mobile POS technologies directly referred to individual differences or traits. For example, some referred to their lack of confidence in the ability to master new technology and to use it in the context of a retail store. Others referred to their ability to figure out new technologies and to use them for novel applications that were not mentioned in the interview protocols, such as price comparisons and to look up product reviews. Table 2 summarizes the outcomes of the exploratory study involving customers.

Table 2. Emerging Concepts and Definitions Related to the Emerging Service Scenarios

Concept	Construct	Definition	Source
Drivers	Perceived enjoyment	"The extent to which the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system use."	Venkatesh (2000, p. 351)
	Perceived benefits	A customer's subjective perception about the potential positive values from the mobile shopping point-of-sale solution.	Adapted from Kim and Kankanhalli (2009)
Inhibitors	Privacy concerns	"The extent to which individuals have a desire to control or have some influence over data about themselves."	Belanger and Crossler (2011, p. 1017)
	Effort expectancy	"The degree of ease associated with the use of the system."	Venkatesh et al. (2003, p. 450)
Individual Differences	Technology anxiety	"Computer anxiety is defined as an individual's apprehension, or even fear, when she/he is faced with the possibility of using computers."	Venkatesh (2000, p. 349)
	Computer self-efficacy	"Computer self-efficacy is the judgment of one's ability to use a technology (e.g., computer) to accomplish a particular job or task."	Venkatesh et al. (2003, p, 427)
	Personal innovativeness	"Personal innovativeness is defined as the willingness of an individual to try out any new information technology."	Agarwal and Prasad (1998, p. 206)

METHOD

In order to evaluate the emerging shopping scenarios, we first conducted an exploratory study to better understand customers' reactions related to our emerging shopping technologies and to inform the survey instrument development. Second, we evaluate customer reactions to our 16 shopping scenarios.

Exploratory Investigation and Survey Development

Our exploratory investigation included store intercept surveys and focus group discussions. We anticipated that these exploratory studies would help us to gain a deep understanding of customers' perceptions of the emerging scenarios and help us in developing scales for measuring consumers' reactions in a large-scale survey (discussed later). The store intercept surveys were conducted at three retailers in the southern U.S. including a home improvement retailer, a general merchandise retailer, and a department store. Customers, who had completed their shopping, voluntarily completed a 10-minute survey that captured their views toward and opinions on the emerging shopping scenarios. The open-ended questions used in the survey are attached in Appendix 1. To facilitate the interview process, we used visuals of our emerging shopping scenarios (see Table 1) and briefly explained the relevant technologies (e.g., mobile devices) and processes (e.g., scanning procedures) to the participants. In total, we captured reactions from approximately 200 participants. In sum, the store intercept surveys suggested that customers were interested in the emerging shopping scenarios. We also received useful feedback regarding our survey questions (see Table 4) and our visuals and scenario descriptions. For example, the visuals we used to illustrate the mobile unassisted scanning shopping scenario (see Table 1) were critiqued by several participants due to the fact that the scanning process was illustrated insufficiently. Based on this, we modified the scenario descriptions and visualization. Following the store intercept surveys, we conducted two focus group sessions to better understand customers' perceptions toward mobile technologies in a retail context. The focus groups consisted of 32 customers and 21 customers respectively. Data collection was carried out through semi-structured focus group discussions including open-ended questions. Each focus group discussion lasted a little over an hour and was moderated by one of the researchers. The interview recordings were transcribed after the focus group discussions and we used coding procedures to analyze the data. Overall, the discussions indicated that the participants perceived our emerging shopping scenarios as a valuable concept for retailers and our discussions indicated customers' interests in using emerging technologies during the checkout process while shopping.

Online Survey

Participants and data collection. We drew the sample from the target population of a general consumer pool that was developed to represent the U.S. population. All data were collected using an electronic survey that was administered by a professional research firm. The research firm sent out email invitations to potential respondents—i.e., those in the sampling frame. Each individual was asked to complete an online survey and those who agreed to participate in our study received small monetary incentives provided by the research firm. Our sample matched the sampling frame provided by the market research firm. Due to this, we felt that non-response bias was not a concern. We also felt that comparing early versus late responses was not useful because all responses were collected during a single week and the market research firm did not send out reminders (see Hair et al., 1998). We collected a total of 1,090 responses. Table 3 includes information on the respondent demographics.

Table 3. Respondent Demographics – Scenario Survey

Demographic	Category	N = 1090
Gender	Men	501
	Women	589
Age groups	Under 20	44
	20-29	684
	30-39	215
	40-49	67
	50-59	54
	60 or older	26
Income (Annual, in USD)	0-10,000	122
	10,000-19,000	114
	20,000-29,000	128
	30,000-39,000	117
	40,000-49,000	116
	50,000-74,000	209
	75,000-99,000	123
	100,000-150,000	107
	Over 150,000	54
Job	ICT	118
	Banking and Finance	44

	Insurance, Real Estate and Legal	17
	Government and Military	28
	Construction and Engineering	30
	Retail and Wholesale	17
	Education	137
	Marketing and Advertising	36
	Student	303
	Other	360

To collect data, we developed a scenario-based study in which consumers were presented with 16 mobile shopping scenarios (see Appendix A1 as an illustration). All emerging service scenarios were designed to represent the various combinations listed in Table 1. All respondents were provided with contextual information on what mobile shopping scenarios could look like and, to infuse vividness, we included images that further illustrated the processes described in a given scenario.

Measurement. Most questions were adapted from prior studies and contextualized for the mobile shopping environment. The items used in our study are shown in Table 4.

Table 4. Items Used to Measure Each Construct

Construct	Item Used	Source
Privacy concerns	I would be comfortable giving personal information on mobile shopping.	Bart et al. (2005)
	I would be comfortable using mobile shopping.	
Perceived enjoyment	I would find mobile shopping enjoyable.	Venkatesh (2000)
	The actual process of using mobile shopping would be pleasant.	
	I would have fun using mobile shopping.	
	I would not enjoy using mobile shopping.*	
Perceived benefits	I think using mobile shopping is convenient in the store.	Kim and Kankanhalli (2009)
	I can save money by using mobile shopping in the store.	
	I can save time by using mobile shopping in the store.	
Intention toward using the medium	I would use mobile shopping to shop in the store.	Froehle (2006)
	I intend to use mobile shopping the next time I see it in the store.	
	I will not use mobile shopping the next time I see the system in the store.*	
Technology anxiety	I feel apprehensive about using technology.	Keh and Pang (2010)
	Technical terms sound like confusing jargon to me.	
	I have avoided technology because it is unfamiliar to me.	
	I hesitate to use most forms of technology for fear of making mistakes I cannot correct.	

Notes: All items were measured using a 7-point Likert-type scale (1=strongly disagree... 7=strongly agree).
* reversed coded items

We also circulated preliminary versions of the survey to industry experts to ensure the relevance to them and receive feedback on our questions. The industry experts had a few minor suggestions—e.g., pagination—and indicated that the instructions were clear and easy to follow. Next, we asked two information systems researchers to read the instructions and provide us with feedback on the items and the survey structure in general. Both researchers held Ph.D. degrees from U.S. universities and were unfamiliar with the study. The feedback suggested that both researchers found the instructions to be clear and straightforward.

Prior to analyzing the data, we screened all responses for completeness and accuracy. We excluded those respondents who did not correctly answer reverse-coded filler items and/or took less than five minutes to complete the survey. Five minutes were provided as a quality threshold by the market research firm and we felt that those respondents who spent less than five minutes paid inadequate attention to the questions.

ANALYSIS AND RESULTS

We first analyzed the reliability and validity of the measurement scales that we used for each of the constructs in the experiment. We did not observe any threats to internal consistency as Cronbach alphas were greater than .80 for all scales measured. We aggregated the data across all conditions and ran a factor analysis with direct oblimin rotation to allow for correlated factors and found that no threats to discriminant validity. All factor loadings were greater than .70 and cross-loadings were lower than .35. Thus, the evidence suggests that the scales were reliable and valid in our context. As explained earlier, we were interested in intention to use, as well as in drivers of and inhibitors of adoption, and individual differences. We identified constructs relevant to our study organized in these groups as follows:

(1) **Technology adoption:** intention to use
(2) **Drivers of adoption:** perceived enjoyment, perceived benefits,
(3) **Inhibitors of adoption:** privacy concerns, effort expectancy
(4) **Individual differences:** technology anxiety, self-efficacy, personal innovativeness

Table 5 shows the descriptive statistics for the various constructs for each of the manipulated features in the treatment conditions (fixed/mobile and assisted/unassisted). Interestingly, a comparison of the means for perceived benefits from mobile location scanning showed that there were no major differences compared to fixed location scanning. The perceived enjoyment of mobile location scanning was also not much higher compared to fixed location scanning. Further, privacy concerns were not much higher for mobile payment compared to fixed payment.

Concept	Construct		Scanning				Payment			
			Location		Autonomy		Location		Autonomy	
			Mobile	Fixed	Assisted	Unassisted	Fixed	Mobile	Assisted	Unassisted
Technology adoption	Intention to use	Mean	4.25	4.23	4.03	4.43	4.37	4.14	4.16	4.30
		N	320	122	202	240	200	242	158	284
		Std. Dev.	1.51	1.69	1.53	1.56	1.43	1.65	1.54	1.56
Drivers	Perceived enjoyment	Mean	4.40	4.35	4.19	4.56	4.44	4.35	4.31	4.43
		N	320	122	202	240	200	242	158	284
		Std. Dev.	1.33	1.63	1.39	1.42	1.34	1.48	1.40	1.43
	Perceived benefits	Mean	4.43	4.43	4.17	4.65	4.47	4.40	4.33	4.49
		N	320	122	202	240	200	242	158	284
		Std. Dev.	1.25	1.40	1.26	1.29	1.30	1.29	1.29	1.30
Inhibitor	Privacy concerns	Mean	3.70	3.85	3.97	3.55	3.73	3.75	3.75	3.74
		N	320	122	202	240	200	242	158	284
		Std. Dev.	1.35	1.49	1.43	1.33	1.31	1.46	1.36	1.41
	Effort expectancy	Mean	5.35	5.28	5.22	5.42	5.33	5.32	5.27	5.36
		N	320	122	202	240	200	242	158	284
		Std. Dev.	1.00	1.28	1.06	1.09	1.15	1.08	1.03	1.11

Table 5. Descriptive Statistics for Scanning and Payment Scenarios

The descriptive statistics for the various constructs for each scanning and each payment scenario are shown in Tables 6 and 7. Similarly, Table 8 shows the descriptive statistics for each scanning and payment combination – given that the scanning/payment treatments were within-subjects, each individual saw a combination of a specific scanning and a specific payment scenario. In order to analyze the data to study the impacts of technology design and content design, we used ANOVA without assuming equal variances (Games-Howell) and a Tukey HSD test to compare the means across groups. The results of these comparisons are shown in the last column of Table 8.

We found that for the scanning scenarios, mobile unassisted scanning had significantly higher intention to use, perceived enjoyment, perceived benefits, and significantly lower privacy concerns than mobile assisted scanning. All other pairwise comparisons were not significant. For payment scenarios, we found no significant differences for all pairwise comparisons.

Table 6. Comparing Scanning Scenarios

Concept	Construct	Mobile assisted	Fixed assisted	Mobile unassisted	Fixed unassisted
Technology adoption	Intention to use	3.99 (1.52)	4.18 (1.57)	4.52 (1.45)	4.26 (1.75)
Drivers	Perceived enjoyment	4.14 (1.38)	4.40 (1.46)	4.67 (1.23)	4.33 (1.72)
	Perceived benefits	4.12 (1.28)	4.37 (1.14)	4.74 (1.15)	4.47 (1.53)
Inhibitors	Privacy concerns	3.97 (1.45)	3.96 (1.38)	3.43 (1.19)	3.80 (1.55)
	Effort expectancy	5.21 (0.94)	5.25(1.30)	5.47 (0.93)	5.25 (1.19)

Table 7. Comparing Payment Scenarios

Concept	Construct	Mobile assisted	Fixed assisted	Mobile unassisted	Fixed unassisted
Technology adoption	Intention to use	4.13 (1.70)	4.18 (1.40)	4.15 (1.63)	4.51 (1.45)
Drivers	Perceived enjoyment	4.34 (1.45)	4.28 (1.37)	4.35 (1.49)	4.55 (1.32)
	Perceived benefits	4.35 (1.27)	4.31 (1.33)	4.43 (1.31)	4.57 (1.28)
Inhibitor	Privacy concerns	3.67 (1.50)	3.81 (1.23)	3.79 (1.45)	3.67 (1.36)
	Effort expectancy	5.38 (0.96)	5.20 (1.02)	5.30 (1.14)	5.36 (0.92)

As a post-hoc analysis, we further broke down the intention to use data into the 11 treatment conditions by considering the interaction between the scanning and payment scenarios. This is necessary for a few different reasons. First, if any specific combination is dominant as a preference among shoppers, we would not be able to detect this outcome from the prior analyses. Second, if effects were being obscured by highly non-preferred options, it may lead to misleading results. Finally, if there are consistent results across different scanning scenarios for any given payment scenario or vice versa, it would have implications for firm strategies. Note that though there are 16 (i.e., 4x4) possible scanning and payment combinations, we did not include all possible combinations as some scanning/payment sequences would not be logical (as noted earlier). For example, the combination fixed unassisted scanning/fixed assisted-payment would be a self-scan at a checkout lane followed by assisted payment at the same lane—which is not observed in practice. The combination fixed assisted scanning/mobile assisted Payment would be unnecessary as assisted scanning in a checkout lane would not be followed by mobile assisted payment. The results are shown in Table 8, also showing the ranking based on an ANOVA with a Tukey HSD for pairwise comparisons. Specifically, Table 8 shows the ranking such that those cells that were not significantly different are shown in a single column.

<table>
<tr><th colspan="9">Table 8. Comparing Scanning and Payment Combinations</th></tr>
<tr><td>Concept</td><td></td><td></td><td>FA-S
(1)</td><td>FU-S
(2)</td><td>MA-S
(3)</td><td>MU-S
(4)</td><td colspan="2">Comparison</td></tr>
<tr><td rowspan="4">Technology adoption</td><td rowspan="4">Intention to use</td><td>FA-P
(A)</td><td>--</td><td>--</td><td>3.92
(1.41)</td><td>4.45
(1.35)</td><td rowspan="4">**3C
3A
2D
3B
1D
3D
4D
4A
4C
2B**</td><td rowspan="4">**3A
2D
3B
1D
3D
4D
4A
4C
2B
4B**</td></tr>
<tr><td>FU-P
(B)</td><td>--</td><td>4.60
(1.61)</td><td>4.06
(1.39)</td><td>4.95
(1.19)</td></tr>
<tr><td>MA-P
(C)</td><td>--</td><td></td><td>3.69
(1.61)</td><td>4.50
(1.70)</td></tr>
<tr><td>MU-P
(D)</td><td>4.18
(1.57)</td><td>3.93
(1.84)</td><td>4.23
(1.68)</td><td>4.25
(1.43)</td></tr>
</table>

Notes: FA-S: fixed assisted scanning, FU-S: fixed unassisted scanning, MA-S: mobile assisted scanning, MU-S: mobile unassisted scanning, FA-P: fixed assisted payment, FU-P: fixed unassisted payment, MA-P: mobile assisted payment, MU-P: mobile unassisted payment.

We found that the most preferred scenario (combined scanning and payment) is for mobile unassisted scanning with fixed location unassisted payment. This scenario is similar to what several grocery stores (e.g., Walmart) have implemented or trialed. We also found that the least preferred scenario is for mobile assisted scanning with mobile assisted payment. This scenario has been implemented or pilot tested by several department stores (e.g., Nordstrom).

Finally, we conclude our analysis by examining the role of individual differences. We computed a median split of the observations for personal innovativeness, computer self-efficacy, and technology anxiety. In comparing individuals high in personal innovativeness (M=4.91, SD=1.38) with individuals low in personal innovativeness (M=3.48, SD=1.39), we found that greater personal innovativeness is associated with increased intention to use t(440)=10.805, *p*<.001. Similarly, we found that individuals high in computer self-efficacy (M=4.64) have higher intention to use than individuals low in computer self-efficacy (M=3.68, SD=1.44), t(401.344)=6.744, *p*<.001. We also found that individuals high in technology anxiety (M=3.97, SD=1.30) have lower intention to use than individuals low in technology anxiety (M=4.54, SD=1.74), t(399.807)=-3.87, *p*<.001.

DISCUSSION

Drawing on the operations and service management literature and the growing business interest in leveraging big data in retail stores, we studied how firms can exploit big data to improve in-store service operations and design technologically mediated POS processes. We initially conducted a series of interviews with industry experts. This helped us to develop 16 different emerging shopping scenarios that were relevant to the various industry experts we interviewed. The findings showed that the emerging shopping scenarios were highly valued by the interviewees. Based on this, we piloted and conducted a large-scale customer survey involving more than 1,000 U.S. customers. First, we found that customers viewed the perceived benefits of mobile location scanning differently from fixed location scanning. Second, the respondents' perceived the mobile location scanning process as more enjoyable compared to the fixed location scanning process. Third, customers' privacy concerns for mobile location payment processes were greater compared to fixed location processes.

Research Implications

Our work has key implications for research. First, to the best of our knowledge, our work is among the first that has investigated customers' reactions toward emerging in-store mobile shopping scenarios that are a promising source of big data as well as a means to exploit the velocity of big data. The emerging operations and service management literature in the context of big data has primarily focused on developing theoretical explanations for how firms can exploit big data and offer customers more attractive solutions based on their individual preferences (Aloysius et al., 2013a; Barton and Court, 2012; Bughin et al., 2010; Chen et al., 2012; Fosso Wamba et al., 2012). Our work complements this emerging literature because we provide a theoretically motivated discussion on how technologies can be leveraged to collect large volumes of customer data in retail contexts. Specifically, based on our relevance check with retail experts, we suggest that there are two necessary and sequential service components of a shopping checkout process, namely a scanning and a payment service component. Both components could be either fixed or mobile. Likewise, stores could either implement scanning or payments as assisted or unassisted. Our studies showed that customers perceived mobile scanning service components differently in terms of benefits, perceived enjoyment and privacy concerns.

Second, and related to the previous point, much research has focused on technology adoption, such as mobile payments (see Hoehle et al., 2012) to better understand how technology can be integrated into existing service operations. Much of this research has leveraged traditional technology acceptance models (see Brown et al., 2014 for a discussion) and studied customers' reactions toward a given technology in retail settings. These studies typically focused on a single technology or service process, such as a mobile payment or an e-commerce platform, instead of aiming to understand how technologies can be seamlessly woven into service processes (Hoehle et al., 2012). Our work attempts to overcome this shortcoming and we evaluate sequential service processes that underlie the broader concept of mobile POS. As such, our findings offer rich and specific insights, compared to more general views that treat all involved steps of mobile POS as a single service process. Due to this, our findings speak to several calls for context-specific theories (Alvesson and Kärreman, 2007; Bamberger, 2008) because there is “a general tendency to seek causal explanations at lower rather than higher levels of analysis, a tactic referred to unflatteringly as explanatory reductionism” (Johns, 2006, p. 403).

Third, we create a direction for future researchers with our finding that traits are strong significant predictors of individual’s willingness to use mobile checkout scenarios. Given the context of emergent and ubiquitous technologies, we believe that the effects of technology anxiety, computer self-efficacy, and personal innovativeness may be amplified in comparison to more familiar technologies that are less pervasively integrated into common service processes (Yang et al., 2012). A theory of context for the role of individual differences in technology adoption enriches the technology adoption literature while a theory in-context for ubiquitous technologies similarly advances knowledge (Whetten, 2009).

A strength of our research is that it exemplifies how operations and service management research could leverage relevance checks to identify meaningful technologically mediated service processes in organizations. To ensure that the outcomes of research projects are valuable to practitioners, Rosemann and Vessey (2008) proposed that applicability checks be conducted in early phases of research projects. These checks are evaluations by practitioners of the technologies and theories that the academic community either uses or produces in research. Applicability checks help researchers to ascertain if the research project is appreciated by and would be useful to the industry (Rosemann and Vessey, 2008). We employed applicability checks with industry experts in order to identify and develop emerging shopping scenarios design that help retailers to effectively capture customer data and service customers more effectively in stores using cutting edge POS technologies. The information obtained confirmed our assumption that retailers are considering how emergent technologies, such as mobile devices, can be used to provide better in-store service for shoppers. Moreover, all practitioners welcomed the inclusion of a relevance check in our research, and they indicated that they appreciated being part of novel academic research. These interviews thus provided us with a basis for ensuring that our emerging shopping scenarios possess relevance.

Practical Implications

As retailers implement or experiment with emerging and ubiquitous technologies as sources for the real time collection of big data, they also seek to integrate insights from big data into their customer offerings. Emerging and ubiquitous technologies will only be able to fulfill these functions as a means of collection and as a source of business intelligence if customers adopt and use them in the retail store. One key insight is that customer preference for mobile unassisted scanning was significantly higher than for mobile assisted scanning. Looking at the drivers and inhibitors of adoption, mobile unassisted scanning had higher perceived enjoyment, perceived benefits, and lower privacy concerns (effort expectancy was not significantly different).

There were no differences between mobile scanning scenarios and fixed scanning scenarios (for any configuration of assisted or unassisted). Further, there were no differences between any configurations of payment scenarios. Therefore, intended use of these mobile payment scenarios would not be driven or inhibited by particular objective characteristics (in this case location and autonomy) of payment processes. This finding is surprising and counterintuitive. Furthermore, the choice and implementation of a particular configuration of scanning and payment processes may be determined by factors (Aloysius et al., 2013b) such as:

(1) Fit with the retailer type: A department store that wants to provide a high-service experience for example may choose to provide assisted scanning to maximize the opportunity for store employees to interact with customers and to try to upsell, cross-sell, provide product recommendations and advice, and provide customers with a pleasant human interaction. Because there was no significant difference with the intention to use fixed scanning processes (or with the drivers and inhibitors), the retailer may implement mobile assisted scanning in order to take advantage of these ancillary advantages. Future research should more specifically test for preference for mobile unassisted versus mobile assisted scanning in the contexts of different retailer types.

(2) Product assortment: A retail store with products that have packaging that does not carry much

product information can choose to implement mobile self-scanning, as it allows customers to scan products as they browse in the store, and access product information by scanning the products—after which they can choose to remove the product from their shopping basket if they want.

(3) Labor costs: A retail store with high labor costs, for example, could implement unassisted scanning and payment processes.

(4) Capital budget: A retail store with limited access to funding for capital expenditure could implement a scanning solution in which customers use their mobile phones to scan rather than one in which store employees were equipped with dedicated equipment to assist with scanning.

The second key insight is that individual differences seem to be the important determining factor in a customers' intention to use mobile technology in the retail store. Technology anxiety, self-efficacy, and personal innovativeness relate to intention to use scanning and payment scenarios. Because the particular configuration of scanning and payment scenarios does not seem to matter, retailers who seek to reach adoption by a critical mass of customers may determine the feasibility of an implementation by evaluating these characteristics in their customer base. If a high proportion of their customers are high in self-efficacy and/or high in personal innovativeness and/or low in technological anxiety, the introduction of a new configuration of scanning and payment processes is more likely to be successful – regardless of what that configuration may be.

CONCLUSIONS

Despite the potential for mobile checkout in the store to be a rich source of high-velocity data that can also be exploited in real-time shopping visits, low rates of customer adoption have proved to be a hindrance to large scale rollout by retailers. The current research presents a framework of sub-processes for the checkout process and provides insight into customer reactions to configurations of the sub processes. Specifically, we found that mobile self-scan combined with fixed location payment is the preferred mode and we also found that individual differences are a strong driver of adoption. These findings inform theory in the context of in-store service processes as well as mobile technology, create opportunities for future research, and have significant practical implications for the retail industry.

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APPENDIX A 1 – SHOPPING SCENARIO[5]

Thank you for agreeing to participate in our mobile shopping study. This is what mobile shopping means. Imagine that on your visit to the store, you select all the items you would like to purchase. You take your shopping cart to an employee who scans all items you put into your shopping cart. The picture below illustrates the mobile scanning process.

Once you have completed shopping, you take your shopping cart to any sales representative in the store. The sales representative is equipped with a mobile payment terminal that is capable of accessing the information stored on the employee's mobile scanning device. The sales person swipes your credit card over the mobile payment terminal and asks you to authorize the payment. The picture below illustrates the payment process.

<u>Open-ended questions:</u>

- What do you think about mobile shopping in the store?
- Do you have any concerns regarding mobile shopping in the store? If so, what are they?

[5] A complete list of all 16 scenarios is available from the lead author.