Consumer Perceptions of Mobile and Traditional Point–of–Sale Credit/Debit Card Systems in the United States: A Survey

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Abstract

In recent years, rapidly emerging technology has introduced mobile Point-Of-Sale (MPOS) systems to the North American market. These systems allow merchants to process transactions conveniently and quickly using mobile phones or tablets rather than "traditional" point-of-sale (TPOS) credit card-processing systems. However, the long-term success of these new payment systems relies on consumers perceiving the device to be secure, accurate, and free from criminal activity. We present a case vs. control clustered field study that evaluated consumers' impressions of the security, trust and convenience of mobile (MPOS) versus traditional (TPOS) readers. Consumers were recruited from a local sandwich shop (MPOS) and an ice cream shop (TPOS) and surveyed about their perceptions of the devices immediately after completing transactions using their credit/debit cards. Implications for consumers and industry, including prevention of cyber crime, are discussed.

Keywords: Point–of–Sale Systems, Consumer Perceptions, New Technology.

Introduction

Point–Of–Sale (POS) systems are used globally to accept payment from consumers using credit or debit cards to purchase goods or services. The most popular form of POS reader, especially in the United States (US), involves swiping a credit or debit card

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through a magnetic scanner (Smart Card Alliance, 2011). This "traditional" POS (TPOS) system requires a dedicated, standalone card reader deployed solely for the purpose of processing transactions using credit/debit cards. Such systems have been used for many years and most consumers are familiar with them.

Recently, a new POS system was introduced to the market, the mobile POS (MPOS) system (Johnson, 2012). Manufactured by several venders, including Square®, Intuit GoPayment® and Paypal Here®, MPOS systems take two forms. One type, hardware-based MPOS systems, consists of a small reader that plugs into a mobile device such as a smart phone or tablet. Consumers swipe their credit/debit cards through the device to make a payment. Merchants typically use the mobile device not just to accept payments but also for various other personal or business purposes. Payments are processed through software apps stored on the device. The other type of MPOS system is software based and usually requires manual entry of card information onto the phone or tablet. In some cases, the merchant can photograph the credit/debit card instead of entering data found on the card (www.card.io).

A large body of research suggests consumers may have anxiety, fear, or concern about their personal safety and security when using new technology, especially when they are sharing personal or secure information such as credit or debit card numbers using that technology (Liu, 2012; Meuter et al., 2003; Perea y Monsuwé, Dellaert, & de Ruyter, 2004). Such anxiety was reported by consumers, for example, when making Internet-based credit card purchases a decade ago (Perea y Monsuwé et al, 2004) and more recently in using self-service bank machines (Liu, 2012). Given recent mass media publicity about cyber-crime and the potential for personal data to be stolen electronically (e.g., Whitaker, 2014), MPOS systems may introduce particular concern about crime victimization among consumers for several reasons. These include: (a) the electronic devices are used for multiple purposes by merchants, including personal matters, which may introduce greater risk of consumer information being stolen or misused; (b) they are small, mobile devices connected wirelessly and often insecurely to the Internet, which may raise fear of ready access by criminals to personal information; (c) third-party apps are both easily and typically stored on MPOS host devices and may contain malware; and (d) credit card theft has been featured prominently by national US media outlets in recent years.

Given the rapid increase recently in the use of MPOS systems, the potential for high levels of consumer anxiety about crime victimization while using them based on research with similar technologies, and the dearth of empirical research on consumer anxiety about crime and personal security surrounding MPOS systems and the implications of that anxiety for industry, this study was designed to evaluate consumer fear, anxiety, and discomfort using MPOS devices at local merchants. Specifically, we tested four hypotheses: (a) consumers will generally feel comfortable using either MPOS or TPOS systems, but (b) consumers will report less concern using TPOS systems than with using MPOS systems; (c) consumers will report greater trust in TPOS systems over MPOS systems; and (d) consumers will find TPOS systems as convenient as MPOS systems. To test these hypotheses, we conducted a clustered case vs. control survey research study. Consumers making purchases at two small businesses, an ice cream shop that used a TPOS reader and a sandwich shop that used an MPOS reader, were surveyed.

Methods

Research Sites

Study sites were selected to meet the following criteria: (a) large and diverse consumer population, (b) high levels of consumer traffic during peak hours, (c) located geographically (< 5 miles) to our campus to ease data collection, and (d) served a client-base that included many non-university-affiliated consumers. We also sought businesses that appeared to be similar in physical size, in customer base (age, gender, race/ethnicity, wealth), that had a high proportion of sales completed using credit/debit cards rather than cash, and were willing to cooperate with our research project. Following a selective process that involved creating a list of potential sites, discretely visiting each to observe customers and customer behavior at length, and then writing letters to our target businesses asking for permission to conduct our study at their location, the owners of an ice cream shop and a sandwich/wrap shop agreed to participate in the research. Both sites included about 10 tables for eating. One used TPOS and the other MPOS for credit and debit card sales. We offered a $500 honorarium each to the shops for their cooperation.

The TPOS device used at the ice cream shop was the Lipman reader (Nurit 2085) and the MPOS device used at the sandwich shop was a Square reader running the Square Register app 3.2.2 and connected to an iPad 2 (via audio jack), a hardware-type MPOS device. Figure 1 shows photographs of both devices.

Figure 1: Photographs of the POS devices used in the study

(a): Traditional reader (TPOS)

(b): Mobile reader (iPad + Square) (MPOS)

Protocol

Data were collected during peak business hours (Wednesday through Friday lunch hours at the sandwich shop and Wednesday through Saturday afternoons at the ice cream shop). Research assistants approached all adult customers at each study site who used a credit or debit card to make purchases during the pre-selected study hours. Participants were approached immediately following their purchase and given an information sheet about the study. They were permitted to ask questions. Those that provided signed informed consent to participate then completed a paper-and-pencil survey on-site. Most participants completed the survey in about 5-10 minutes. Participants were given a $5.00 cash incentive for their time. All study protocols were approved by the university IRB.

Participants

Table 1. Descriptive Analysis of TPOS and MPOS Survey Group Participants

	TPOS (N=62)	MPOS (N=113)
Variable	Percent (n)	Percent (n)
Age	M = 32.49; SD = 13.58 n = 61	M = 37.08, SD = 12.33★ n = 111
18–30 years	53.3 (32)	38.7 (43)
31–50 years	36.7 (22)	45.9 (51)
> 51 years	10.0 (6)	15.3 (17)
Sex		
Female	74.0 (45)	60.0 (67)
Male	26.0 (16)	40.0 (44)
Race		
White	77.0 (44)	80.2 (89)
African American	6.6 (4)	10.8 (12)
Other	16.4 (10)	9.0 (10)
Highest Education Completed		
High School	19.7 (12)	11.6 (13)
College	24.6 (15)	19.6 (22)
Graduate School	55.7 (34)	68.8 (77)
Annual Family Income		
< $25,000	7.0 (4)	5.4 (6)
$25,001-$55,000	19.3 (11)	20.7 (23)
$55,001-$85,000	10.5 (6)	39.1 (35)★★
≥$85,001	63.2 (36)	38.7 (43)
★ t = 2.25 (p < .05); ★★x^2 = 13.49 (p < .01)		

A total of 62 participants completed the TPOS survey at the ice cream shop and 113 participants completed the MPOS survey at the sandwich shop. Descriptive data about the two samples appears in Table 1. As shown, the two samples were similar in most respects. Statistical analyses to compare the two samples on demographic characteristics revealed just

two differences. The TPOS sample (M = 32.49 years, SD = 13.58) was slightly younger than the MPOS sample (M = 37.08, SD = 12.33), t (173) = 2.25, p< .05, and the TPOS sample had slightly more (63%) individuals in the highest income bracket ($85,001 and over) and slightly fewer in the next income bracket lower (11%; $55,001-85,000) than the MPOS sample (39% in highest income bracket and 39% in next bracket lower), x^2 = 13.49, p < .01.

Measures

Participants at the ice cream shop completed a two-part survey and participants at the sandwich shop completed a three-part survey. The first part of both surveys contained items addressing perception of the POS system encountered at the study sites. Each item was answered on an 11-point scale, responses to the items were coded such that a lower score represented a positive response and higher scores a negative.

The MPOS survey contained 7 items as Part II. Five of these items asked respondents to compare their confidence in MPOS readers with their confidence in TPOS readers typically used at major retailers and eateries in the area, such as Walmart and McDonald's. Given the relevance of personal physical space to anxiety (Dosey & Meisels, 1969), a sixth item asked respondents how comfortable they were being in close physical proximity to the merchant's iPad. Foreseeing future use more broadly of MPOS systems, the final item related to perceptions about using the MPOS system themselves to *accept* payments, for example, if the respondent was hosting a garage sale. All responses were again on an 11-point scale and were reverse coded as needed so all scores on the lower end of scale indicated a strongly positive response to the item. Both surveys concluded with a short set of 5 items assessing demographic characteristics (Part III in MPOS, Part II in TPOS).

Data Analysis Plan

Data analysis occurred in three steps. First, we examined descriptive and comparative data on the 13 identical survey items presented to both groups. Because responses were highly skewed, nonparametric Mann-Whitney U tests were used to compare the groups. Second, principal components analysis (PCA) was used to collapse the 13 items into meaningful constructs. Three constructs emerged and descriptive and comparative data were computed between the three constructs. Again distributions were skewed and Mann-Whitney U was used to compare the groups. Last, descriptive data from the survey items administered only to the MPOS group were considered.

Results

Table 2 presents descriptive and nonparametric analyses comparing responses to the 13 identical survey items across the two groups. Two observations from the analyses in Table 2 are especially noteworthy. First, as hypothesized, responses for all the items consistently fell at the low end of the scale (< 3.0) in both groups, indicating generally positive feelings about both TPOS and MPOS devices. Second, there was a consistent trend for mean responses by MPOS members to be higher than those of TPOS members, indicating that participants perceived the TPOS device to be more safe, trustworthy, efficient, and resistant to failure than the MPOS device. Nine of the 13 item differences reached traditional levels of statistical significance between groups.

Given the number of comparisons made and the impression based on face validity that distinct theoretical constructs might underlie the items, Principal Components Analysis was used to detect underlying factors within the survey instrument. Using PCA with Varimax rotation and Kaiser Normalization, we found evidence for three such components based on Eigenvalues of > 1 (See Table 3). The three components explained 68% of the total variance and were labeled Concern, Trust, and Convenience.

Table 2. Mean Differences in 13 Identical Survey Item Responses by TPOS and MPOS Group Participants

Survey Item	TPOS Mean (SD)	MPOS Mean (SD)	Mann–Whitney U Coefficient (n)
How long transaction took (0 = very short; 10 = very long)	0.73 (.908)	0.89 (1.78)	–0.64 (175)
How likely reader fail (0 = very unlikely; 10 = very likely)	2.03 (2.21)	3.04 (2.94)	2.25★ (174)
How easy is reader to use (0 = very easy; 10 = extremely hard)	0.50 (.864)	0.90 (1.97)	0.94 (174)
How secure is reader (0 = very secure; 10 = very insecure)	1.05 (1.46)	2.16 (2.06)	3.90★★★ (174)
How anxious using reader (0 = not at all anxious; 10 = extremely anxious)	1.37 (2.69)	1.94 (2.43)	2.87★★ (174)
How worried using reader (0 = not worried; 10 = extremely worried)	.84 (1.60)	1.95 (2.51)	3.53★★★ (174)
How vulnerable feel using reader (0 = not vulnerable; 10 = very vulnerable)	1.13 (1.87)	2.47 (2.76)	3.81★★★ (174)
How likely credit card info stolen using reader (0 = extremely unlikely; 10 = extremely likely)	2.05 (1.80)	3.14 (2.56)	2.72★★ (174)
How likely to use reader again (0 = extremely likely; 10 = extremely unlikely)	0.95 (2.00)	1.39 (2.30)	1.92 (174)
How likely use reader for < $50 purchase (0 = extremely likely; 10 = extremely unlikely)	0.87 (61)	1.00 (1.68)	1.56 (173)
How likely use reader for > $50 purchase (0 = extremely likely; 10 = extremely unlikely)	1.27 (2.39)	2.44 (2.94)	3.11★★ (174)
How likely use reader if self-swipe (0 = extremely likely; 10 = extremely unlikely)	.92 (2.13)	1.45 (2.12)	2.48★ (173)
How likely tell friends reader is secure(0 = extremely likely; 10 = extremely unlikely)	1.79 (2.39)	2.63 (2.54)	2.61★★ (175)
★ p < .05; ★★ p < .01; ★★★ p < .001			

Table 3. Principal Components Analysis of 13 Identical TPOS and MPOS Survey Items

Survey Item	Factor		
	Concern[a]	*Trust*[b]	*Convenience*
How vulnerable feel using reader	**0.877**	0.124	0.286
How worried about using reader	**0.832**	0.180	0.276
How likely credit card info stolen using reader	**0.788**	0.136	–0.046
How anxious using reader	**0.656**	0.223	0.220
How likely tell friends reader is secure	**0.630**	0.260	0.021
How secure is reader	**0.593**	0.191	0.498
How likely use reader in purchase < $50	0.096	**0.827**	0.061
How likely use reader if self-swipe	0.284	**0.786**	0.106
How likely use reader in future	0.134	**0.786**	0.187
How likely use reader in purchase > $50	0.311	**0.774**	0.018
How long did transaction take	0.082	0.101	**0.857**
How easy was reader to use	0.238	0.221	**0.831**
How likely is reader to fail	0.122	–0.014	**0.742**

[a] Eigenvalue = 5.48; [b] Eigenvalue = 1.84; [c] Eigenvalue = 1.48. Factors explain 68% of total variance.

Table 4. Mean Differences in Concern, Trust, and Convenience Scales by TPOS and MPOS Group Membership

Scale	Group	Mean (SD)	Mann–Whitney U Coefficient (n)
Concern Scale (6 items)	TPOS	1.37 (1.51)	3.77★★★
(α = 0.87)	MPOS	2.38 (1.93)	(171)
Trust Scale (4 items)	TPOS	1.03 (1.69)	2.28★
(α = 0.84)	MPOS	1.57 (1.93)	(170)
Convenience Scale (3 items)	TPOS	1.09 (0.97)	1.39
(α = 0.83)	MPOS	1.63 (1.90)	(171)
★ p < .05; ★★★ p < .001			

We next created scales for the Concern, Trust, and Convenience constructs by aggregating items that loaded onto each construct. Concern consisted of 6 items, while Trust consisted of 4 items, and Convenience 3 items. All three had strong internal reliability (Cronbach's α > 0.80). As shown in Table 4, Mann–Whitney U test comparisons between the groups replicated the pattern on individual survey items and indicated participants had generally positive impressions of both systems, but somewhat greater perceived concern with (Mann–Whitney U = 3.77, *p*< .001) and mistrust of (Mann–Whitney U = 2.28, *p*< .05) the MPOS device compared to the TPOS device. The comparison on the aggregated convenience component between the two groups was not significant (Mann–Whitney U = 1.39).

Table 5. Analysis of "MPOS Only" Survey Items

Item	Mean (SD) (n = 112 – 113)
How comfortable using MPOS to receive self-payments? (0 = very comfortable, 10 = very uncomfortable)	3.31 (3.66)
How comfortable being close to MPOS reader (merchant's personal device)? (0 = very comfortable, 10 = very uncomfortable)	3.31 (3.66)
(Compared to TPOS)	
How confident that MPOS protects card information? (0 = very confident, 10 = not confident at all)	4.41 (2.21)
How confident MPOS efficiently processes transactions? (0 = very confident, 10 = not confident at all)	3.12 (2.23)
How confident MPOS saves time? (0 = very confident, 10 = not confident at all)	2.50 (2.28)
How confident MPOS provides good documentation of transactions? (0 = very confident, 10 = not confident at all)	3.87 (2.55)
How confident MPOS processes transactions without failure? (0 = very confident, 10 = not confident at all)	3.75 (2.43)

Our last analytic step was to examine descriptive data from the portion of the survey administered only to the MPOS portion of the sample. Results of that analysis appear in Table 5. Three items – good documentation, process transactions without failure, and protecting card information – yielded mean responses greater than 3.70, indicating the sample had some concern in those domains. Participants felt the least confidence (M = 4.41, SD = 2.21) in the domain of whether MPOS readers could protect card information compared to TPOS readers, reinforcing other findings that indicate some reluctance and concern about MPOS reader usage among the sample.

Discussion and Conclusion

As hypothesized, consumers in our study were generally comfortable using both the MPOS and TPOS systems, but expressed somewhat less concern and greater trust in the TPOS system. Participants generally found both systems to be convenient. These results generally correspond to those found in previous studies of consumer anxiety with and mistrust of new technologies (Liu, 2012; Meuter et al., 2003; Perea y Monsuwé et al., 2004) and imply merchants should demonstrate some caution in using MPOS in the US marketplace too quickly, given mixed consumer confidence about security and crime. This cautionary tale for industry may be particularly important given our findings regarding consumers' perceived risk of fraud or identity theft victimization when using MPOS and TPOS systems.

Importantly, our sample was comprised only of individuals who had just completed a transaction using the system in question; a broader consumer population may have shown even greater caution and concern about crime victimization. Further, such consumer

perceptions represent valid concerns, as the likelihood of theft or malicious activity which may compromise consumers' credit card information is potentially higher with MPOS devices than with TPOS devices (Frisby, Moench, Recht, &Ristenpart, 2012). A malicious application (malware) on mobile phones may sniff card information soon after a card is swiped through the hardware reader (Felt, Finifter, Chin, Hanna, & Wagner, 2011; Frisby et al., 2012). Recent media reports about identity thefts have fueled such anxiety among consumers (Rosenblum, 2014). Related technology, such as the Near Field Communication based payment system, has struggled to succeed in the US partly due to consumers' privacy and security concerns (Geiger, 2011).

Beyond the validity of the consumers' concerns about crime victimization, we offer three other explanations that might contribute to consumers' comparative mistrust and anxiety about using MPOS systems compared to TPOS. First, past experience using TPOS may invoke higher levels of consumer confidence in MPOS compared to new and less familiar readers (Turner, Kitchenham, Brereton, Charters, & Budgen, 201).Sometimes called the "halo effect," consumer comfort with the familiar has been well demonstrated. (e.g., Beckwith, Kassarjian, & Lehmann, 1978). Second, TPOS readers are standalone devices used solely for the purpose of card reading, whereas MPOS readers are connected to devices such as tablets that may also be used also for other purposes, both personal and business. Although MPOS reader device vulnerabilities exist (Frisby et al., 2012), consumers may perceive reduced security regarding tablets given the rampant publicity about and presence of mobile device malware (Felt et al., 2011). Third, MPOS transactions often do not provide a printed receipt, including at the site in our study. This creates a situation of no "proof of purchase" that may undermine consumers' perceptions of security. A similar effect has been observed in other payment systems, such as mobile branchless banking (Panjwani, Ghosh, Kumaraguru, & Singh, 2012).

In an ecologically-valid between-subjects survey research study, we found that consumers using credit or debit cards are generally fairly comfortable with both MPOS and TPOS systems, but expressed somewhat greater concern with and mistrust of MPOS systems compared to TPOS systems. These results have implications for consumer behavior and merchant practices and are in need of continued study as technologies for credit/debit card payments are implemented in the US and globally.

Limitations and Future Directions

Our study was conducted in a field setting, offering excellent ecological validity by surveying participants immediately after completing financial transactions using TPOS or MPOS readers. This methodology offers several strengths. One is recency of recall of emotions, feelings, and moods (Reis & Judd, 2000): participants completed questionnaires immediately after completing the financial transaction. A second strength of this methodology is the amelioration of negative factors generally associated with laboratory studies such as the Hawthorne effect, where participants' behavior in a laboratory-based study may change given they know they are being observed (McCarney et al., 2007). Third, we were able to follow the same study protocol with both the TPOS and MPOS participant groups.

Collecting ecologically valid data in field settings also introduces methodological limitations. Although the two samples were demographically similar, they were not identical. The settings also were not identical. Although similar in size, the simple matter

of ordering and eating ice cream versus luncheon sandwiches may cause different responses or emotions for respondents. Our samples also were not random and included only consumers who paid for their product using credit or debit cards.

Other study limitations stem from the types of businesses we examined. Most participants made low-cost (< $15) purchases and may have perceived minimal risk from use of a credit card or debit card for such a small purchase. Further, the participants we sampled may use credit and debit cards routinely, creating a perceived sense of normalcy couched in an awareness that if card fraud were to occur, card issuers or retailers would typically reimburse consumers for their losses (FDIC, 2014).

Our findings open several avenues for future research. A large-scale multi-site evaluation of consumer perceptions of mobile POS systems would be a natural extension. Such an evaluation may allow detailed assessment of whether demographic characteristics, such as consumer age, gender, family income, or race/ethnicity, have impact on consumers' impressions of mobile POS systems compared to traditional POS systems. Our study was not designed to test such effects and may have been under-powered to do so, but exploratory post-hoc analyses revealed no statistically significant effects in this regard.

It would be interesting also to compare consumer perceptions of mobile POS readers that are connected to a smart phone (e.g., an iPhone) versus a tablet (e.g., an iPad), given that smart phone-connected readers are also becoming popular and may introduce different impressions for consumers. One small study conducted for a magazine compared the usability of the two approaches, but did not explore consumers' concerns and trust associated with them (Morgenstern, 2010).

A third interesting future direction would be to compare different types of mobile POS readers – hardware-based and software-based (involving manual card entry and camera snapshot) – as perceived by the consumers. Finally, our study captured typical TPOS/MPOS transactions at small businesses. Though transactions were not necessarily "high-risk," the goal of this study was to quantify user's perceptions in "ordinary" common use scenarios. Future research may examine consumer perceptions in "high-risk" scenarios such as individual merchants at garage sales, community sites, festivals, and so on.

Methodologically, we chose a clustered between-subjects design. Future work might consider other methodologies such as a between-subjects design at the same business where consumers are randomly placed in MPOS versus TPOS check-out lines, a within-subjects research design where consumers make purchases at the same or different business using both systems and provide impressions, or simulation studies where participants undergo simulated purchases in either computer or live simulation role-plays.

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