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Digital Receipts: Fostering Mobile Payment Adoption

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Auto-ID Labs White Paper WP-BIZAPP-066

January 2014

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Business Processes & Applications

Originally published as: “Ho, E., Apostu, S., Michahelles, F., Ilic, A., Digital Receipts: Fostering Mobile Payment Adoption, Fourth International Joint Conference on Ambient Intelligence (AmI-2013), Dublin, Ireland.”

Abstract

Mobile payment adoption remains low. This paper presents a user-study that evaluates whether providing digital receipts in-store to customers could drive mobile payment adoption. Our results reveal that although our smart phone based payment and digital receipt processes took up to 60% longer than getting paper receipts and paying with cash, users perceived the digital receipt approach as fun, useful, and even time-saving. These insights may help drive adoption of mobile payment systems. Since our results show that consumers desire value added services like digital receipts, this study suggests that manufacturers and retailers should adopt standardized product identifiers and work towards the development of accurate product data, in order to enable and profit from such services.

Keywords: Mobile Payment; Digital Receipt; Usability; Retail.

1. Introduction

The large adoption of smart phones has inspired retailers to explore new ways of in-store payment. While Google Wallet and others are already being deployed, the adoption of in-store mobile payment systems by consumers remain slow, blocking the emergence of new process changes enabled by pervasive computing. Latest studies show that consumers are quite satisfied with current payment instruments at the point-of-sale (PoS) [1]. We argue that instead of replacing one payment method by another, value added services are needed. In our approach, with each payment transaction the user will receive a full itemized receipt on their phone. From this data, context-driven applications ranging from personal money management to shopping suggestions can be derived. The consumer value of such applications has been validated stand-alone both in research [2] and in rising m-commerce solutions like mint.com, which has reached over one million downloads in Q1 2013; this paper explores how such applications arising from digital receipts could be leveraged to drive mobile payment adoption. To this end, we have developed a mobile application for digital receipts and conducted a user study in a near real-world supermarket environment.

2. Related Work

Researchers and practitioners have already explored separately the ideas of consumer empowerment applications, digital receipts, and payment - but combining all three has been rare. Krüger et al. [3] examined virtual shopping assistants embedded into several in-store artifacts. Bhattacharya et al. [4] evaluated customers' product recommendation and shopping assistance systems. These applications depend on having rich and rapidly available data about the user. In this vein, Mankoff [5] proposed a nutritional assistant solution by scanning paper receipts and deriving shopping recommendations accordingly. Following Apple in 2005, several practitioners and start-ups such as alletronic.com or lemon.com have started to provide receipts to customers digitally. Mobile payment, which offers an alternative to paying with cash, check, or credit cards by allowing the consumer to use his mobile phone at the check-out, has research mostly centered around the technical development and evaluation of new payment systems (summarized in [1]), and theories of mobile payment acceptance [6]. While there are various systems on the market advertising the advantages for merchants of those systems, a research gap exists in identifying and evaluating the added value for consumers to adopt mobile payment solutions. Thus, the contribution of this paper is an approach that combines the information of digital receipts with a layer of applications built on top, to motivate users to adopt a new method of payment..

3. Concept of a Digital Receipt Solution

We developed a smartphone application in order to assess the level of acceptance of a digital receipt solution with subjects in a near real-world supermarket environment.

3.1. Text Formatting

A visual representation of each item on the receipt provides access to detailed information on each product. Fig. 1 shows a comparison between a traditional paper receipt and the mobile digital receipt solution. The user can click on individual items to view a short description and nutritional information. As users might be also shopping for other members in the same household, the application's personalization is designed for the household level.

Fig. 1: Paper (left) and digital receipt (right).

3.2. Value Added Solutions

On top of the digital receipt data, we envision applications were users get feedback about their shopping, can set shopping goals and spending limits, and receive related product recommendations. In our study, mock-ups of these functions were deployed which users could interact with. Since our evaluation dealt with the user perceptions of these functions at a high level, these features were not developed to be fully functioning, but rather at the level where the user experience during our test was close to reality.

4. Implementation and Study Setup

4.1. Implementation Details

The study followed a randomized repeated-measures design of two tasks. The independent variables were the method of obtaining a receipt and the digital receipt applications shown to the users. The dependent variables were task completion time and measures of user perception of the digital receipt applications via a questionnaire. In addition, we conducted short interviews with the subjects to collect also qualitative feedback. The study was run in a close-to-reality test supermarket. The test center has been setup by a supermarket chain for research on consumer responses to new technologies. This approach of conducting a user study in a retail laboratory is in line with related work in the field [5,6]. The mobile application

was deployed on Samsung Nexus S phones running Google Android 2.3.3 with NFC capabilities for one of the receipt obtainment methods. Each subject used the same phone type and same software.

4.1.1. Digital Receipt Obtainment Method

For the independent variable, we varied among three methods of getting a receipt at checkout: a paper receipt, and two digital methods below.

- **2D Bar Codes.** The user scanned a QR code that was generated on a POS screen facing the customer, to directly pick up the receipt data. QR codes have become standard method for phone users to acquire data and have sufficient data capacity to encode all required receipt data.

- **Near Field Communication (NFC).** Here, the receipt information was contained in an NFC tag which the user touched with the smartphone to obtain the receipt information. We also simulated a “pay” function with the phone that is confirmed by inputting a personal code on the smartphone screen. Similar to the value-added solutions, only the user experience of payment was developed, rather than a “true” payment solution.

Once the receipt has been received by either method, the digital receipt indicates on the smartphone which products have been bought, in what quantity and for what price.

4.1.2. Users’ Characteristics

The study was completed with a convenience sample of 12 users (3 of which were female). Ages ranged from 24-47 years with a median age of 26. Professions ranged from researchers, students and secretaries.

4.2. Evaluation Procedure

The study consisted of an introduction, an interactive demonstration task on the mobile phone, a shopping check-out task, and a follow-up questionnaire and validation interview to gather data about the two tasks (See Fig. 2). All users completed both tasks.

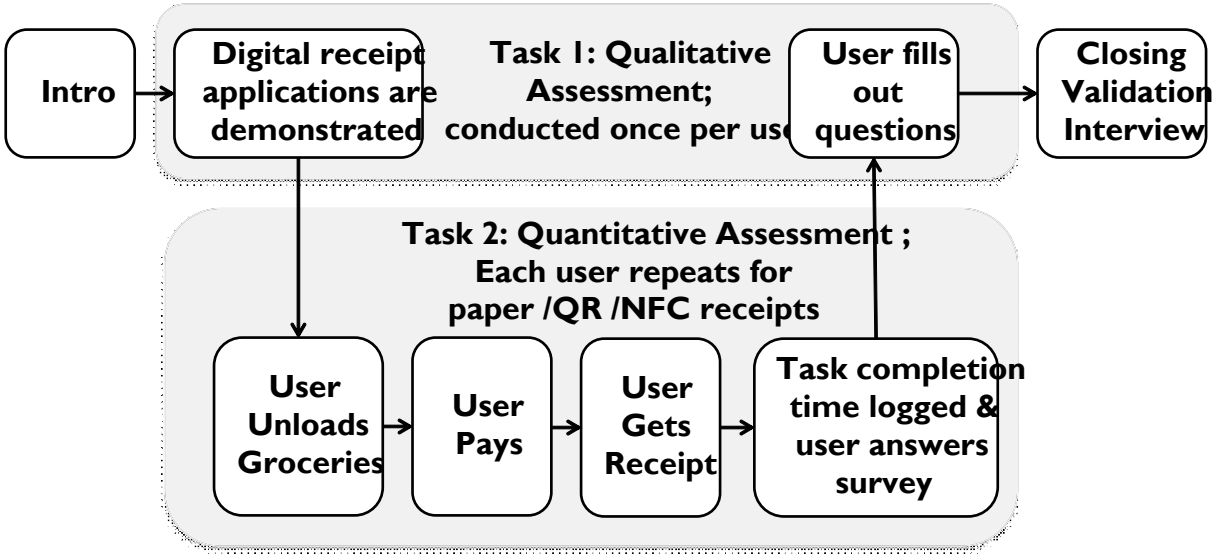

Fig. 2: Steps and tasks of the user study.

4.2.1. Introduction

The introduction was read from a script. One experimenter guided the user, and the other observed. The guide explained the study's objective was to compare the perceived usefulness of different digital receipt applications and the digital receipt obtainment methods. We mentioned to each participant that we were comparing our designs and not evaluating their skills, to avoid biasing users into rushing through the tasks.

4.2.2. Task 1: Evaluation of Digital Receipts Applications

The objective of the first task was to determine the perceived value of digital receipts. Users were shown and walked through the ancillary functions and use cases of goal setting, history of spending, recommendation, past receipts, and check-out information features.

Then, users were allowed to interact and to become acquainted with the applications. They proceeded to the second task when they confirmed that they understood what was presented. After the users completed all iterations of Task 2 (see below), they were then given a set of questions to evaluate key functions and overall impressions of the presented digital receipt solution (i.e. the solution consisting of the app prototypes in Task 1 in combination with the payment schemes in Task 2).

4.2.3. Task 2: Evaluation of Digital Receipt Deployment in Store

The objective of this task was to compare three possible deployments of making payments and getting receipts at the point of sale:

1. Cash Payment, Paper Receipt - the user paid with the wallet we provided, and then received a paper receipt.
2. Cash Payment, Digital Receipt by QR scanning – the user paid with the wallet we provided, and then unlocked the phone, turned on the app, and retrieved the receipt by scanning the fixed QR code we provide on an adjacent screen.
3. Phone Payment, Digital Receipt – the user walked up to the NFC terminal, scanned the tag with the phone, entered a PIN code, paid and got the receipt in the same step.

Users were first shown a demo of how to complete the deployments and could subsequently practice with the application until they were comfortable.

Afterwards, users were given a wallet with a fixed amount of cash and a shopping basket with five most common items. The amount of money in the wallet was chosen to minimize change and to make the non-digital form of payment as fast as possible. They were then instructed to put their phones and wallets as they normally would have them, then to put the goods onto the check-out counter, before attempting to pay and get the receipt; this reset people's behavior at the start of each trial. In a pre-test we saw that without this step, people would violate realism by putting their phones next to the cash register before the test even started.

Users completed these three deployments in a randomized order, in order to reduce possible biasing effects of the task order on our dependent measures.

4.2.4. Measures and Instruments

Dependent measures were collected as follows: First, at the end of each deployment in Task 2, the task completion time was recorded. The task completion time started after the last grocery basket item was unloaded and stopped after the person received the receipt, resulting in the actual time to pay and to get the receipt. Additionally, we also needed to empirically evaluate how they accepted the overall system (i.e. the app prototypes in Task 1 in combination with the different payment schemes in Task 2) and their future intention to use it. We aimed for parsimony in our measurements, so to this end, we applied constructs from the original Technology Acceptance Model (TAM), widely used for empirically evaluating the end-user perception of the information systems [7]. The original TAM model contains constructs for "Intention to use", "Perceived Usefulness" and "Perceived Ease of Use", which suit our purposes. The TAM model has been since extended from its original form [8], for example, with constructs like "Computer Playfulness", which we included since our app might be perceived as enjoyable. In order to maintain a parsimonious survey and also to maintain

only the most important items, we did not include other constructs from the TAM extensions. Users could rate their agreement with the statements on a 7-point Likert scale from 1=“strongly disagree” to 7=“strongly agree”. In effect, users had to apply the TAM to these three use cases: (1) No app, with cash payment and paper receipt, (2) Digital receipt applications with cash payment and digital receipts by QR scanning and (3) Digital receipt applications with phone payment and digital receipts.

Secondly, after all iterations of Task 2 were completed, users were given a questionnaire with statements representing the main functions of the digital receipt solution as experienced by the users in Task 1. They were asked “How do you value the following statements about the presented solution?” and given 9 statements representing specific functions and use cases of the presented solution. Results were collected on a 7-point Likert scale. The order of all the questions was randomized. Finally, users were asked to record their age, profession and how often they shopped.

4.2.5. Final Interview

For qualitative feedback, we asked users about how much they spent in general on different product categories and what their shopping goals are; then we asked them what applications shown or additional functionalities would convince them to adopt the presented solution.

5. Results

5.1. Task 1: Evaluation of Digital Receipts Applications

During this task we collected users’ opinions about “How do you value the following statements about the presented solution?” Of the nine statements, four lie prominently above a neutral answer (shown in Fig. 3), while two functions which do not rank so prominently are “I can receive recommendations about future purchases” and “I can see the opinions of other users about products”.

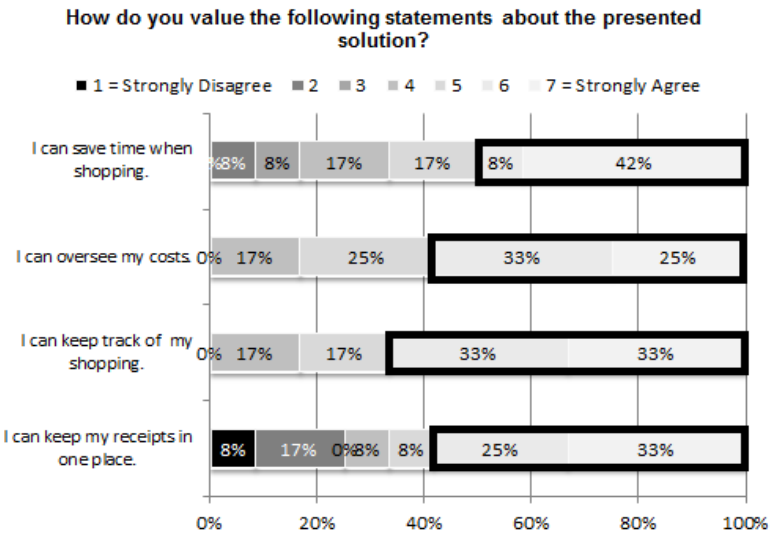

Fig. 3: User replies to "How do you value the following statements about the presented solutions?"; frequencies are presented, with four features perceived strongly positive.

5.2. Task 2: Evaluation of Digital Receipt Deployment at the POS

The results of Task 2 are the task completion times, measured for each of the different methods of paying and getting the receipt. We saw that users have different habits while checking out. Also, there are different approaches for handling both phone and wallet simultaneously: some users set one down while using the other, while others held both at the same time. Although this led to different check-out times between users, a one-way repeated-measures ANOVA proves the significant effect of the receipt/payment method on task completion time, $F(2,22) = 12.15$, $p < 0.01$. Mauchly's test did not show a violation of sphericity ($\chi 2\ (2) = 3.008$, $p = 0.22$).

When comparing between the three methods, the present method of cash & paper receipt ($\mu = 14.9s$, $\sigma = 5.3s$) was the fastest. Post-Hoc tests showed that in comparison with the present method, cash & digital receipt ($\mu = 28.3s$, $\sigma = 7.3s$, $p = 0.000$) and full digital payment & receipt ($\mu = 23.7s$, $\sigma = 6.6s$, $p = 0.014$) were slower and statistically significantly different. Meanwhile, the difference between the new methods was insignificant ($p = 0.611$).

5.3. Overall Evaluation of the Solution

The overall evaluation of the solution was embedded in the TAM responses. We can observe the following qualitative trends from the user's answers below:

- **Intention to Use** was perceived positively and qualitatively similar between the present method of payment and getting the receipt (Method 1) and the fully digital method (Method 3); 9 users answered six or higher in both cases. For the cash payment and digital receipt method (Method 2), 7 users answered six or higher.
- **Computer Playfulness / Fun** was experienced during both digital methods (Method 2 and 3) (with half of the answers six or higher) compared the present day method of payment and getting the receipt (Method 1), where no one answered six or higher. For Method 1, the most positive answer was slightly above neutral (5 users gave a rating of five).
- **Perceived Ease of Use** was experienced by 9 users during Method 1 and 2 with a score of six or higher, while 10 people gave such ratings for Method 3.
- **Perceived Usefulness** was perceived during the digital methods (Methods 2 and 3) by a majority of users (7 or more) answering six or higher, whereas Method 1 resulted in a majority of answers neutral (score of 4) or lower.

To illustrate these trends, the perception of usefulness and fun between the different methods are shown in Fig. 4.

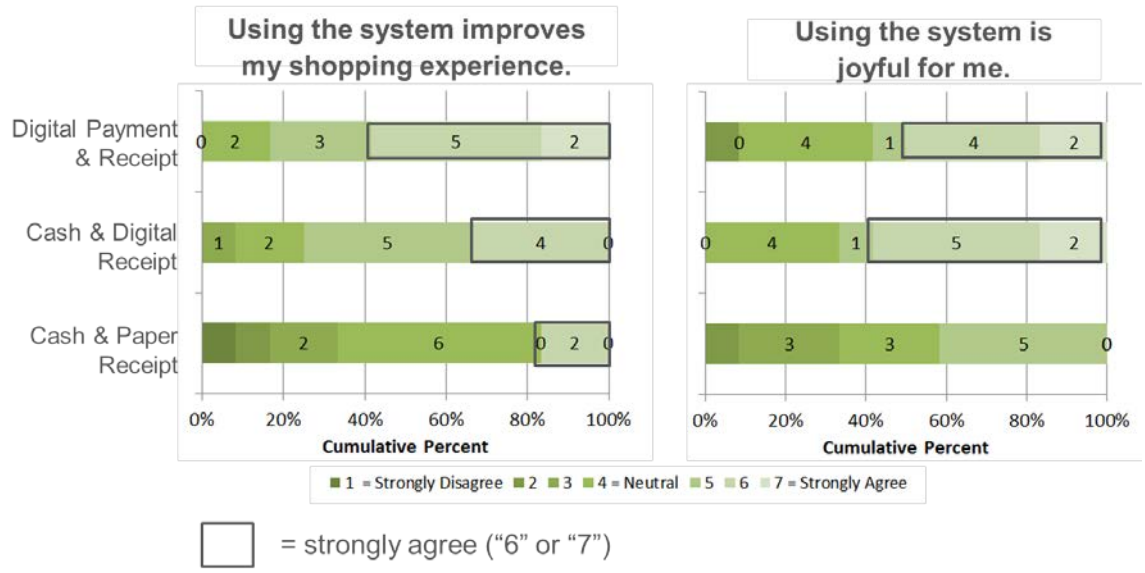

Fig. 4: User replies to the TAM questions of Perceived Usefulness and Computer Playfulness; the digital receipt solutions were perceived as more fun than traditional payment methods.

Notably, users perceived the digital receipt and digital payment solutions as fun and useful, eventhough the implementation in this study took longer than traditional methods.

5.4. Interview, Observations, and Comments

Five users wanted to be able to compare product characteristics (e.g., price) across competing retailers and three would consider paying for the presented solution if they could use the presented solution to pay at check-out. Two users requested a shopping list functionality. We also found that a majority (ten people) did not have any awareness of how much they were spending on different categories, but would be interested in knowing.

6. Discussion

6.1. Added-Value versus Objective Time Savings

The task completion time recorded in Task 2 showed that acquiring a digital receipt could take at least 60% longer than a paper receipt. In spite of this, the digital methods received the highest TAM scores; users perceived the digital receipt methods more positive than paper receipts. Within the two digital methods, the perceived fun and usefulness were similar, even though the payment methods were different (cash versus simulated pre-pay). This implies that the underlying method of payment had little impact on user perceptions; rather it suggests the digital receipt applications boosted the acceptance of the digital payment methods. This result is consistent with previous findings that consumers are already satisfied with traditional payment instruments at the point-of-sale [1]; our result extends this by showing that digital receipt applications could motivate consumers to try other payment instruments.

Counter intuitively, users also perceived the digital receipt solution as being able to “save time when shopping”. The mobile payment adoption literature emphasized fast checkout time [6] as a key driver for adoption; our results complements this by showing that that the added-value of a digital receipt can even overcome non-optimal checkout times. Studies in the consumer behavior literature on in-queue time perception [9,10,11] corroborate our results; studies have shown that the consumer perception of time during check-out could be influenced by external factors such as distractions or an engaging environment. Since our solution was perceived as fun by the users, it could be that it led to a perception of a shorter check-out time than it objectively was. Accordingly, our contribution increments the body of work on the consumer acceptance of mobile payment, by introducing a dimension of fun through digital receipts and their applications. Additionally, our work is also relevant to existing commercial solutions of mobile payment by providing insight on how to get users to accept mobile payment in general via value-added applications. We acknowledge that for a full scale roll-out, checkout times are of importance to the retailer and the proposed solution

needs to be further improved. Regarding mobile payment, there needs to be an improvement in terms of operational speed. For receiving the digital receipt, there are already technologies for increasing the speed [12] so that a mass deployment would be feasible.

6.2. Important Digital Receipt Applications

The previous results suggested that offering value added applications to complement mobile payment led to positive evaluations of the overall system, which could foster mobile payment adoption. This empirical result is in line with correlational models of mobile payment acceptance [6]. We found that users prefer utilitarian functions; both ranking of statements and interviews indicate a strong preference for utilitarian functions in a digital receipt application, e.g. cost-tracking of purchases. Other desired functions were product comparison and the possibility to track and review one's own shopping habits. Instead of recommendations, some users proposed a subscription or reminder function which remains under user's decision and control. These desired functions were also consistent with the findings by Bhattacharya et al. [4] regarding preferred in-store mobile applications.

6.3. Limitations

Our study sampled user experience in a single moment in time in a close-to-reality setting; a longer period of time with a larger sample of users in the field is a next step. This can validate the extent of acceptance when people shop under stressful or tired conditions, and the impact of the increased check-out time.

We note that this study focused on the user perception of services associated with digital receipts; the technical implementation was not the focus of this study. A key technical enabler for digital receipts would be widespread adoption of standardized product identifiers and the development of accurate product data, made accessible by internet and mobile services; since we showed that digital receipts were perceived as valuable by users, the adoption of such product standards would be key in connecting data-rich retailers and manufacturers with service-hungry consumers.

7. Conclusions

By using in-store digital receipts on smart phones, we compared different checkout scenarios of receipt obtainment and payment methods. We built our own prototypical solution and tested it in a near real-world environment. Our study revealed that users perceive the digital receipt solution as fun and time-saving, even though it objectively took longer than the other methods. Retailers can use this insight as a stepping stone towards mobile payment

adoption. It also opens up opportunity for new research on faster digital receipt obtainment and value-added receipt applications. Since consumers desire value added services like digital receipts, this study also provides impetus for manufacturers and retailers to adopt standardized product identifiers and work towards the development of accurate product data.

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