Poster: User perception of usability and security of a mobile payment system

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1. INTRODUCTION

This paper presents the design and first results from an on-going series of experiments on the perception of usability and security of an NFC-based mobile payment system.

Mobile (feature) phone-based monetary transactions are common in the developing world, where there are millions of users in Africa and India. These mobile payment systems are often offered by network carriers acting as a clearing house for a small fee on each transaction. This payment system does not require the user having a bank account. Evaluations of these payment systems usability and security have been done in [1].

The NFC-based system in our tests differs in using existing credit/debit cards in a virtual representation on a smart phone application. No transaction fee is involved for the user. In the western world the introduction of NFC-based payment methods is imminent. Even TIME magazine proclaimed "The End of Cash" in its January 9th, 2012 issue [2]. Several tests are currently running (e.g. Google Wallet), but paying with mobile phones is not commonly used in the U.S. and Europe. This study evaluates a mobile payment regarding user perception of security and usability, and user acceptance (possibly leading to guidelines to implement appropriate security features on a mobile payment system), as research in this area is still scarce [3].

2. TEST DESIGN

2.1 Mobile Payment System

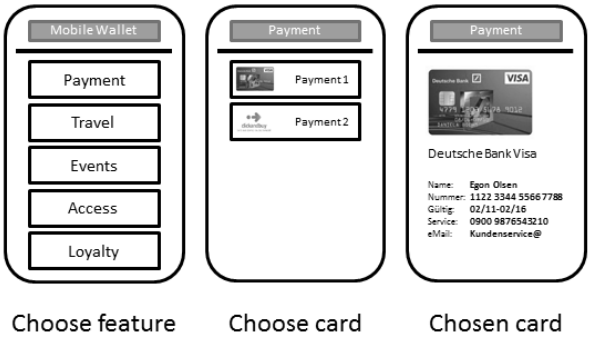

Figure 1 – The three consecutive Mobile Wallet screens shown to the user during the payment process

We used a prototype based on an Android application called "Mobile Wallet" on an HTC G2 Touch with an external RFID tag taped to the back of the phone. The application had the following features: payment, travel tickets, event tickets, access (e.g. opening doors), and customer loyalty cards. The payment features were presented as pictures of debit and credit cards (card paradigm). A „slide to unlock"-screen lock was used. The app itself had no security features, such as PIN, gestures, or warnings. The application did not generate any feedback, such as for successful usage (e.g. vibrations), warnings (alarm sounds), pop-up messages, or virtual receipts. The app offered no identity card feature, e.g. electronic versions of a driver's license. The app was located in the middle of the phone's home screen. After unlocking the screen and opening the app, the user had to select "Payment" from the top of the five features offered by Mobile Wallet, then the appropriate card. Fig. 1 shows the three screens seen by the user during the payment process. The user had to hold the phone near the POS' NFC reader to conclude the transaction.

2.2 Participants

32 persons participated in two experiments between September and November 2011. They were recruited by bulletin at TU Berlin and were offered a compensation of 20 Euro. Participants were between 19 and 49 years of age, with an average of 26.8 years. 18 participants were male and 14 female. 78% were university students, 22% were employed. All participants rated themselves as very experienced using electronic devices; computer and internet use have similar ratings, mobile phones slightly less. The average experience rating over all systems was 4.44 (STD: 0.65) with a scale ranging from 1 (little experience) to 5 (very experienced). While all considered themselves computer-literate, they were not all technical affine. All participants owned a mobile phone, 31% of those were smart-phones and approx. 28% used the screen lock with a PIN.

2.3 Experiment settings

The experiments were done in a lab setting, because a field study was not feasible as NFC-based mobile payment systems are not introduced into the European market yet. Furthermore, the lab setting provided us with far more transactions in a short timeframe than would be possible in real life.

In the first test, participants sat at a table and used Mobile Wallet in an interview-like situation, where the test supervisor would ask the participant to imagine several payment situations and to use the device accordingly. In the second experiment we built four more realistic stations for simulated shopping (public office, newspaper kiosk, supermarket, movie theater) to have different shopping environments from "formal" to "relaxed". The stations were fitted with several real goods like sweets, cigarettes, and beverages (different categories and price levels). Posters and similar accessories were used to enact an appropriate environment. In both experiments the participants used symbolic

cash, a symbolic debit card, and Mobile Wallet (as depicted in Fig 1). Each participant was tested individually.

2.4 Methods

The test was divided into three main parts. The first part consisted of general questionnaires (approx. 20 minutes): Demographic information; experience with computers, mobile phones and applications such as text messages, e-mail, and mobile internet; risk perception using mobile phones; influencing factors for using an electronic system. These questionnaires were developed by the authors of this paper. For other questions we used established questionnaires. The Big Five Inventory questionnaire [6] is used to measure the personality characteristics neuroticism, extraversion, openness for new experiences, compatibleness and conscientiousness. The questionnaire Technical affinity – electronic devices („TA-EG“) [7] is used to measure the technical affinity of users. The Domain-specific Risk-taking Scale – German Version (DOSPERT-G) [8] assesses tendencies to engage in risky behaviors, perception of risk and expected benefits from such behavior. There was no intervention by the supervisor, but participants were able to ask for clarification.

The second part consisted of a sequence of shopping events (20-30 minutes). The participants were handed out the Mobile Wallet prototype device, a symbolic debit card, some symbolic cash, and a symbolic ID card. During the second run of the experiment they also got a shopping bag to carry the goods "bought" at the different stations. The shopping sequence was divided into four blocks. The first block consisted of 8 pre-defined transactions (3x Mobile Wallet, 3x debit card, 2x cash) and one access event by opening a door using a key or the Mobile Wallet. After each transaction a paper receipt was handed out. During Block 2 (6 transactions) the participants were free to choose their preferred method of payment and access. The third test block consisted again of 4 pre-defined transactions (1x Mobile Wallet, 2x debit card, 1x cash) and was used to simulate security threats by handing out incorrect bills or short-changing the buyer (cash-only). Block 4 consisted of 7 transactions. The participants were now primed from the experience before. The four blocks generated 736 transactions, 278 using Mobile Wallet. 32 of 128 simulated security attacks were targeting Mobile Wallet. The participants rated Mobile Wallet for overall impression, usability, and security (using it like depicted in Fig. 1) after each block.

The third part consisted of questionnaires specific to the use of mobile payment and the usability of the specific prototype (approx. 15 minutes). The questionnaires were designed after AttrakDiff mini [4], which is used to measure perceived product attractiveness (ATT), which is composed of pragmatic quality (PQ) and hedonic quality (HQ), and System Usability Scale (SUS) [5]. Further, we asked how users perceived the features of Mobile Wallet and to rate their impression regarding overall opinion, usage, security, and interaction.

3. RESULTS

SUS ratings reached 81.25 of 100 (a rating between good and excellent [5]). The overall impression and usability ratings were good, but security scored poor. The relatively high SUS score can be used for comparison with a variant of Mobile Wallet with implemented security features. The priming effect was visible in the ratings between the different blocks. Over the four blocks, the average ratings were 3.37, 3.57, 3.38, and 3.42 (scale 1 to 5, sig.=0.07). The users on average preferred Mobile Wallet over using a debit/credit card independent of the pricing level. The raw numbers of transactions (free choice blocks) were: 199 using cash (mostly cheap items up to 9 euros), 67 using debit card, and 178 using Mobile Wallet (goods between 10 and 250 euros). Participants favored using a PIN upon starting Mobile Wallet. Using any feature without starting the app (compared to Mobile Wallet running as a background process) scored low (between 2.55 for access and 1.68 for payment). The ability to configure the security settings got the highest rating (4.73, STD 0.75).

4. CONCLUSIONS AND FUTURE WORK

The three key findings from the first experiments were: First, Mobile Wallet appears to be a good debit/credit card replacement, the overall impression rating is high (despite security concerns). Most of the users linked the card paradigm to a real debit card, and the familiarity of the concept seemed to build trust. Second, the security issue was addressed by the participants through low ratings (They often mentioned that just adding a PIN would satisfy their security needs). Third, the priming has a small but significant effect, but has to be verified by a manipulation check in a future test. Upcoming tests are: verification of the priming effect (manipulation check); variation of the security method (no security, PIN, fingerprint) [9]; use of compensation money during the test (so the participants will use their "own money").

5. ACKNOWLEDGMENTS

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