Usability of pocket-based cash recyclers for self-service

Phil Day, Maggie McKendry, & Marshall Munro

User Centred Design, NCR Corporation, UK

ABSTRACT

In this paper we present the results from six user tests conducted between 2014 and 2017. These tests investigated the usability of depositing and withdrawing money from a pocket-style cash recycler; where the notes are inserted into and removed from an open receptacle rather than from a slot. Some of these involved working modules, some used purely static models of pockets, and others used early prototypes. Results are presented from these evaluations, along with broader conclusions as to the usability and acceptability of pocket-style cash recyclers for use in self-service devices such as automated teller machines (ATMs).

KEYWORDS

Self-service, cash, pocket, slot, ATM, usability

Introduction

Automated teller machines (ATMs, also known as cash machines in the UK) offer a convenient method for people to have access to cash at any time of the day or night. This can be an important method of accessing banking services as the number of local bank branches in the UK roughly halved between 1986 and 2014, with this trend having continued since this date. This situation is particularly acute in rural areas (Bennett, 2020; Statista, 2021). In addition, although many in the UK do have access to online banking (whether via a computer and internet connection at home, or a smartphone and data connection), not all have access to these services, meaning that an ATM may be the primary method for accessing banking services for some people.

Figure 1: ATM cash slot and pocket

Typically, ATMs in the UK tend to have a cash dispenser that presents cash through a slot to the user. This works well but means that the cash needs to be regularly replenished, particularly in high traffic areas, which necessitates dispatching a person to replenish the machine, costing the operator of this ATM money, and taking the machine out of service during replenishment. To solve these issues, there is a developing trend for ATMs to use a cash recycler which enables cash to be deposited by a user into the unit, recycled, and then dispensed to another user (NCR, 2015; Miller,

2018). A common use case for this is that of the small business owner depositing the proceeds of a day of business, which drives the need for higher capacity than would typically be required for general banking customers. This higher capacity means that a change in geometry from a simple slot to a pocket (an open receptacle that contains the cash notes) is often part of this migration to a recycler (Figure 1).

Over the years we have therefore conducted several evaluations to ascertain the impact of a change from a slot to a pocket for both depositing and dispensing cash. Some of these user tests involved working modules, some used purely static models of pockets, and some used early prototypes. The work described was all conducted long before the COVID-19 pandemic when attitudes towards cleanliness and hygiene were somewhat different to the present situation.

User test November 2014; functional models

20 participants (11 female, nine male), recruited from friends and family of NCR staff, were asked to use a SelfServ 83 free-standing lobby pocket recycle ATM, along with early builds of the SelfServ 84 through-the-wall ATM and some early prototypes of another concept (Figure 2). The 83 had a pocket cash recycler, the 84 unit had a slot cash dispenser; both units were functional and dispensed test media.

Participants were asked to complete a simple dispense and deposit transaction using the pocket recycler (both with receipt) and a dispense using the slot dispenser. After this the participants provided subjective ratings using 7-point Likert items, open comments, and the Microsoft product desirability toolkit (Benedek & Miner, 2002). All participants stood to use the machine, i.e., no assessment was made for wheelchair users, and all but one were regular ATM users.

Results

All participants rated the ease of use of using the pocket positively (5-7/7). Visibility to the cash in the pocket was rated almost as highly, with 18 rating as good (5-7) and only two as bad (2/7).

There were some negative comments regarding the noise of the mechanism, and the unfamiliarity of using such a device (Figure 3), with several people commenting that having lighting in the pocket would be an improvement. However, despite this, there was a slight preference in this test for using a pocket rather than slot, with ten preferring pocket, eight preferring slot, and two being happy with either.

Figure 2: experimental setup

Figure 3: Reaction to pocket recycler ATM

User test 7th June 2017; functional ATMs & non-functional models

25 participants (17 male, eight female) were recruited from NCR staff and asked to use two functional ATMs; a SelfServ 87 (pocket recycler) ATM and a SelfServ 28 (slot recycler) ATM; along with three non-functional foam-core prototype cash pockets. These were: C - Pocket with full

front edge, (~165mm tall), 21° from horizontal; D - Pocket with lowest front edge (~120mm), curved shutter, 51° from horizontal; and E - Pocket with lower front edge (~135mm), straight shutter, 21° from horizontal (Figure 4 to Figure 6).

Participants were asked to complete a cash deposit then withdrawal action on the two ATMs (order was randomised and balanced). Ratings (7-point Likert items) and open-ended questions were used to elicit feedback on each concept. They then inserted and removed a mixed bunch of notes from the three prototype pocket concepts (again order was randomised & balanced). Finally, participants were asked comparative questions and invited to rank the concepts in order of preference, along with more discussion about what pocket features were particularly beneficial or unhelpful.

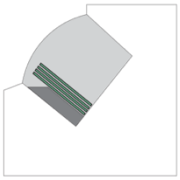

Figure 4: pocket D

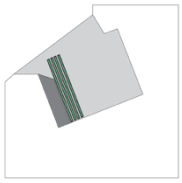

Figure 5: pocket E

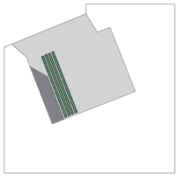

Figure 6: pocket C

Figure 7: Participant removing notes

Figure 8: pockets D, E, C

Results

Participants again showed a preference for pocket, with 20 preferring pocket, four preferring slot, and one with no preference. This may have been influenced by people doing a deposit transaction first but was still a surprise as slot is the method that participants would be familiar with.

In terms of rankings, D (foam core pocket, 51° from horizontal) was preferred (mean rank 2.2), then the SelfServ 87 pocket recycler (mean rank 2.48), then E (foam core, 21° from horizontal with cutaway front edge) with a mean rank of 2.68, followed by C (foam core, 21° from horizontal with full front edge) and the SelfServ 28 slot recycler being ranked last. Similarly, when comparing the ratings the SelfServ 87 had more positive ratings than the 28 for ease of inserting and removing cash and visibility to the cash. In terms of ratings for the foam core models, C was rated worst, with D best for visibility & overall rank, and E best for insert and deposit.

Generally, participants liked the fool-proof insertion of cash into the pocket. Some participants didn't like inserting the cash into the slot (on the 6628), they felt it was exposed, some had to step back to view the slot, and they didn't know at what stage the cash would be grasped by the mechanism, so were worried when they let go of the cash that it would fall out.

Overall, participants preferred to insert the cash into the pocket but receive cash from the slot; some people did not like putting their hand into the pocket as there were uneasy (and unfamiliar) with the mechanisms.

User test 29th June 2017; non-functional ATMs & models

12 participants, recruited from NCR staff used four competitor pocket recycler machines (non-functional) and two 3d-printed, non-functional prototypes for a cash recycler pocket (one with two fixed compartments, and one with a single compartment). It followed the previous user test which found a preference with a large open pocket for deposit, but some preference for withdrawal from a slot. All participants used all machines and pockets (order was randomised and balanced), were asked to rate ease of use for inserting and removing cash, and visibility to the cash using seven-point Likert items and were also asked to rank the options. Participants stood to use each machine, but there was also a wheelchair available for people to try accessing the pockets from a seated position. Results are shared for the 3d-printed prototypes, detailed comparisons of the competitor units are omitted for reasons of commercial sensitivity.

Figure 9: ATMs and pocket concepts evaluated

Results

The curved pocket with a single compartment was rated the highest (including the competitor units) for inserting cash (mean 6.42), removing cash (6.42), and visibility to the cash (6.64). The 3d-printed pocket with two compartments was also rated highly for ease of use for inserting (5.67) and removing cash (5.42) and visibility (6.25), although not quite as highly as the single compartment version. These results were supported by the rankings; with the single compartment pocket being ranked first, and the two-compartment pocket second.

The least preferred of the competitor machines had a pocket that was very far back in the machine, was deep, and was close to vertical – based on ratings and comments this significantly impacted visibility and ease of use, with the problem being particularly acute for people in wheelchairs.

The results of this user test gave two preferred directions for the design of a cash pocket; with the first being a large, open pocket, and the second being a smaller, lifting pocket that presents the notes to the user.

User test July 2017; semi-functional models

21 participants (16 male, five female, all NCR staff), four 3d printed prototypes (with some functional mechanical parts). A: open pocket; B: carrier lifts through the fascia, scalloped front; C: carrier sits behind the fascia (at three different heights); D: transport belts behind the fascia (**Error! Reference source not found.**). Each participant did the same tasks on all four concepts (order was randomized and balanced). Ratings & open-ended questions were used to elicit feedback.

Results

A (open pocket) was preferred based on rank for withdrawing, depositing and overall. However, when considering ratings, concepts B and C were at least as good, and in some cases better than the open pocket (A).

This mismatch between the rank and ratings may well have been due to concepts B/C/D all having moving parts that were manipulated by the evaluator to make the pocket concept accept/dispense notes. Unfortunately, this may have resulted in these concepts appearing more complex based on comments made by participants. Despite this, it appeared that concepts B and C had some benefit based on the ratings and should be explored further.

These findings were therefore used in further developing and refining a pocket design which took elements of B and C.

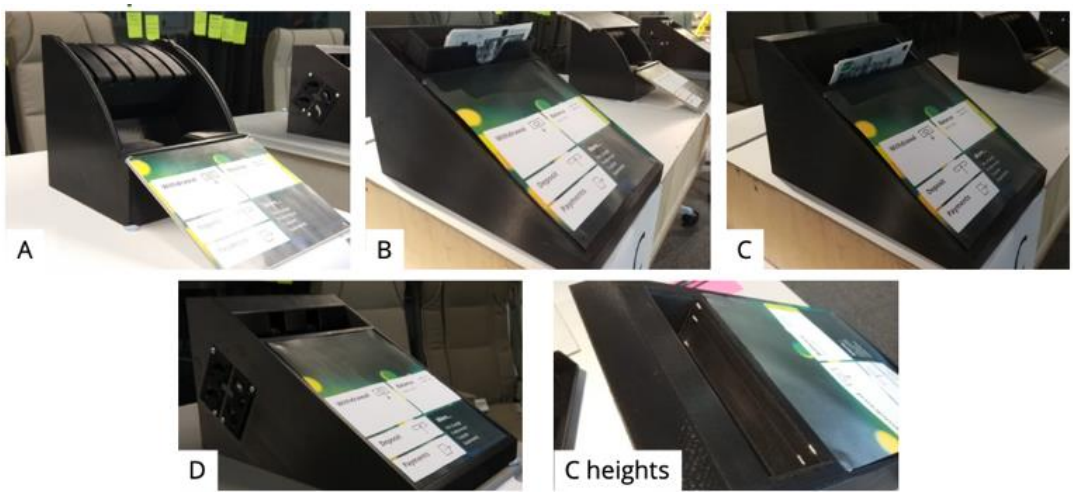

Figure 10: Pocket concepts evaluated

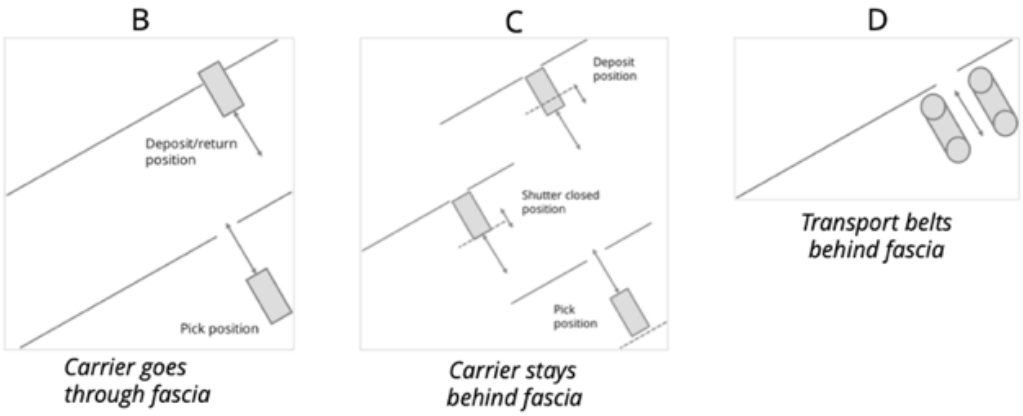

Figure 11: Pocket concepts illustrated

User test October 2017; non-functional models at drive-up

This user test was part of a larger evaluation of a drive-up ATM concept; the participants therefore used the lifting pocket prototype (and other features) along with a more conventional slot dispenser prototype from their vehicles (Figure 12, Figure 15). In addition, different positions were tested for the display with the pocket concept (Figure 13). There were 40 participants (27 male, 13 female, all NCR staff); and a representative spread of vehicle types and sizes (from sports car to large pickup

truck). Feedback was gathered with 7-point Likert items and comparative questions. The lifting pocket was manually operated by the evaluator to simulate the intended experience (Figure 13).

As an aside, although drive-up ATMs are typically used from the left side of the vehicle (as they are used in USA, Canada and the Middle East), people differ as to whether they use their left or right hand to operate the unit; with people often leaning on their left arm (resting on the bottom of the vehicle window opening) to then pivot and use their right hand when parked further away, or choosing to use their left hand when parked closer to the unit. Participants were allowed to use whichever hand they preferred in this test.

Results

The lifting pocket for presenting cash was very well received. Overall, the lifting pocket was rated significantly easier than the slot for ease of use of withdrawal (mean 6.73 for pocket, 6.28 for slot, $W=3.40$, $n=40$, $p<.001$) and for deposit (mean 6.8 pocket, 5.68 slot, $t=-4.11$, $n=40$, $p<.000$). In both cases the difference was statistically significant. Participants also showed a clear preference for the lifting pocket for withdrawals (36 preferred pocket, one preferred slot, and three had no preference) and deposits (32 pocket, three slot, five no preference).

Figure 12: ATM models evaluated

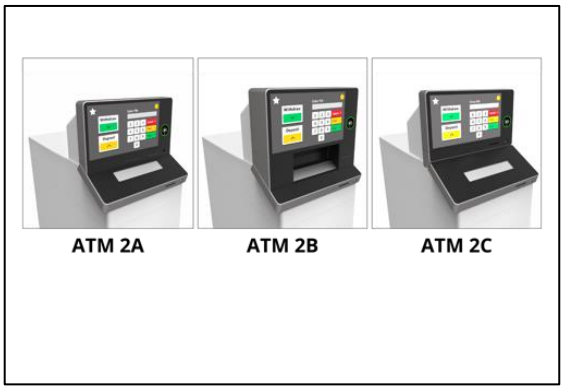

Figure 13: Display variations tested with pocket

In terms of display position, the recessed pocket (with display brought further forward creating a recess for the pocket) was rated the same for ease of use as the version where the pocket was fully open (both had a mean rating of 6.8) meaning that this recess did not impede usability of the pocket. Similarly, reach to the display was rated significantly higher for the recessed pocket version (mean 6.35) vs the mid or open pocket versions where the display was further back (5.78 and 3.70 respectively). Most participants (24) preferred the recessed pocket, with three preferring the open pocket, and 13 having no preference. Based on additional comments from participants the recessed pocket seemed to give a sense of security and protection to the pocket area, as well as bringing the display closer thus improving reach.

Figure 14: Evaluator lifting notes

Figure 15: Participant removing cash from pocket

These ratings were supported by overall rankings where the recessed pocket version was ranked first, the slot version rated 2nd worst, and the open pocket with the display furthest away was rated worst.

As a result of these findings, the lifting pocket was refined and then tested in a conventional walk-up (standing) context.

User test December 2017; functional models

In this user test 34 participants (26 male, eight female, all NCR staff) used a functional prototype of a lifting pocket, combined in a test rig with a touchscreen application (Figure 16). Participants were asked to insert and remove cash from the pocket, with both a medium (100) bunch of new US dollar test notes (Figure 17) and a very large bunch (200) of conditioned (well used) 200 Euro test notes (Figure 18). The 200 Euro notes were used as they were larger, and conditioned notes generally cause more difficulties as they get caught more easily and are more difficult for a mechanism to move. The 200 conditioned note bunch was the absolute maximum that the pocket could take – and thus was used as an extreme edge case in evaluating the prototype. Participants were asked to rate their experiences using 7-point Likert items from extremely difficult (one) to extremely easy (seven).

Figure 16: Participant using touchscreen

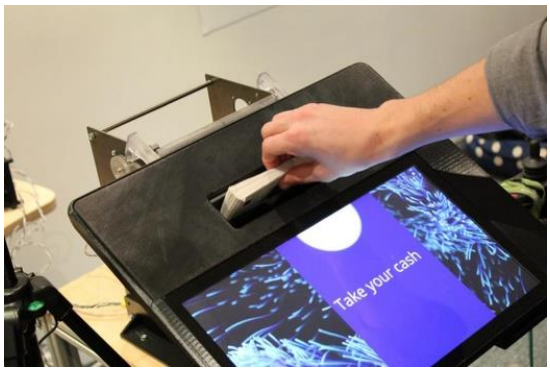

Figure 17: Withdrawing medium bunch

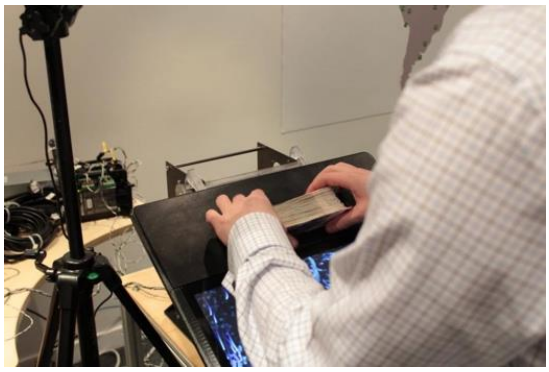

Figure 18: Depositing large bunch

Figure 19: Large bunch problems

The pocket was rated as very easy for withdrawing (mean 6.18) and depositing (mean 6.15) the medium bunch of notes. Ratings were lower for the very large bunch of conditioned notes with a mean rating of 4.82 for deposit, with many participants commenting that they would never insert such a large bunch of notes. It was considerably more difficult to deposit the bigger bunch of used notes (200 conditioned). In some cases, notes got caught on the top and/or bottom of the bunch (Figure 19). As a result, some participants experienced notes getting rejected or stuck with this large bunch.

The results from this user test were used to drive improvements to the design of the pocket, and subsequent expert reviews found that the large bunch of conditioned notes could be successfully deposited using the improved design.

Conclusions

Despite the limitations of these user tests with small numbers of participants and a variety of semi- or non-functional models being used, they give a clear message when considered as a whole.

Firstly, a pocket-style of cash recycler can be at least as usable as a slot-style of dispenser or cash recycler. Secondly, although it is rather different, people seem to quickly adapt, and in some cases, prefer this form of cash insertion and removal from an ATM. Thirdly, large bunches of cash can be successfully deposited, even by people with no prior experience or training of this type of task. Fourthly, lifting the notes on returning to the user can improve reach and visibility of the notes.

These results are encouraging given the trend to cash recycling at ATMs; meaning that the ease of use of future ATMs need not be negatively impacted by migrating to a pocket recycler.

The use of multiple, small-scale, user tests illustrate the benefits of iteration during the design process, and in having an in-house team that conduct user testing as part of the development of new technology.

More refinement is required to handle extremely large bunches of conditioned notes. Since the work that is reported here was conducted, there have been several changes made to the latest pocket recycler which address these issues.

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