Developing instructional decals for depositing cash at automated teller machines (ATMs)

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SUMMARY

This paper describes the iterative development of instructional decals by means of expert reviews and user testing to solve a field issue. Findings are presented and conclusions drawn on developing language-free, graphical decals to convey note orientation and positioning.

KEYWORDS

Instruction, decal, deposit, recycle, ATM.

Background

There is a trend in automated teller machines (ATMs) to move from those that solely dispense cash to ATMs that can accept and dispense cash through the same module (also known as a cash recycler). For example, by 2024, it is predicted that approximately 30% of all ATMs will recycle cash (NCR Atleos, 2022, PYMNTS, 2022). This migration to cash recycling meant that there was a need to help users to understand how to use the new technology. In self-service, this instruction often needs to take place on the device at the time of first use; through onscreen lead through and instruction, along with additional labels or decals affixed to the machine.

In some parts of the world (particularly North America) some ATMs had previously offered a cash dispenser (cash out) and a separate media deposit slot, into which a mixed bunch of cash notes and cheques could be inserted. This added to the challenge of migrating users to a cash recycler; now they were being retrained to put cash into a pocket, and cheques into a dedicated slot where previously they were able to deposit cash and cheques into one slot. Issues being reported in the field (through internal information channels) included users inserting cheques into the cash recycler, inserting cash into the cheque deposit slot, cash being inserted in the wrong orientation (short edge first instead of long edge first), or in the wrong axis (laid flat in pocket instead of stacked vertically).

Method

In this paper we outline an iterative, pragmatic approach combining expert (heuristic) reviews with small-scale, formative user tests to develop, evaluate, and refine instructional information for use in printed decals and onscreen.

The process consisted of the following steps:

- Instructional graphics were developed to show users how to insert cash correctly into the recycler.
- Expert reviews of the graphics by a multi-disciplinary team consisting of an interaction designer, an industrial designer, and a usability and accessibility specialist.
- First user test with 19 people investigated 3 decal designs.
- Decals were modified to address the main findings from this first user test.

- Expert reviews of the revised graphics were conducted by the team.
- Second user test with 19 people evaluated 1 revised decal design and 2 possible screen lead through designs.
- The decals and onscreen lead through were then refined to address the results of second user test, with subsequent expert reviews from the team.
- The decals then went into production to be used in the field (at early controlled deployment sites that took the cash recycling product).

First user test

This user test was conducted with 19 participants from NCR Atleos staff (11 male, 8 female). 14 stated that they had prior experience of depositing cash into an ATM. All used a non-functional ATM appearance model for the evaluation, with the decal being affixed to the left-hand side of the pocket, and yellow arrows being added inside the pocket (Figure 1). This test evaluated 3 different decal designs for the cash deposit 'pocket', and 1 design for cheque deposit.

The first decal variant for cash deposit showed the cash almost vertical with a hand above (Figure 2). The second variant eliminated the hand and yellow arrows, and instead had a single large green arrow showing the intended orientation (Figure 3). The third variant was a more abstract outline illustration giving less visual noise and visual affordance that eliminated the hand and all arrows, instead just showing the notes in a stylized pocket (Figure 4).

Figure 1: Experimental setup

Figure 2: Decal A, vertical notes, hand, yellow arrows

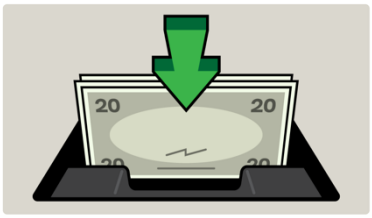

Figure 3: Decal B, vertical notes, large green arrow

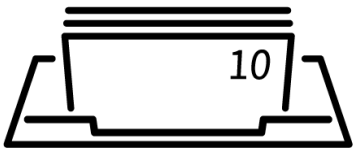

Figure 4: Decal C, vertical notes, outline illustration

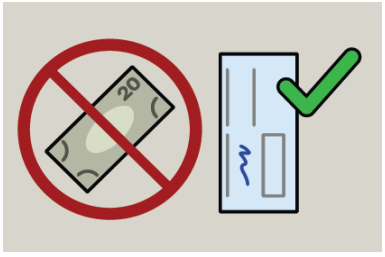

Figure 5: Decal D, no cash, cheques only

Figure 6: Cash inserted correctly into the pocket

First user test: Procedure

Task 1. Each participant was given a bunch of cash notes and asked them to insert the cash into the ATM, with decal A (Figure 2) being affixed to the machine. The evaluators did not give any indication of what was required and did not direct attention to the decal. Observations were taken of whether cash was inserted correctly. This included whether the cash was inserted in the correct

portion of the interface, namely the pocket; and whether the notes were oriented correctly within the pocket. Participants were then asked the following questions:

- Did the decal help you work out how to insert the cash?
- How easy or difficult did you find the decal to understand?
- How confident would you be depositing cash on an ATM like this?

Task 2. Each participant was then asked to compare decals B (Figure 3) and C (Figure 4) and state if they were better, worse, or the same as Decal A. Decals B & C were shown on a printed piece of paper that was held next to Decal A (Figure 10, Figure 11).

Task 3. Participants were also asked what they thought an additional decal, D, giving instruction for depositing cheques, meant (Figure 5).

Figure 7: Cash inserted incorrectly (long edge first)

Figure 8: Cash inserted incorrectly (short edge first)

Figure 9: Cash inserted into wrong fascia location

Figure 10: Decal B being shown

Figure 11: Decal C being shown

First user test: Results

Task 1. Participants were asked to insert cash notes. 15 inserted the cash correctly into the correct place (pocket), and in the correct orientation (long edge first, with notes stacked vertically in the pocket, as shown in Figure 6). Examples of incorrect note insertion are shown in Figure 7 and Figure 8. They were then asked if the decal helped them to know how to insert the cash. 9 found it helpful, with the other 10 not noticing the decal. Participants were asked how easy or difficult they found the decal to understand. 15 found it easy to understand, but 4 did not. Of these 4 all gave comments that suggested that they struggled to interpret 3-dimensional data from the perspective view that was given. *"Doesn't make sense with note perspective." "Cash angle was wrong." "Looks more like cash is being removed than deposited." "The hand should be at front not above."* Participants were also asked how confident they would be depositing cash on an ATM like this. All replied that they were confident, even those who inserted cash incorrectly or struggled with understanding the decal.

Task 2. Each participant was then asked to compare decals B (Figure 3) and C (Figure 4) and state if they were better, worse, or the same as Decal A (Figure 2). Decal B was found to be slightly worse

than decal A, with 5 saying it was better, 7 the same, and 7 worse. Comments included the following. *"Hand makes decal A easier to understand." "Makes the pocket look vertical not angled." "Green arrow helps." "Yellow arrows need to be on decal." "Needs the hand."* Decal C was found to be much worse than decal A, with 1 saying it was about the same, and 18 worse. Comments included the following. *"Hand is clearer on decal A." "Like this one but probably still need arrows." "Prefer the yellow arrows." "Not nearly as clear." "Lack of detail." "It's basic."*

Task 3. Participants were asked what they thought an additional decal meant (Figure 5). All participants correctly responded that this meant that no notes/cash should be inserted; instead, cheques only should be deposited.

Second user test

This user test had 19 participants from NCR Atleos staff (14 male, 5 female). Only 1 had taken part in the previous user test. 9 stated that they had prior experience of depositing cash into an ATM. All used the same non-functional ATM appearance model along with 1 decal design and 2 onscreen instruction proposals.

Figure 12: Decal E

Figure 13: Screen image 1, static

Figure 14: Screen image 2, sequence

Second user test: Procedure

In this user test a new decal, E, was evaluated based on the observations and comments from the first test, and to attempt to help those who appeared to struggle with interpreting the perspective. This new decal (Figure 12) again had yellow arrows, and these were also affixed to the pocket as before. 2 possible screen designs were also evaluated to further help people to know how to correctly orient the notes in the pocket. The first screen design was designed to be static, and just showed a representation of an incorrect orientation of notes, alongside a representation of the correct orientation (Figure 13). The second screen design, although printed as a static image, could be an animated sequence of images that show the notes being inserted into the pocket in the required orientation and alignment (Figure 14).

Task 1. The refined design of decal E was affixed to the same prototype machine used in the previous test. Again, each participant was given a bunch of cash notes and asked to insert the cash into the ATM (i.e., the pocket). Again, no indication was given by the evaluator of what was required.

Task 2. Participants were asked what they thought the 2 screen images (Figure 13, Figure 14) meant.

Second user test: Results

Task 1. Each participant was asked to insert cash into the ATM (using decal E, Figure 12). This time, all participants were able to insert the cash correctly first time (long edge first, with notes stacked vertically in the pocket, as shown in Figure 6). Participants were asked whether decal E helped them to work out how to insert the cash. 8 found it helpful, with the remaining 11 not

noticing the decal. They were also asked how easy or difficult it was to understand the decal; all 19 participants found it easy to understand. On being asked how confident they would be depositing cash on an ATM like this, all 19 participants were confident.

Task 2. Participants were asked what they thought the first screen image (Figure 13) meant. Comments included the following. *"Don't put cash in flat, put in vertical." "Insert notes straight down - don't put in flat." "Don't put flat, put straight in." "Icons don't mean anything - first look thought it meant don't insert cash but after read words it made sense." "Right and wrong." "Don't put it flat, put in angled." "Don't lay money flat." "Cash has to in pocket not on top." "Don't lay it flat." "Don't put it flat."* Participants were also asked what they thought the second screen image (Figure 14) meant. Comments included the following. *"Correct process.". "Put in from above." "Easier to understand - easier to understand with no words." "How to do it." "How to do it right." "Take money out and reinsert it." "Put cash in one wad - more confusing." "Instruction to do it right." "Vaguer - instructions could seem wrong." "Show you how to put cash in - more confusing." "Shows the wrong way to do it – confusing." "Have cash with number one way - would rather mixture of the 2." "Instruction how to insert." "Don't like it - the first picture is misleading."* Finally, participants were asked which screen was more helpful. 3 preferred screen image 2 (Figure 14), with 15 preferring screen image 1 (Figure 13), and 1 stating that they were about the same.

Discussion and Conclusions

These two user tests demonstrate how difficult it is to design a static, 2-dimensional illustration that accurately communicates a rather complex 3-dimensional action (that of orienting and inserting cash correctly into an ATM cash recycler pocket). Several general conclusions can be drawn from these two tests, particularly when the results are considered alongside notes taken by multiple observers during the evaluations.

The first of these is that the angle of perspective used in the illustrations matters. The decals used in the first user test (A to C; Figure 2 to Figure 4) were all designed to best mirror the actual perspective that would be seen by most people (i.e. angle of illustration was selected to approximate that seen from a user's eye height; that is looking from the side). However, participants preferred a less 'natural' perspective that was closer to a top-down view (E, Figure 12). It may be that this angle highlighted the key information that participants found to be useful; namely that of position of the notes in the pocket along with the note orientation. This is interesting, as it demonstrates that although perspective was helpful in giving 3-dimensional cues, it need not capture the most realistic view to be useful in giving information. This parallels the differing ways that perspective and depth have been represented through the history of art. In early Palaeolithic art, occlusion was used to denote depth, but there was no other representation of depth. Then in Egyptian art, everything was represented from its most characteristic angle; with the head and feet in profile, but the eye, shoulders, and chest best seen from the front (Gombrich, 2006). Shading to denote surface curvature, along with use of aerial perspective were used in 1st century Pompeiian art. The formalisation of the rules for linear perspective were formed in the 15th century (recorded by Battista Alberta) and since that time linear perspective was widely used in art (Brooks, 2017). Then in the 20th century, the Cubists (e.g., Metzinger, 1910) introduced the idea that a subject could be broken up, then reassembled in an abstract form, showing the subject from multiple perspectives at the same time. Although the results are different visually, there are some similarities with the ancient Egyptian mixing of angles for the same subject. It should therefore not be a surprise that it is sometimes helpful to mix or manipulate the perspective in an informational decal.

Another general comment is that the extra visual information (closer to a skeuomorphic representation, i.e. something that includes elements that mimic real-world counterparts) was judged to be more helpful than a flat, abstract illustration (as demonstrated by the poor ratings and lack of understanding of decal C, Figure 4). More particularly, the extra depth information including shading and occlusion appeared to help people to interpret the meaning of the decals.

This preference for the decals that included skeuomorphic elements (like decal E) over flat design (decal C) occurred regardless of age or experience. This is somewhat surprising as Backhaus *et al.* (2018) suggested that skeuomorphic design would be preferred by older adults, with flat design being preferred by younger people. Their paper (and much of the work in the literature comparing flat with more detailed icon design) is in the context of graphical user interfaces (GUIs) rather than printed decals, but one would still expect at least some of the findings to apply more broadly. If this was the case one would therefore have expected to see more positive ratings for the flat design by younger participants, with negative ratings being more likely by older participants. This was not the case in our evaluation, with the vast majority (18/19) rating it worse than any other design.

Oswald et al. (2014) suggested that flat designs may be more effective as users learn the meaning (e.g. the affordances offered by metaphoric-physical hints are less necessary). Similarly, Liu *et al.* (2023) stated that the cognitive load when using skeuomorphic icons was lower for novice users with less experience in interacting with the interface, with flat icons having a lower cognitive load only for users who are familiar with the interface. If this was the case, one would expect the flat design decal to have been better rated as people have been using paper/polymer notes for a very long time, and thus an abstract representation would seem to be sufficient. Again, this was not supported by the data; instead, a flat, somewhat abstract representation was found to not be understandable by participants and was rated badly. It may be that much of the work in this space has been on icons that have a very simple action associated with them (e.g. touch or slide here), whereas an instruction to correctly align, orient, and insert cash into an aperture in an ATM is a more complex task; thus the additional visual information offered by a skeuomorphic representation is useful to convey some of this complex information.

During our small-scale evaluations it was observed that people differed in their interpretation of the 3-dimensional illustrations, and that some appeared to apply very different interpretations to the spatial information (including positioning and orientation of the notes). It may be that this is due to individual differences in spatial reasoning (as reported by Hegarty *et al.*, 2006, Huttenlocher & Presson, 1973, and Coren & Porac, 1987 among others). Zancada-Menendez *et al.* (2015) found that spatial reasoning differed by gender, measured with the perspective taking/spatial orientation test (Kozhevnikov and Hegarty, 2001). They also demonstrated that spatial reasoning performance decreased across age groups. Zacks & Michelon (2005) supported these conclusions.

Similar findings have been reported in research investigating perception of depth in virtual environments. For instance, Caitlin (2007) found differences between people in their ability to correctly perceive depth. Depth perceptions varied for both real and virtual worlds, including judgement of distance. There were clear individual differences in depth estimation (Fahle & Henke-Fahle, 1996; Lampton *et al.,* 1995), and there was evidence that spatial ability is correlated with performance in tasks that rely on depth perception. Westerman & Cribbin (1998) found that the ability to perceive depth using binocular cues was not associated with the ability to perceive depth using monocular cues but was a strong correlate with ability to integrate multiple cues (similar to the multiple systems view outlined by Zacks & Michelon).

It also appears that these individual differences (in spatial reasoning, depth perception, and understanding of pictures) exist across cultures. Day (1989) found that similar difficulties in understanding pictures occur in pictorial and nonpictorial cultures. So, although there may be

individual differences, these difficulties exist across cultures, despite different cultural groups using different skills to perform the same perceptual task.

Although beyond the scope of this paper, it is also worth noting in passing the challenges of designing instructional information that does not use lots of text (language free). Abstract icons can be designed, but they usually need to be learnt, often by adding text labels to them. Once the meaning has been learnt, the text can be removed (see for example, Wiedenbeck, 2010). Arrows were helpful in drawing attention to the area of the pocket, but based on comments from participants there seemed to be some confusion as to what exactly the arrows were meant to represent.

All participants were from the UK and were therefore used to using a slot cash dispenser type of interface as these are prevalent in the UK. Even with a prototype ATM with the only source of information being a single decal affixed to the machine (Figure 1), some participants still attempted to insert cash into a 'slot'; with the only 2 possible options being a cheque deposit entry, or the receipt slot. This could be due to them using past, learned behaviour, rather than the information conveyed on the decal. Caroll & Olson (1988) suggested that this difficulty in changing behaviour without a prior period of training or familiarisation, particularly when that behaviour is well-established, can be understood as people having already constructed a robust mental model of how to do this task, and that retraining means that they need to construct a new mental model.

Alternatively, it may be yet another example of the fact that many people do not look at instructional information when using self-service technology such as an ATM (either on-screen or in any decals or instructions on the machine). We have seen this latter behaviour in many of our user tests over the years and have also observed this in the field (at live sites). Unfortunately, ATMs in the field often have a more complex interface, so any decal is even less likely to be noticed, recognized, or used.

The authors would like to thank all participants for their time and input.

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