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Designing for Spontaneous and Secure Delegation in Digital Payments

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Delegation is the practice of sharing authority with another individual to enable them to complete a specific task as a proxy. Practices to permit delegation can range from formal to informal arrangements and can involve spontaneous yet finely balanced notions of trust between people. This paper argues that delegation is a ubiquitous yet an unsupported feature of socio-technical computer systems and that this lack of support illustrates a particular neglect to the everyday financial practices of the more vulnerable people in society. Our contribution is to provide a first exploration of the domain of person-to-person delegation in digital payments, a particularly pressing context. We first report qualitative data collected across several studies concerning banking practices of individuals over 80 years of age. We then use analytical techniques centred upon identification of stakeholders, their concerns and interactions, to characterize the delegation practices we observed. We propose a *Concerns Matrix* as a suitable representation to capture conflicts in the needs of individuals in such complex socio-technical systems, and finally propose a putative design response in the form of a *Helper Card*.

RESEARCH HIGHLIGHTS

- A thematic analysis of interviews conducted with people aged over 80 reveals three common workarounds used to delegate small financial tasks to a trusted helper.
- A framework is set out to capture the interaction steps in these workarounds between four key stakeholders: the recipient, the helper, the service provider and the account provider.
- Critical properties of a delegation supporting system are proposed along with high-level concerns for each of the four key actors.
- A user-centred analysis of these delegation practices highlights potential conflicts and concerns in the workarounds we identified.
- The potential value of this framework for refining the design of new payment methods is illustrated through the design of a theoretical 'Helper Card'.

Keywords: human and societal aspects of security and privacy; access control; accessibility technologies; elderly usability of security and privacy

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1. INTRODUCTION

Computer security has its roots in the early years of computing in a military context, where system designers did not consider the impact of rigid security policies upon users. Today, computing technologies contribute to society in much more profound ways; however, traces of this security culture still exist in our everyday technology. These traces can be seen in systems that attempt to configure users to interact with computers in a way that prioritizes security, yet is incompatible with existing work practices, human cognitive limitations or processes of

interpersonal trust. This has led to a recognition that user-centred security (Zurko and Simon, 1996) is essential unless users find insecure workarounds to imposed systems or simply cease to use them at all (Adams and Sasse, 1999). Indeed, there is an increasing body of literature that documents how users can be forced to trade-off password security to obtain missing usability, often in creative ways unforeseen by designers (Kaye, 2011; Singh *et al*., 2007).

The practice of delegation (Dourish *et al*., 2004) appears to be one such phenomenon that provokes these creative workarounds, yet has so far received little attention from researchers in human–computer interaction (HCI). The act of delegation involves the entrusting of personal resources or system access privileges to another individual, who is then requested to use them according to specific instruction. By such a process, users are able to compensate for an experienced lack of capacity. Indeed, there are a number of contexts where it may be desirable for delegation to take place, e.g. access to email or mobile devices; however, the case of delegating everyday financial tasks is arguably the most pressing due to the direct risk of financial loss if resources are abused. There are formal legal mechanisms for sharing control of finances with a named substitute (e.g. substitute decision making), but these arrangements appear to be a blunt instrument for dealing with day-to-day financial matters (Tilse *et al*., 2003). Those in need of assistance and those willing to assist must—unsupported by payment systems—develop workarounds that represent a trade-off between trust, convenience and immunization against financial abuse. The invisibility of user practices that depart from this core assumption of one user, one account can be particularly harmful when considering older or disabled people, who may be more dependent upon others to gain access to money and to pay for goods. In this context, the lack of lightweight support for delegation and the imperative for users to carry out this practice can encourage the taking of undue risks with resources, and hasten the premature formal surrender of financial control.

System designers have typically taken a stance of ignorance towards person-to-person delegation; generally, the preference is an assumption of one user per account on a system, which intuitively is the most convenient configuration to implement and manage. However, we argue that a fresh approach is required: *spontaneous and secure delegation* is an easily initiated delegation with flexible but specified limits in terms of duration, value and function. Systems of this class should provide a lightweight means to share fixed-scope access to resources, while empowering users to make trust decisions, and allow helpers to feel valued. In this paper, we investigate the requirements for systems of this class with the motivating context of individuals over 80 years of age in the UK. This group is of interest for a number of reasons: firstly, they are diverse in terms of physical mobility and are not served well by the banking sector (Age UK, 2011); secondly, they grew up in a different landscape to younger generations in terms of management of finances and exposure to digital technology. By studying the practices of these users we hope to challenge the normal assumptions made by designers and discover insights that could benefit much wider user groups.

Our contribution is a first exploration of the domain of delegation in digital payments. As we will describe in this paper, the need to spontaneously and securely delegate financial matters is a complex socio-technical issue with many conflicting concerns at play. In response, workarounds are common practice, poorly understood and largely ignored by service providers. The discussion we present serves as a reminder of the impact of overly conservative security policies designed in isolation from those who will experience their effects. The paper is organized as follows: in the next section, we further motivate the need to explore spontaneous secure delegation. In Section 3, we present qualitative data that highlight workarounds observed in residential care homes that enable residents to obtain cash and carry out everyday financial tasks. The main contribution of the paper is Section 4, which presents an analytical framework for the features that systems providing spontaneous and secure delegation might provide. Analytical HCI techniques are used to characterize the delegation practices observed; these techniques are based upon representations of the actors involved, their concerns, the interactions between them and the properties of the delegation process. Finally, we propose a putative design response in the form of a *Helper Card*.

2. THE NEED FOR SPONTANEOUS AND SECURE DELEGATION

2.1. The needs of the recipient

We define a *recipient* as an individual who requires assistance to complete a task, and so will be the recipient of support. Access to finances and the ability to make payments is a basic need if one is to live independently. Indeed, countries such as Denmark have legislation that makes access to basic methods of payment a service obligation for banks (Age UK, 2011). In most cases the need for support from others to access money or services can increase vulnerability to fraud and *financial abuse*: the illegal use of the resources of an individual. In the UK, financial abuse of the elderly is thought to be severely underreported, although one charity estimates that those losses alone were worth £7.8 million (Action for Elder Abuse, 2006). In the USA, one study estimates that total losses were worth around $2.9 billion in 2008 (Metlife:Mature Market Institute, 2011). If a recipient has to increase his/her vulnerability to financial abuse on a daily basis to complete simple financial tasks, he or she may surrender financial independence sooner than is necessary. This might have considerable personal costs to the individual concerned as well as a potentially large financial cost to the state.

In the UK, mechanisms exist for formal substitute decision-making in the form of a *Lasting Power of Attorney* (LPA) as defined in the Mental Capacity Act 2005 (Great Britain,

2005). This enables the law to reason over the ability of a person to make decisions for their own benefit. Key features of LPAs include the assumption that a person has capacity until it is established they do not, and a lack of capacity cannot be demonstrated purely on the basis of an unwise decision. An LPA builds upon this legislation to enable one person to formally act on behalf of another person. LPAs are a very blunt instrument for the kinds of delegation we are considering here, and in practice may still not help a person to perform day-to-day transactions such as withdrawing money from the bank (Tilse *et al*., 2003). Paid formal carers are often discouraged from taking such responsibilities (Commission for Social Care Inspection, 2007; Department of Health, 2000) and families are the only realistic pursuers of such powers. It is worth noting that family members do not represent a silver bullet for problems of trust, as they are commonly perpetrators of financial abuse. A support line for care home residents revealed that 71% of complaints of financial abuse regarded family members (Commission for Social Care Inspection, 2007). Where formal powers of attorney are not suitable, there are financial systems that can form legitimate workarounds. Age UK (2011) presents a number of options, including direct debits and joint accounts. Such systems are useful, however, represent more permanent and invasive arrangements that do not fit our definition of spontaneous and secure delegation.

2.2. The needs of the helper

Dourish *et al*. (2004) have observed that delegation may be to: a person; to a piece of technology, e.g. a computerized standing order; or to an organization, e.g. Net Neighbours (Blythe and Monk, 2005). In this paper, we are concerned with delegation to a person. We define a *helper* as an individual who is willing to accept responsibility to be delegated to—i.e. carry out a task on behalf of a recipient within some specified parameters.

Helpers have different needs to recipients, and many are unpaid for their assistance. Unpaid i.e. informal helpers are an important societal resource; figures from the 2011 UK census showed that 10% of the population (5.8 million people) provided unpaid care for someone with an illness or disability. More than two million of these people were giving 20 or more hours of care a week. A recent report from Carers UK (2011) estimated that the economic value of the contribution made by unpaid carers in the UK was a remarkable £119 billion per year, considerably more than the annual cost of all aspects of the UK National Health Service in the same period.

A survey in Australia suggests that financial support by unpaid carers can take many forms, the most prominent being completion of paperwork, paying bills, banking and accessing money (Tilse *et al*., 2005). The same survey also uncovered that only 15% providing this support had a formal substitute decision-making procedure in place. Despite the obvious importance of these unpaid helpers when it comes to delegating financial tasks, current payment systems do not make the task of the helper easy. A helper is trusted with the financial resources of a person and must perform these tasks while avoiding the accusations of theft, particularly if a close relationship is not shared with the recipient. This creates the need for the helper to prove that they have behaved appropriately with the resources they have been assigned. False accusations can remove the incentive to participate in a delegation process in future. A strong argument is made here that spontaneous secure delegation should not only make the life of the unpaid helper convenient, but should also provide the helper with a positive experience.

Section 4 sets out a framework that can be used to create and reason about new procedures for secure spontaneous financial delegation. This will provide guidance for the design of future technology mediated payment systems and services to ensure that they meet the needs of recipients and helpers. However, first we report some of the delegation practices observed during our experiences working with the older old.

3. DELEGATION WORKAROUNDS

Researchers in HCI are beginning to explore the values held by those over the age of 80 regarding money and banking. Vines *et al*. (2011) assembled *Financial Biographies* from individuals over the age of 80; themes that emerged from the interviews suggested that the materiality of money and perceptions of control and locality were important in shaping money management practices. This study also uncovered that some participants had early experiences of spending money on behalf of family members as an exercise in trust, which shaped their own approach to sharing money with others in later life. Subsequent work explored the affordances of cheques as a payment instrument in order to understand the fierce opposition from this age cohort towards their abolition (Vines *et al*., 2012b). Participatory design methods have also been proposed to engage older cohorts in the design of future banking technologies (Vines *et al*., 2012a).

What is not fully explored in the previous work are the measures taken by participants in a state of decreased mobility, to reconfigure their interactions with payment systems to provide a means to access money via others. In order to explore this domain further, we performed a re-analysis of data collected by Vines *et al*. (2011, 2012a,b) using thematic analysis (Braun and Clarke, 2006). Interview participants included 12 individuals over the age of 80, two care home managers, a welfare-benefits officer, rights advocates for older people and representatives of financial organizations. Workshops included 10 individuals over the age of 80, and were carried out in groups of two to six. Data from the transcripts were summarized by codes and grouped together into themes. Three new themes emerged from this re-analysis: credential sharing workarounds, payback workarounds and cashier workarounds. Each theme is a workaround in the sense that users have built usage protocols, values and etiquette around existing payment technologies

to provide spontaneous financial delegation that serves to immunize against risk to a certain extent and be relatively convenient. The quotes presented in Sections 3.1–3.3 emerged as a result of our new analysis and serve to provide examples of the three themes; the data excerpts and corresponding discussion has not appeared in any prior work. As we will see, each workaround still bears risk or inconvenience for one or the other of the parties involved.

3.1. The credential sharing workaround

We commonly encountered descriptions of credential sharing during the project as a means of spontaneous delegation. This is where access codes such as passwords or personal identification numbers (PINs) are shared in order to allow access to payment systems for a designated other. *Chip & PIN* is a brand name attached to the EMV (Europay, Mastercard, Visa) smartcard technology introduced to UK payment cards in 2004. This technology was initially championed as a fraud reduction measure; however, paradoxically this technology also makes it easy to share card credentials with others, which is common among all age groups (Age UK, 2011). A recurring example of delegation encountered in our data involved a helper visiting an ATM using the payment card of another person. As an example, one participant recalled a situation where she had helped a friend by visiting the ATM on her behalf to withdraw cash.

> I was asked by a friend who couldn't get out […] she said can I give you my pin number and would you go to the cash machine and I did. She gave me a piece of paper and I clutched this piece of paper all the way there and all the way back and gave it to her. I went with the pin number to the cash machine and then went straight back to her.

During the research, we were informed of many similar instances where care home residents requested that a paid carer withdraw money on their behalf. Regulations for those working in care homes advise against carrying out Chip & PIN transactions for residents (Department of Health, 2000). This is to safeguard the carers against accusations of fraud, and preclude the possibility that the payment card is misused by the withdrawal of additional money from the ATM. One care home manager recalled a situation where a resident requested that money be withdrawn from the ATM on their behalf, but staff refused.

> Her response was: I'll get the taxi driver to do it. […] Of course that's the problem, you can say here's my PIN number, take out £50, and if they give you £50, you've no idea if they've taken 50 or 500 or whatever their daily limit is.

There is clearly a tension between the formal regulations for carers handling the money of others, and the imperative to provide support. One carer noted that she would be happy to help with exceptional 'one off withdrawals' but 'wouldn't want to have an authority to be going in regularly'. Another paid carer recounted an experience of providing situated support at an ATM and at a grocery store, assisting with PIN entry at the point of payment. She reflected upon her position if anything were later to go missing from the account: 'It makes me incredibly vulnerable.'

It is interesting to note that if a bank can prove *gross negligence* in the way an individual protects their PIN, they can reject liability for any financial loss (Financial Ombudsman, 2001). It appears that gross negligence consists of revealing the PIN to a third party or if it can be deduced that appropriate steps were not taken to keep it private e.g. it was written down. The definition of the term gross negligence appears deliberately vague when used in the banking regulations. However, it is clear that if an individual voluntarily gives the PIN to another party, and subsequently suffers financial loss, they will not be reimbursed for that loss.

3.2. The payback workaround

The second workaround we observed is a model of reimbursement. In a situation where access to a store or bank is limited (and sharing of credentials is inappropriate), the helper buys the required goods from their own funds, and is reimbursed upon delivering the goods to the person receiving care. This arrangement can serve to provide access to either goods or cash. Tilse *et al*. (2005) report that in a survey of 1259 informal caregivers, 49% reported that they had been delegated to using a payback arrangement within the previous 12 months. In fact, this study reports that a *payback* reimbursement is the most common informal financial arrangement reported, with use of an ATM PIN accounting for only 9.8% of cases. This practice was also evident in our research. One participant regularly takes part in such an arrangement, and mentioned that they have:

> elderly friends or neighbours and I do shopping for some of them. They either give me some money and I go and spend it, or I spend my own and then they pay me back.

The incentive for the helper to participate in this arrangement is based upon the assumption that they will be repaid for the purchased goods. Informal caring relationships, such as those between friends and neighbours, often work on the basis of this workaround. For many of our participants, there was an implicit trust of certain friends and carers that they will be repaid: 'if you know a person well you can trust them with anything.' The receipt for the goods provides reasonable documentation of the money spent by the helper; and the initial spend by the helper places the recipient in a position of power and likely increases their incentive to adopt this arrangement. However, this arrangement may become unattractive to the helper if a large purchase is to be made. Indeed, in a formal care setting this arrangement may also be undesirable, due to the fact that a carer may provide support to a number of individuals simultaneously, which might exert strain upon personal finances. In response, we noted that the payback workaround can be reconfigured to disperse this financial burden. Rather than being tasked to buy goods on an ad hoc basis, the care home would anticipate the goods that

would be in demand, buy them in advance, and sell them at face value in the home; this reduces the time burden upon the carers and their personal finances. One carer described the mini-shop they organized in the care home that sells everyday items:

> We have a little shop […] I buy stuff at the supermarket and put it on here almost at the price we buy for. The profit goes back to the residents and it covers losses in the shop. They can't get down to the shops for a bar of chocolate so that's why we have that.

In this case, the arrangement turns a small profit that is invested back into facilities for the residents. Similarly, *NetNeighbours* (Blythe and Monk, 2005) was a volunteer-based organization that performed online shopping for those with decreased mobility, and who were unfamiliar with the Internet. Money changed hands on the basis of a payback arrangement; volunteers paid in advance for goods and were reimbursed by the organization upon production of a receipt. This arrangement was preferred to the collection of money directly from the recipient, so as to not burden their face-to-face relationship with financial matters.

3.3. The cashier workaround

The final workaround we noted is the cashier workaround, which appears to form a compromise between credential sharing and a payback arrangement. If there is difficulty in providing a resident with access to the bank, then a bank (of sorts) must come to the resident. In this context, a care home manages a pool of money to be distributed by the carer who adopts the role of a cashier. In cases where family members take an active involvement in the care of an individual, this pool of money can be provided and maintained via their own involvement in the finances of a particular care home resident. One care home manager explained how she effectively becomes a cashier:

> We have a system where the family gives us an amount of money, for example £100, we use that money to pay things like the hairdresser, the chiropodist, any bits they want from the shop. Occasionally we have people coming along and asking for cash for whatever reason. It's taken from the envelope.

Such an arrangement removes the need for carers to interact with the financial institutions of its residents, but it also means that they must accept increased responsibility to account for the expenditure of the money. Holding this money on-site means care home staff once again may find themselves vulnerable to accusations of theft if cash were to go missing. To mitigate against this, staff have had to adopt methods of careful and transparent record keeping:

> We've got to cover our backs. As much as possible we get receipts or we get people to sign to say they've taken the money, why they've taken it, where's it gone. We keep a very accurate log of how this £100 has been spent.

In prior work it has been noted that a similar process would be used where the care home would temporarily make its own funds available on-site as a cash reserve (Vines *et al*., 2012b). Residents could then write out a cheque or an alternative promise of payment to the care home and receive cash on the spot. The use of cheques served to protect carers against accusations of theft as they form an audit trail for the resident via their bank statements, and for the care home via its accounts. The transparency of this process is a pressing concern, as the poor transparency of involvement in the finances of residents accounted for 33% of inspection failures for care homes in the UK (Commission for Social Care Inspection, 2007).

The main disadvantages of this arrangement are that the helpers must compensate for the lack of provision by the bank to serve its customers. Through the time that helpers must spend managing this arrangement a financial cost is incurred to the care home; however, this allows them a relatively close interaction with the cashflow and expenditure of an individual which means additional budgeting support can be provided. Of course, the goodwill involved in this process could be manipulated if the process is dependent upon cheques; these may be cancelled in advance of them being presented at the bank by the carer (or they may simply be rejected due to insufficient funds).

4. DESIGNING FOR SPONTANEOUS AND SECURE DELEGATION

Rogers *et al*. (2011) discuss a number of analytical evaluation methods for reasoning about the design of user interactions in socio-technical systems. Such methods enable the systematic analysis of an existing process to identify improvements or can help one to identify requirements for a completely new design. One class of such methods are termed *inspection methods*, of which, *Heuristic Evaluation* (Nielsen, 1994) is one of the best known examples. The intention behind this section of the paper is to provide an inspection method for understanding and designing systems to support spontaneous and secure delegation. The meaning of security in this sense is not to prevent poor trust decisions being made by a recipient, but to ensure that they are empowered to be in control of their resources and distribute them as they see fit; an approach to usable security in this context is important. The workarounds described in Section 3 can be thought of as procedures that have evolved around existing payment technologies and procedures to provide spontaneous delegation, with no explicit support from the payment system itself. Each workaround has a number of stages in common such as initiating the delegation and transferring funds. This section describes a generic delegation framework in terms of actors, concerns, interaction steps and delegation properties that can be used to reason about and improve design.

4.1. Actors, concerns, interaction steps and delegation properties

Figure 1 has some of the properties of a *Rich Picture* (Monk and Howard, 1998): a representation of the main actors in a

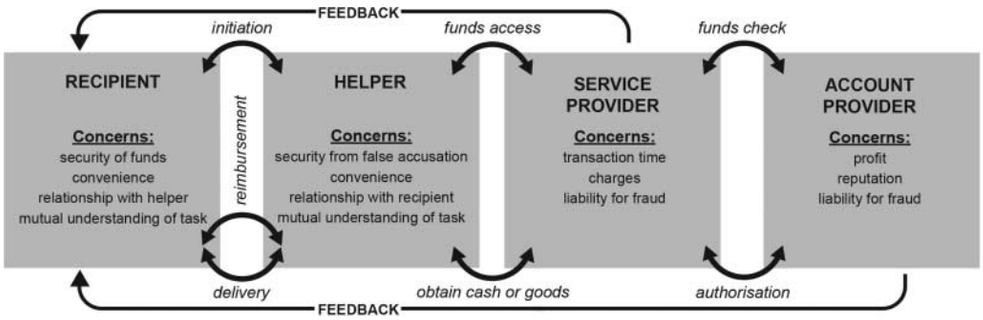

Figure 1. A generic model of spontaneous financial delegation, actors, their concerns and the possible interactions between those actors.

socio-technical system and how they interact to get tasks done. The representation also records the overarching concerns of these actors, which can be valuable in contexts where needs and concerns can be diverse and conflicting. The purpose of the representation is to enable designers to understand the high-level requirements of the deployment context. The presumption here is that there is a bank account holder who is the recipient of assistance from the helper. There are thus four actors: recipient; helper; service provider and an account provider. The arcs in Fig. 1 record the different interaction steps that might occur between these four actors. Most are two-way transfers of information indicated by double arrows. For example, the recipient interacts with the helper to initiate the delegation. This is a negotiation where the recipient contacts the helper and identifies the task they would like to be performed, and the helper must respond. Other interaction steps are similarly defined as two-way interactions between actors; these are, funds access, funds check, authorization, obtain cash or goods, delivery and reimbursement.

The set of actors, concerns and interaction steps were derived from the analysis of workarounds described in Section 3. The recipient and the helper have similar concerns; the recipient is concerned for the security of funds, while the helper seeks security from false accusation of fraud. Both desire convenience in the sense that any proposed process should fit everyday practices as much as possible. Both also wish to maintain the relationship they have with each other, as this is critical to any future assistance arrangements. Finally, there needs to be a mutual understanding of what the task is and the criteria for successful completion. The latter may seem trivial but we will be considering processes where helper and recipient communicate electronically where misunderstandings may arise. Mutual understanding corresponds to Clark's notion of common ground (Monk, 2008). The concerns presented relating to the service and account providers were derived informally from intuition, and conversations with payment professionals.

As a starting point, we presume that a service provider, such as a bank owning an ATM or a retailer owning a payment terminal, wants a fast payment method that costs little and does not leave them liable to claims in the case of fraudulent payments. The account provider also wishes to minimize liability in the case of fraud; both wish to make profits and maintain their reputation. The stakeholders identified in Fig. 1 are the key stakeholders, i.e. the four actors involved in the transaction, allowing a detailed analysis of possible space for their activities. Of course, there are many other stakeholders who have an interest in the behaviour of these key stakeholders. Family of the recipient will have opinions about these arrangements (Setterlund *et al*., 2007), and these relationships can impact their concerns at a given time. Regulators will have opinions about the activities of banks, and so on. This paper concentrates primarily on the concerns of the recipient and helper though the discussion returns to these broader issues.

At this early stage of analysis, the interactions identified in Fig. 1 already highlight space for innovation. For example, Fig. 1 indicates possibilities for more timely and sophisticated feedback from service provider and account provider to the recipient. These are single direction flows of information as indicated by the unidirectional arrows. For instance, during funds access the service provider could use technology to facilitate the authentication of the helper as someone to be trusted. The account provider could use additional logic at the authorization phase that would provide more fine-grained criteria by which to evaluate particular transactions; this could involve limiting the scope and permanence of transactions, and providing more sophisticated channels of feedback.

The analysis process proposed here involves representing a delegation process in terms of interaction steps and then reasoning about the advantages and disadvantages of that process as it impacts on the concerns of each of the actors in order to identify possible design innovations. To make this possible, it is necessary to first define a number of generic properties critical to an end-user facing delegation process.

4.2. Delegation properties

Table 1 provides a list of properties likely to be important in the understanding and design of a system that supports spontaneous and secure delegation. The starting point in constructing Table 1 was the discussion of key properties that

Table 1. Delegation properties.

Property	Description
Initialization	How the delegation is started and how parties become aware of the requirements of the delegation. Parties may be required to be collocated, or initiation may be actioned remotely should technology allow.
Scope	How the delegation is constrained, for example, by time or by amount. Once the delegation is out of scope no more transactions can be conducted.
Permanence	How parties determine the period of time for which the delegation is active. The delegation could be a recurring event or just a single event.
Accountability	How parties involved in the delegation can be held accountable for their actions. It might be desirable for the helper to be named, however, for more spontaneous arrangements this might not be desirable. Which transactions should be recorded, who should have access to these records and when?
Feedback	The granularity of the feedback regarding the occurring transactions, this could range from real-time notification to monthly feedback in bank statements. Is there a need for immediate feedback to helper or the recipient?
Surrender of access	The extent to which the recipient loses access to their resources as a result of delegating access to another person. The act of delegation should not remove the access privileges of the recipient.
Revocation	How either party stops their participation in the delegation. This could range from allowing a time period to expire or an explicit action using technology.

should influence the design of machine-to-machine delegation provided by Barka and Sandhu (2000). We translated this list into a form more suitable for person-to-person delegation, and then added additional properties abstracted from the discussion of workarounds in Section 3. To avoid repetition, Table 1 will not be expanded upon here. Rather, the remainder of Section 4 illustrates how it might be used to analyse existing scenarios of use by applying them to the three workarounds described in Section 3, and in Section 4.5 how they might be used to analyse the design for a putative system to support delegation. As a discussion aid we introduce three personas: *Jim* is an individual aged in his 80s who lives in a care home; he is not as mobile as he would like, and often needs assistance doing the shopping and withdrawing cash. Jim has the role of the recipient. *Mandy* is an 'informal' unpaid helper, a friend, who pays Jim a visit a couple of times a week to make sure he has everything he needs. *Debbie* is a paid or 'formal' helper, a staff member in the care home where Jim lives, who helps him get groceries and cash as best she can. In the following, we explore the impact of each workaround upon the concerns of Jim and either Debbie or Mandy depending upon which persona provides the most suitable example for the context.

4.3. Analysing the credential sharing workaround

The first scenario concerns the credential sharing workaround described in Section 3.1. This captures delegated transactions performed through the sharing of debit or credit card credentials for shopping or obtaining cash. The interaction steps required are characterized as follows (see also Fig. 2):

(i) *Initiation*: Jim (recipient) asks Mandy (unpaid helper) to go to the shop to buy a small number of groceries. Mandy visits the house of Jim to collect his payment card and remind herself of his PIN.

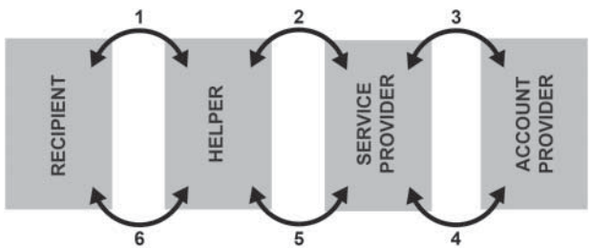

Figure 2. Interactions in the credential sharing workaround.

(ii) *Funds access*: Mandy visits the grocery store, finds the items Jim needs and uses his card and PIN to pay for the goods.

(iii) *Funds check*: the transaction is checked electronically by Jim's bank to ensure sufficient funds are in place to cover the transaction.

(iv) *Authorization*: Jim's bank sends an electronic response to the grocery store that there is sufficient credit in the account to proceed.

(v) *Obtain cash or goods*: the grocery store places all the items in a bag for Mandy and thanks her for her visit.

(vi) *Delivery*: later that day Mandy returns to Jim with his shopping and returns the payment card she used for the transactions along with the receipt as a sign of goodwill.

The credential sharing workaround represented in this way can now be evaluated step by step against the delegation properties in Table 1 and the concerns of Mandy and Jim listed in Fig. 1. Table 2 is the delegation *Concerns Matrix* that was used to do this. A delegation Concerns Matrix lists each noteworthy

Table 2. Delegation Concerns Matrix for the credential sharing workaround. J = Jim, D = Debbie (paid helper), M = Mandy (informal helper), − potential negative concern, + potential positive concern.

	Security		Convenience		Relationship compatibility		Mutual understanding	
	+	−	+	−	+	−	+	−
Initialization				Step 1 (D)	Step 1 (J,M)		Step 1 (J,D,M)	
Scope		Steps 2–5 (J,D,M)						
Permanence		Steps 2–5 (J,D,M)						
Accountability		Step 6 (J,M)						
Feedback		Step 5 (J)						
Surrender of access				Steps 2–5 (J)				
Revocation				Steps 1–2 (J)				

potential negative or positive concern with regard to a delegation property and the steps in the process where this concern applies.

The second column in Table 2 lists the interaction steps where perceived security could be improved for Mandy and Jim. The main issues of credential sharing relate to the permanence and scope of delegated access. Mandy has unrestricted access to Jim's money between Step 2 and Step 5. As indicated above, the notion of spontaneous and secure delegation implies limited scope and permanence. At Step 5, the feedback Jim receives is in the form of the receipt provided by Mandy, however feedback from the bank only arrives with the next printed bank statement; this is potentially weeks after the transaction has occurred. Also in terms of feedback, Mandy has no record that the groceries were received by Jim at Step 6; if Jim were malicious or confused he could claim that Mandy did not provide him any goods or spent his money inappropriately. This can be considered as an accountability issue that conflicts with the concern of Mandy to feel secure from accusations of fraud.

The third and fourth columns in Table 2 are used to reason about the convenience of the process for Jim and Mandy. One limitation at the initiation phase in terms of convenience is that Mandy must visit Jim at Step 1; although, it is possible that on a social level Jim might appreciate two separate visits from Mandy. Another limitation with regard to convenience is that during Steps 2–5 Jim must surrender access to his card, and thus his bank account, and must hope that Mandy returns with the card in a timely manner. If a number of disputed transactions occur or Mandy does not return with the card, and Jim wishes to revoke her card access, then he must call the bank and cancel the payment card. Unfortunately, this would amount to surrender of access for Jim until a new card could be issued. Cancelling the card would also have implications where coercion is a factor in the relationship between Mandy and Jim, as Mandy would certainly know that only Jim could have blocked the card in this way. If Jim changed his mind about the groceries he needed, or that he needed those goods at all i.e. wanted to revoke the access of Mandy to his account, he must contact her via a telephone call between Steps 1 and 2. The remaining columns in Table 2 are used to reason about possible effects of the process on the relationship between Jim and Mandy, and their mutual understanding; both of which are positively impacted upon due to the need for face-to-face contact both before and after the delegation is performed.

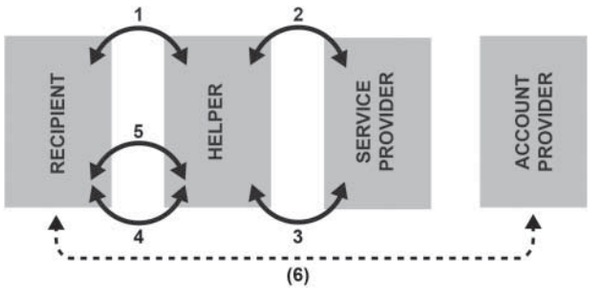

Figure 3. Interactions in the payback delegation workaround.

4.4. Analysing the payback workaround

The second scenario concerns the payback workaround first described in Section 3.2. This involves the recipient asking the helper to buy goods in advance with reimbursement upon delivery. The payback workaround can be characterized (again using Jim and Mandy) according to the following steps (see also Fig. 3):

(i) *Initiation*: Jim (recipient) calls Mandy (unpaid helper) on the phone and asks her to buy a specific set of groceries, and promises to pay for them once she visits him later on to make the delivery.
(ii) *Funds Access*: Mandy visits the grocery store when she finds the time, collects the goods that Jim required, and pays the grocery store using her own payment card or cash.
(iii) *Obtain Cash or Goods*: The payment is approved by the grocery store, and the clerk packages the goods and bids Mandy farewell.

Table 3. Concerns Matrix for the payback workaround. J = Jim; D = Debbie (paid helper); M = Mandy (informal helper); −, potential negative concern; +, potential positive concern.

	Security		Convenience		Relationship compatibility		Mutual understanding	
	+	−	+	−	+	−	+	−
Initialization	Step 1 (J)		Step 1 (J,D,M)		Steps 1, 5 (J,M)		Step 1 (J,D,M)	
Scope	Step 1 (J)							
Permanence	Step 1 (J)							
Accountability		Step 5 (H)		Steps 2–5 (J)	Step 1 (J,M)			
Feedback	Step 5 (J)							
Surrender of access	Steps 1–5 (J)		Steps 1–5 (J)					
Revocation			Steps 1–2 (J,D,M)					

(iv) *Delivery*: Later in the day, Mandy calls round to the house of Jim and presents him the goods, and the receipt that shows how much money she spent on the goods.
(v) *Reimbursement*: Jim is satisfied with the goods, and inspects the receipt to ensure that Mandy did not spend more money than he thinks is appropriate. Then he reimburses her with cash he keeps in the house.

In this case there is also an implication that to perform the reimbursement at Step 5, Jim has been able to obtain cash from his bank already or can arrange payment by cheque. This assumption is captured in Fig. 3 as the dotted interaction (number six). The Concerns Matrix in Table 3 identifies potential problems arising from the fact that Mandy must pay for the groceries in advance of being reimbursed at Step 5. There is a risk, hopefully tempered by the fact that Mandy and Jim know each other quite well, that Jim could refuse to repay the full costs incurred. This results in a negative mark in terms of the security of the arrangement to Mandy. In addition, if Jim repays the money using a cheque, Mandy must then visit the bank herself at some stage. From the perspective of Jim, this workaround is advantageous for both convenience and security. The scope and permanence of the delegation are implicitly constrained, as Mandy would hopefully not spend more money that she has to, due to the risk of not being repaid. Also there is an implication of trust due to the promise to reimburse Mandy made at the initiation phase; successful completion of the task on this basis can strengthen their relationship. There are convenience benefits for both Mandy and Jim in terms of initialization as they do not need to be collocated to action the delegation i.e. to exchange payment instruments. Revocation of the arrangement is also convenient (via a phone call). While accountability is desirable from the perspective of Jim (Mandy must prove to Jim the amount she spent), there is no paper record available for Mandy to record her actions. The latter would be useful for formal paid carers who may need to maintain an explicit audit trail.

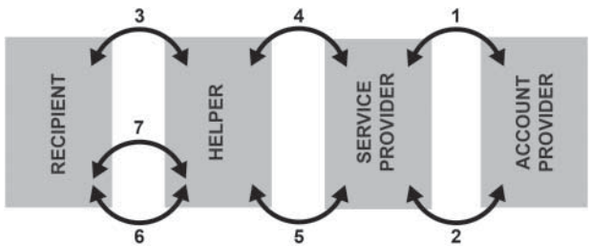

Figure 4. Interactions in the cashier workaround.

4.5. Analysing the cashier workaround

Both the credential sharing and the payback workarounds provide some risk that financial resources of the two active parties will be abused, however, delegation in both cases is relatively spontaneous. The next generalized use case is the cashier workaround (see Section 3.3). Here, the risks are mitigated by the care home becoming a service provider and taking responsibility for providing a source of cash that can be made available to residents. In this workaround, Jim can access cash by providing some promise of payment to Debbie, who manages the source of money. The interaction steps are the following (see also Fig. 4):

(i) *Funds check*: Debbie (paid helper) makes a request to the care home to provide a pool of cash for residents.
(ii) *Authorization*: The care home authorizes the request, and withdraws the money, to be managed and accounted for by Debbie.
(iii) *Initiation*: Jim (recipient) needs some cash to buy a present for a friend, he finds Debbie and asks whether he can draw a specific amount of money from the source managed by the care home.
(iv) *Funds access*: Debbie determines that this amount of money exists in the money source.
(v) *Obtain Cash or Goods*: Debbie removes the cash from the money source.

Table 4. Concerns Matrix for the cashier workaround. J = Jim; D = Debbie (paid helper); M = Mandy (informal helper); −, potential negative concern; +, potential positive concern.

	Security		Convenience		Relationship compatibility		Mutual understanding	
	+	−	+	−	+	−	+	−
Initialization				Step 7 (J) Steps 1, 2 (D,M)	Step 3 (J,M)		Step 3 (J,D,M)	
Scope		Step 7 (J) Steps 1, 2 (D,M)						
Permanence								
Accountability		Step 7 (D,M)		Steps 2, 6 (M)	Step 3 (J,M)			
Feedback		Step 7 (J)						
Surrender of access								
Revocation				Steps 3–6 (J,D,M)				

(vi) *Delivery*: Debbie gives Jim the required cash from the funds of the care home.
(vii) *Reimbursement*: upon receiving the cash, Jim gives Debbie a cheque for the same amount, made payable to the care home.

In this arrangement, the role of the helper and the service provider appear very similar, however, the helper provides the interface to the money service. This arrangement is not convenient for Debbie who must take responsibility for the locally held funds (Steps 1 and 2). Despite the formal care context, under most circumstances the relationship between Jim and Debbie would not be negatively impacted due to the transparent initial exchange of cash for cheque. It also provides mutual understanding of the task at Step 3 due to the face-to-face context. This exchange at Step 3 also conveniently limits the permanence and scope of access to the account of Jim, and does not require Jim to surrender access to his account.

Concerns of security overall are increased by the need for Jim to keep a cheque book (Step 7), and Debbie to manage locally held funds (Steps 1 and 2), respectively. The security column in the Concerns Matrix in Table 4 reflects the risk to Jim that Debbie or a malicious colleague could steal one of his cheques and draw money from the money store. This is a more pressing problem due to the fact that previous cheques written by Jim (as a regular user of this service) are likely to exist in the care home providing both blank cheques and examples of his signature. For Jim to detect this kind of activity he would have to contact his bank or wait for the periodic statement. For this reason, an electronic transaction with immediate feedback of a transaction at Step 7 might be preferable to the existing cheque clearance procedure. There is also a risk that Jim could cancel the cheque after Step 7 and before Debbie could visit the bank to cash the money. The overall limitations of this workaround are that an organization or a group must exist to mediate between the two parties; and the burden upon the helper to record the money that changes hands.

4.6. Design case study: Helper Card

Each of the aforementioned workarounds represent trade-offs between the need to help Jim access money or pay for goods, be convenient for all parties and provide some security of resources. The *credential sharing* workaround described in Section 3.1, the *payback* workaround in Section 3.2, and the *cashier* workaround in Section 3.3 illustrate how workarounds can emerge that shift the vulnerability to risk to suit either the helper or the recipient. Based upon analysis of those workarounds there is a need for a solution that can simultaneously overcome a number of limitations that each workaround illustrates individually:

(i) The account provider is not aware of a delegated transaction is taking place.
(ii) The service provider is not aware of a delegated transaction is taking place.
(iii) The risk to the recipient of making a poor trust decision can be unlimited.
(iv) The recipient receives no feedback as regards to the progress of delegated transaction.
(v) The need to keep manual records of transactions.
(vi) The resources of helpers and recipients are placed at risk.

This section illustrates the potential value of our framework for refining the design of new payment methods, by applying it to the design of a *Helper Card*: a payment card connected to a bank account in a conventional manner except that it is designed for use by someone other than the holder of the account, and can be configured to give limited access to that account. Also as the account provider knows that the user of the card is not spending their own money in person, it can institute internal fraud detection mechanisms and assign liability in the case of fraud. The value of our proposed Helper Card is not its use of novel technology to make payments, but the recognition demonstrated by its design that existing infrastructure still has

Figure 5. Mock up of how a delegation card might look, this would be visibly different from a normal credit card to emphasis the different type of transaction.

untapped potential to support future solutions in this domain. We chose to incorporate the usage of a common payment card due to it being a familiar method of making payments in the high street to users, and the infrastructure to support payment cards is ubiquitous. Indeed, the Helper Card can even make use of the infrastructure that is already in place to facilitate prepaid Visa and Mastercard payments. We argue that such compatibility is a strength of the Helper Card proposal; the conservative nature of the banking industry with respect to novel technologies means that minimal disruption to existing infrastructure is an attractive attribute of any proposed solution in this domain.

There are a number of ways the Helper Card could be instantiated and configured; in this section, we assume that touchscreen technology is available to allow the design of a simple and usable interface. Expenditure on such a device could be justified especially where particularly high reliance on delegation is noted, although other technologies, such as a telephone call, could be more appropriate given the context. In order to provide a sense of the likely user experience we mocked up a card (see Fig. 5) and a number of screen designs (Fig. 6). We designed the card to look different to a normal payment card to make clear to merchants that the person carrying it is a helper. The first screen invites the recipient to touch one of three buttons depending on whether they want to delegate shopping, cash withdrawal or record a receipt (see below for explanation of the latter). It is assumed that the account provider has registered a small number of helpers who have been given Helper Cards to keep with their other bank cards. The next screen has pictures of the helpers registered for the relevant task. Two further screens could provide a choice of maximum payments (e.g. £10, £20, £50 or £100) and expiry times (e.g. a recommended 2 h, 4 h, 1 day or 1 week). The recipient then confirms or cancels what they have specified and in the former case receives feedback that the Helper Card has now been authorized for that task and can specify a one-time PIN for the transaction on that card.

In the following, we describe the efficacy of such a solution in terms of interaction steps and design considerations when reasoning about the design space. The initial design described is for use by a paid helper where accountability is particularly valuable. This is analysed in Section 4.6.1 (Debbie helping Jim). Section 4.6.2 analyses the same system with regard to the concerns of an unpaid informal helper (Mandy helping Jim).

4.6.1. The Helper Card—Debbie

The care home where Jim lives recently adopted the Helper Card system. This enables all the carers to support residents with their finances in a way that is controlled by the residents and allows carers to keep an audit trail of their activities. Jim has a single Helper Card that he can charge up and distribute to whichever carer has the time to help him on that particular day. The interaction steps involved when using this are the following (also illustrated in Fig. 7):

(i) *Initiation*: Jim (recipient) asks Debbie (paid helper) whether she can visit the store to buy his friend a gift; Debbie agrees, and so Jim interacts with his Helper Card device to credit the card with enough money to buy the gift, and limits the scope for the delegation to a single afternoon. Jim then hands over the card to Debbie who writes down the one-time PIN.
(ii) *Funds Access*: Debbie visits the gift shop and finds the gift that Jim requested her to buy. She brings the item to the cash register and presents the Helper Card when asked for a payment method.
(iii) *Funds Check*: the payment system connects electronically with Jim's bank, notes that this is a delegated transaction, and checks that this payment fits within the constraints chosen by Jim.
(iv) *Authorization:* Jim's bank approves the transaction.
(v) *Obtain Goods:* the store bags up the gift and thanks Debbie for her visit, and gives her a receipt.
(vi) *Delivery:* later that day, Debbie returns to the care home and presents Jim with the gift he requested.
(vii) *Feedback:* Jim can see on his Helper Card device that Debbie did indeed spend the money as he intended, and confirms on the device that Debbie has returned the Helper Card and the item.

These interaction steps are identical to those specified for the credential sharing workaround described in Section 4.3 except that the scope and permanence of the delegation are limited at Step 1, and enforced at Step 4. It could also be possible to add other constraints to the scope of the delegation, such as limiting use to a particular retailer or ATM. Table 5 records this as a positive attribute under security for recipient and helper. The other main innovation in this procedure is to improve accountability; Jim can request information about the use of the Helper Card at any point using his touchscreen terminal giving him confidence in the security of his money. Should

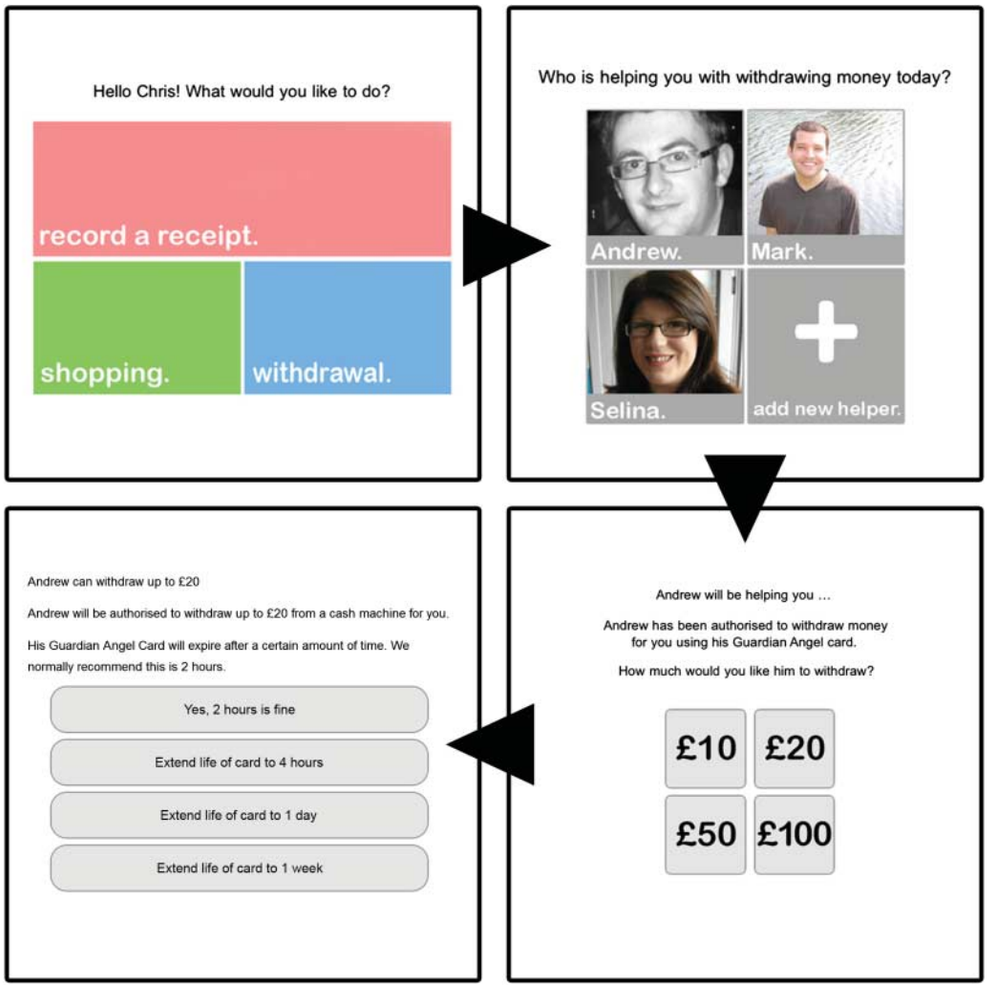

Figure 6. Potential sequence of interfaces to allow interaction with the Helper Card infrastructure.

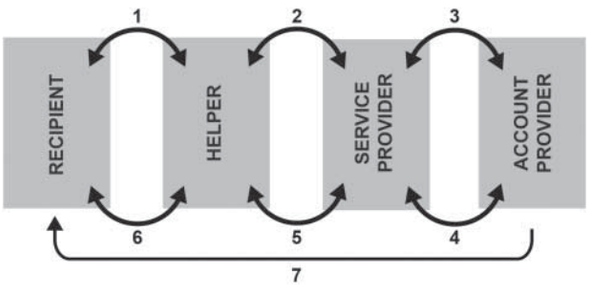

Figure 7. Interactions using the Helper Card.

Debbie be accused of misusing the card, the care home should be able to obtain this record and scrutinize it with Debbie. This gives her confidence in the security of her reputation (see Table 5). It is possible that further delegations to Debbie could be blocked unless Jim completes Step 7. This would ensure Jim used to the interface until completion of the task but in practice might reduce convenience and could lead the helper to feel not trusted. The intention is to increase security, however, to achieve a satisfactory outcome in this context of dispute requires a careful design; the important point to note is that Jim is in control.

At initiation, both Jim and Debbie must be collocated to exchange the payment card and one-time PIN; this is not a problem in the context of the care home and is recorded in Table 5 as a positive attribute reinforcing the relationship between Jim and Debbie due to the face-to-face initiation. This arrangement also presents benefits to Jim in the case of the need for revocation or reconfiguration of the privileges of the Helper Card; Jim could change his mind about the arrangement and simply use the Helper Card terminal to amend the arrangement.

Table 5. Concerns Matrix for the helper card. J = Jim; D = Debbie (paid helper); M = Mandy (informal helper); −, potential negative concern; +, potential positive concern.

	Security		Convenience		Relationship compatibility		Mutual understanding	
	+	−	+	−	+	−	+	−
Initialization			Step 1 (M)		Step 1 (J,D)		Step 1 (J,D)	
Scope	Steps 1, 5 (J,D,M)							
Permanence	Steps 1, 5 (J,D,M)							
Accountability	Steps 1–7 (J) Step 7 (D,M)					Step 7 (M)		
Feedback	Step 7 (D,M)			Step 7 (J)				
Surrender of access			Steps 2–6 (J)					
Revocation	Steps 1–3 (J)		Steps 1–3 (J)			Steps 1–3 (D,M)		

Although if Jim does this without telling Debbie in advance, this could affect their relationship due to awkwardness that could result should her payments be declined with no prior indication from Jim. This is noted in Table 5 as a potential negative impact on relationship compatibility for the helper. In addition, this configuration should have measures to ensure that Jim cannot use the interface to falsely delegate a task to one of the carers and later make accusations of theft.

4.6.2. The Helper Card—Mandy

Jim was also able to register his friend Mandy to use the Helper Card; because Jim sees Mandy fairly regularly he registered her for her own personalized card. He thought this would show her how important her support is, and also increase convenience, as she would always have this card in her possession. The interactions are similar to the case of Debbie (the interaction steps are the same as illustrated in Fig. 7):

(i) *Initiation*: Jim calls Mandy on the phone and asks whether she can help him by visiting the store to buy a gift for Debbie as it is her birthday; Jim appreciates the daily help she gives to him. Mandy agrees, and so Jim interacts with his Helper Card device to credit the card of Mandy with enough money to buy the gift, and limits the scope for the delegation to a single afternoon.
(ii) *Funds Access*: Mandy visits the gift shop and finds the gift that Jim requested her to buy. She brings the item to the cash register and presents the Helper Card when asked for a payment method.
(iii) *Funds Check*: the payment system connects electronically with Jim's bank, notes that this is a delegated transaction, and checks that this payment fits within the constraints chosen by Jim.
(iv) *Authorization:* Jim's bank approves of the transaction.
(v) *Obtain Goods:* the store bags up the gift and thanks Mandy for her visit, and gives her a receipt.
(vi) *Delivery:* later that day, Mandy drops into the care home and presents Jim with the gift he requested.
(vii) *Feedback:* Jim checks his Helper Card device that Mandy did indeed spend the money as he intended, and on the interface confirms that Mandy did indeed perform as instructed.

Much of the Concerns Matrix remains unchanged, however, there are some critical differences that are represented in Table 5. Initialization is particularly convenient for Mandy as she does not need to visit the care home to collect the Helper Card before setting off to perform the shopping; the cost of this is a lost opportunity to reinforce their relationship with a face-to-face meeting. Due to the fact that the relationship at stake is one of friendship, the feedback phase at Step 7 has to be designed sensitively to ensure the perception of being trusted is given by the interactions of Jim with the system. This is recorded in Table 5 under relationship compatibility. Indeed, mediating these kinds of disputes (bearing in mind the diversity of family relationships) via the user interface remains a challenging route for future research in this domain.

This personalized element of the Helper Card could be useful to provide visibility to more long-term delegation arrangements between individuals. It has been noted that family members are often the perpetrators of financial abuse (Action for Elder Abuse, 2006), which means those who intuitively we might wish to trust the most, might require their behaviour to be scrutinized the most. Such an arrangement is beneficial for service providers and account providers as they will gain greater insight into the delegation practices of the recipient; this can serve to shed light on patterns of spending that might otherwise seem unusual. There are also benefits for accountability as Mandy will have her own payment card and PIN and so can

be held accountable for her actions. One limitation of this arrangement is that Mandy could feel distrusted by being asked to formally enrol into such an arrangement (especially if she is a family member). This could mean that social constraints prevent Jim from requesting that Mandy enrols into this personalized arrangement, which may entice them to revert to using one of the workarounds described previously. Alternatively, Mandy may find it less invasive to use a Helper Card that functions the same as in the previous formal care context. Careful design of the Helper Card and its surrounding infrastructure can serve to highlight appropriate ways to introduce the system into an existing relationship, to provide value for both helper and helped.

5. DISCUSSION

In this paper, we have argued that facilities for spontaneous and secure delegation would be a beneficial feature of future digital payment services. Financial matters are arguably the most important resource that a computer user can access, which superficially has been used to justify overly conservative approaches to security. It is often said that flexibility is the enemy of security (Gollman, 2005), however, it is clear that inflexibility in socio-technical systems is also the enemy of security (Adams and Sasse, 1999). Methods to understand practices of users and the constraints placed upon them should ultimately result in the design of system functionality and associated security mechanisms that provide a more appropriate fit for the context. Indeed, previous research in the usable security community has provided critique for strict models of access control that assume a single user per account: Singh et al. (2007) comment how remote islanders gave bank cards and PINs to a single person who would catch a plane to the mainland to perform transactions in bulk for the whole island; Egelman *et al*. (2008) proposed that family accounts would be a useful computer account paradigm to suit the living patterns of some family groups; Karlson *et al*. (2009) explored requirements of allowing constrained access to mobile devices; finally, Kaye (2011) presents self-reported accounts of password sharing between friends, colleagues and family members.

The ubiquity of the practices we report do not serve as proof that the problem of delegation is solved, but illustrate the widespread poor fit that mechanisms have to those in society who deviate from the so-called normal use. There are groups of users, particularly those with reduced mobility, who must trust others for day-to-day financial tasks, often in environments where those who care for them may change frequently. In such cases, the user may not have the luxury of choosing whom to trust. Here, the possibility of secure and spontaneous delegation would empower those with mental capacity to manage their finances via others in formal and informal caregiving contexts. The framework described in this paper is designed to make the specification of such facilities fit in with the concerns of its users, including the concerns of the helper.

5.1. Broadening the application of the framework

This paper has focused on the concerns of the recipient of help and the person helping them. Even within this narrow focus a number of interesting issues likely warrant further exploration. For example, so far we have not discussed privacy; interestingly privacy was not a term used by the participants in the studies described in Section 3. However, in this context there may be more subtle meaning attached to the concept of privacy, perhaps more salient in other groups, which we have not covered here. Technology such as the Helper Card would not facilitate the undue disclosure of financial details to helpers (whereas workarounds such as credential sharing may); privacy concerns could also be embedded in the carrying of the Helper Card itself. Our list of key delegation properties was designed to be minimal to make the analysis tractable, which provides opportunity for other investigators to add to the list in future.

Similarly, a limitation of the framework as described in this paper is that we have only briefly considered the concerns of the payments industry. Figure 1 assumes that service providers are concerned about transaction times, charges and being liable in the case of fraud. The concerns of account providers are specified at a similarly high level. None of these concerns are translated into design considerations in Table 1. As pointed out in Section 4.1, our enumeration of the key stakeholders consists only of the four actors directly involved in the transaction and ignore other indirectly involved stakeholders such as family of the recipient or financial regulators. Also, this paper has focused upon the situation in the UK. Broadening the method in all these ways remains a priority for future work.

On a more positive note, the framework presented could be adapted for use more generally to reason about the design of new payment systems; Sections 4.4 and 4.5 showed that only small modifications were required to describe two rather different use cases to the original credential sharing workaround. Financial delegation has been identified as a problem in other domains (UK Payments Council, 2011). For example, a delegation card with limited scope or permanence could be given to: (i) the recipient of state benefits of one kind or another; (ii) younger people with mobility or cognitive difficulties; (iii) a child who needs to pay for school activities or (iv) an employee of a small business in place of petty cash or a company credit card. As was noted in Section 4.1, the framework assumes that the recipient of help is a bank account holder. If the 'recipient' is replaced by the term 'account holder' and the term 'helper' by 'delegated person' then much of our framework can be used in all of these cases. Clearly, the concerns and processes would be different and would warrant empirical study but the delegation properties

would still hold and could be used to reason about design in a new Concerns Matrix.

5.2. Practical Concerns

A sustainable society requires financial services that are accessible, affordable and bespoke throughout the life course. Governments around the world have reacted to the unprecedented ageing of their populations with research programmes for technology that allows older people to maintain independence. Fundamental to this vision is financial independence, and yet as we have seen new banking systems have developed with little to no regard for the needs of the elderly. The number of people affected is considerable. To re-emphasize two statistics mentioned earlier in the paper: 10% of people over 75 years of age relied on somebody outside of their household to do their shopping for them (Age UK, 2011) and six million people looked after or helped others with 'long-term physical or mental ill-health or disability or problems related to old age' (Carers UK, 2011). Despite this there is no easy and secure way to delegate small tasks such as shopping that meets the needs of both helper and helped.

Happily, much of the infrastructure for something like a Helper Card is already in place. Prepaid cards can be obtained that function just like any other Visa or Mastercard but only up to a pre-paid limit. There are also gift cards that have been available for many years but are limited for use in specific stores and have little in the way of security features. To use an existing pre-paid card as a Helper Card, it is still necessary to interface with the issuing bank in order to provide an easy way to pre-load it with the specified amount and then to remove this sum when it expires. Such innovation is promising, as it demonstrates the flexibility in the surrounding payments infrastructure that could enable methods of spontaneous and secure delegation to be realized.

6. CONCLUSION

The problem of designing digital payment systems to support financial delegation lies at the intersection of a number of challenging socio-technical issues, such as trust, user experience and security. In this paper, we identified workarounds carried out by users to obtain risk-limited delegation functionality from their bank account, and provided a framework to assist designers to both understand and support this functionality in future digital payment systems. Our detailed analysis of these workarounds serves to illustrate the complexity of the practices that users can develop to obtain functionality a system does not provide, and the trade-offs they are prepared to make. Our proposal of the Helper Card enabled us to carry out thought experiments with regard to how one design response to the problem might be appropriated, however future research is required to validate that the overall service as we propose it would result in positive experiences for users. Future research in this domain provides interesting challenges, and requires future developments in terms of payments technology that can be readily studied, and methods to further understand the practices that exist between helper and helped. This paper is a call to designers to focus upon developing an understanding of the relationships between these individuals and user groups, and to design digital payment systems to reflect that understanding. What this means is a need to capture and design for a specific form of user experience—the experience of helping and caring for another person, be that friend, family or service user. The importance of a helper in society is measurable and is also large. We have argued that future digital payment systems should provide functionality that supports the delegation of everyday financial tasks; such functionality is likely to also be embraced by other groups in society too. To design technology in a manner that retains the experience of helping another person, while also taking a more experiential approach to understanding the trust practices at play is an important step in the design of technology that supports spontaneous and secure financial delegation.

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