Follow the Money: Managing Personal Finance Digitally

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ABSTRACT

The move towards digital payments and mobile money, and away from physical cash and banking services, offers users opportunities to change the ways that they can spend, save and manage their money through a variety of personal financial management services. However, set against ordinary, everyday patterns of spending, saving and other forms of financial transaction, it is not clear how users might interact with, understand, or value financial management services that utilise rich data and connected digital content for their personal use. In order to explore how people might engage with such systems, we conducted a study of financial activity, following people's transactional activity over time, and interviewing them about their practices, understandings, needs, concerns and expectations of current and future financial technologies. Drawing from the everyday activities and practices observed, we identify implications for the design of digitally enabled, personal financial systems.

CCS CONCEPTS

• Human-centered computing → Human computer interaction (HCI)

KEYWORDS

Digital money; mobile money; diary study; interviews; interaction design; user experience design

ACM Reference format:

Makayla Lewis & Mark Perry. 2019. Follow the Money: Managing Personal Finance. In *2019 CHI Conference on Human Factors in Computing Systems Proceedings (CHI 2019), May 4–9, 2019, Glasgow, Scotland, UK.* ACM, New York, NY, USA. 14 pages. https://doi.org/10.1145/3290605.3300620

ACM ISBN 978-1-4503-5970-2/19/05.
https://doi.org/10.1145/3290605.3300620

1 INTRODUCTION

As digital technology and connectivity become increasingly pervasive, so too have our opportunities to pay for goods and services, and to access and interact with the increasing digital effusion of financial information. Indeed, the last few years have seen a slew of banking apps, methods of electronic payment, and online financial technology (or 'fintech') services becoming available to users. However, despite a few formative studies in the area, little is known about users' needs for information provision around understanding their finances and what improved interactional opportunities for managing their finances might offer users in their everyday lives. With a few exceptions (e.g. [15,31,32]) we know very little about why and how users track their everyday financial activities. By everyday financial activities, we mean the ordinary, day-to-day payments and other transfers, such as gifts or loans, and how these impact on the choices that users make, such as their selection of payment media, or on the purchases they subsequently make. We position this day-to-day activity in contrast to long-term and large-scale financial decisions, such as debt management, pension planning or portfolio administration that are less frequently undertaken, and consequently may be handled in different ways and for different purposes. Moreover, the set of everyday financial activities that people are undertaking is increasingly happening in a digital-physical hybrid environment, in which payment and the use of other financial services are often undertaken in wholly, or partially digital media, pushing money management and financial interactions away from the kinds of tangible, paper- and offline spreadsheet-based tracking described only four years ago in Kaye et al [15], towards one in which this occurs purely digitally, or requires mapping across digital and physical media. As we show in our data, encouraging or compelling users to engage in digital transactions foregrounds issues around the nature of digital systems' financial tracking and transparency, the balance between a system's convenience and its trustworthiness, and how well-established

financial management practices translate into this new world of digital services and remote access to data.

When developing forms of access to financial data or financial services for users, and to support money management that will allow users to navigate this new financial landscape, it is important to understand what people do, and want to do, so that these technologies support actual user needs, rather than imagined ones. We therefore need to know what financial practices, understandings, needs, concerns and expectations of current and future financial technologies people have. With this set of questions in mind, this paper presents a study of peoples' everyday patterns of spending, saving, sharing and budgeting of money. It shows the social and contextual factors shaping them as they are enacted and given meaning in everyday life, and how users are embracing and seeking out technical alternatives to manage, track and save money. The principal contributions of this paper are twofold, in i) providing empirical findings that situate personal financial practices and transactions within a larger social and cultural web of relations and networks, exploring the interactions of digital financial artefacts with the environments in which these transactions take place and the implications for their users' financial activities and decision making; and ii) developing these to draw data-led opportunities and implications for the design of digital personal financial systems and services.

2 RELATED WORK

There is a growing interest within the HCI and related literatures in financial practices and interaction, the use of digital payment and wallet systems, and in the provision of digital information that is relevant to our examination of everyday financial management. This form of personal financial management falls into a larger set of related activities described by Perry and Ferreira [23] as moneywork. This covers the work of managing everyday financial tasks [see 7] that includes the physical and social interactions that users make individually and collectively in order to enable transactions. While Perry and Ferreira examine the interactional work around mobile payments, their focus on patterns of user behaviour and in exploring the impacts of user's understandings of the financial systems, their practices of use, and the social interactions that these activities lie within are highly pertinent to this paper. In their analysis, they emphasise a critical feature of the relationship that money and payment play in social interaction, echoing the anthropologist Bill Maurer's [21] assertion that money is not just a means of facilitating a utilitarian exchange of value, but is embedded in the social relationships, promises, and records of transactions between people (see also [10,12,29,34]).

Managing money then, may be as much about managing the social relationships that our financial activities are bound up within as it is about simply attempting to audit and balance accounts. The economic sociologist Viviana Zelizer's work on 'special monies' [34] is highly relevant here, showing how we 'assign different meanings and assign different uses' for money from different sources or budgets. Thus, money from paychecks, pin money, children's allowances or lottery winnings are considered as being very different, and as a consequence, will vary how its holder might choose to spend and save it (ibid.). Previous design-oriented work exploring the role of social relationships on financial activity has primarily been undertaken within CSCW, looking at families as they co-develop and use low-tech systems (e.g. [28,32]). This work highlights how the organisation of money management in families often occurs in similar forms to other household tasks and existing divisions of domestic labour [28], and how space within homes was leveraged in organising the physical financial resources so that they were available and comprehensible to other family members, and in ways that incorporated familial values, relationships and routines [32]. While the interweaving of financial structures and spousal or parental relationships is self-evident, exploring *how* these activities and practices operate is critical to thinking about financial design in these settings.

So, if we are to build systems that better support financial management through tracking personal financial data, it seems highly relevant that we should consider how this financial data is embedded within broader systems of use that may encompass contextually and socially relevant features. Kaye et al's key paper on managing personal finances [15] provides insights into how this might be achieved, directly referencing Zelizer's work in doing so. Their work explores a range of concerns from the emotional relationships around peoples' use of money, the tools and processes that users keep track of their money with, and how they plan for their financial future. While this research was hugely formative in shaping our understanding of how people keep track of their money, it steers away from digital aspects; this is likely to be, in part, because it took place prior to the move towards the introduction of sophisticated digital software in consumer-level finance. While the financial

websites and software identified in their paper appear to offer relevant on- and offline money management for a range of views into users' purchasing, balances, bills and credit scores, categorise spending, and allow users to create budgets and track investments (mint.com) amongst other services and systems (e.g., Manilla, Quicken and FinanceWorks), their data showed that these were not used. Several reasons for this were given, including concerns about security, inconvenience, and a frustration with their mismatch against user practices and needs. Similar findings to Kaye et al. [15] were uncovered by Snow and Vyas [27], and while some participants reported downloading budgeting apps on their smart phone or PC, all had stopped after a very short period of use for a variety of reasons.

When examining how people reflect on their spending, there is evidence that the media through which financial activities take place can impact on how people think about and understand their financial interactions, and not just the ways that they enact the mechanics of their transactions. Thus, using different forms of payment can influence users to be more mindful of their patterns of consumption, affect the trust judgements that they hold with their transactors, impact on the pleasure that they take in their spending, and affect their sociability [9]. Similarly, Vines et al's [30] exploration of the use of paper cheques by elderly users shows how the material of payment, and its concomitant physical and social affordances, influences other aspects of how those transactions are managed and understood, for example in how they help to visually document expenditure and can be manipulated in tangible ways. Likewise, there is a growing body of knowledge on how both digital payment systems (e.g. [9,14,16,18]) and digital financial services (e.g. [6,19]), including loans [22], provide distinctive physical and social affordances that can shape patterns of interaction around their users' financial management.

The move towards money management and payments occurring through digital means seems to be growing for a variety of reasons, ranging from institutional imposition by the banks, new financial services, as well as user choice [23]. There may be advantages in handling financial services digitally, as this allows the data from our personal financial activities to be automatically recorded, manipulated, and analysed. More recently, innovations in digital currencies have given rise to the concept of 'programmable money' in which smart contracts underpin intelligent payments that gather data, follow or evolve rules about the conditions in which it is spent, and allow others to inspect users' transactional activity (e.g. ethereum.org). For the vast majority of users today, this development is not something that they are likely to encounter soon, but it does suggest the directions that money management through digital financial services could progress in. If we are to develop useful and usable systems allowing people to access and interact with their finances, we do need to understand what people do, and want to do, when it comes to understanding and tracking their money.

3 THE STUDY

3.1 Participants and Recruitment

Our intention was to explore everyday patterns of spending, saving, sharing and budgeting of money by people over the age of 18 years old in England, United Kingdom (UK). We recruited online, placing an advertisement on callforparticipants.com. Respondents were initially sent a questionnaire asking for demographic information: age range (18-25, 26-35, 36-45, 46-54, or 55 to 68/retirement), employment status (employed full time or part-time, self-employed, student, retired, or unemployed), and dependent relationships. We did not aim for statistical representation, but we did select candidate participants to reflect diversity, especially with regards to age, employment status, and the presence of financial relationships such as partners, housemates, and or dependents e.g. a child or aged parent.

On receipt of the questionnaire, a follow-up discussion, in-person or by telephone, was arranged (~15 mins), in which the researcher explained the study and the potential participants were given an opportunity to ask questions. The most common question asked was whether they had to share their monthly salary. Nine of the respondents selected were uncomfortable sharing this amount, although Emma, Samantha, Oliver and Charlotte did share their salary. This was unsurprising given the geographic location of the study and is similar to previous studies in the US [15]. Personal finances are often considered a taboo subject in the UK, so people may avoid reporting information on these topics [33]. Mindful of the sensitivity of this topic, potential participants were informed they could choose to begin their transaction diary before or after their salary payment.

Of the twelve participants that took part in the study (table 1), all lived in England. Ten were from the South East, greater London area, and two from the East Midlands, a 2-hour train journey from London. Sarah,

Thomas, Emma, Sophia, Liam, Ethan, Samantha and Charlotte worked across a wide-range of employment (business, human resources, marketing, and retail). John worked part time, Oliver ran his own business, and Claire and May identified themselves as students, although Claire was not registered at an educational institution and was in receipt of welfare.

Table 1. Participant demographics.

Participant	Age	Employment	Financial dependencies
Sarah	26-35	Full time	(7) Young child, mother, father, sister, friend in UK, friend abroad
Thomas	55-68	Full time	(1) Partner
Claire	55-68	Student/Unemployed	(1) Adult child
May	18-25	Student	(2) Mother and father
Emma	18-25	Full time	(3) Housemates
Sophia	26-35	Full time	(0)
Liam	46-54	Full time	(0)
Ethan	26-35	Full time	(0)
Oliver	46-54	Self-employed	(0)
John	18-25	Part time	(1) Mother
Samantha	26-35	Full time	(2) Mother, sister
Charlotte	18-25	Full time	(3) Partner, housemates

3.2 Method

The study took place between 02 May to 12 July of 2018 and was divided into two parts, keeping a diary of their transactions, followed by a semi-structured interview.

3.2.1 Transactional diary

Participants were asked to keep a ten-day diary of their day-to-day transactions, longer than most similar studies [3,14]. The diary entries were to include money spent, received, transferred, saved, lent, borrowed, and gifted. Participants were reminded all currencies should be included, e.g. GBP, foreign currencies, local currencies, and cryptocurrencies. A variety of diary methods were offered to participants, including paper based, email, audio recording, instant message (WhatsApp), text document, and a spreadsheet, ensuring that they could choose a method that was most suitable for their needs. Participants were informed they could change their chosen format if their choice became unsuitable. Emma initially chose WhatsApp to log her transactions. However, during the afternoon of day one she contacted the researcher to ask if she could change to email, as she preferred to write her transactions on 'post-it notes' throughout the day, then in the evening send an email of her transactions to the researcher before going to bed. Participants were asked to make entries 'in their own time'; we expected this to be intermittent throughout each day, as emphasis was placed on logging as close to the transactional event as possible although we were aware that participants busy daily lives might hinder this process. Participants who chose WhatsApp (Sarah and Claire) logged and sent their transaction shortly after each event within one hour. Thomas, May, Sophia, Liam, Ethan, John, Samantha and Charlotte, who chose spreadsheets, and Oliver, who chose a word document, typically logged their transactions in groups throughout the day, e.g. during lunch, afternoon 'tea' break, or in the evenings, sending snapshots of their diary to the researcher every two to three days by email. None of the participants chose to log transactions using paper or audio recording.

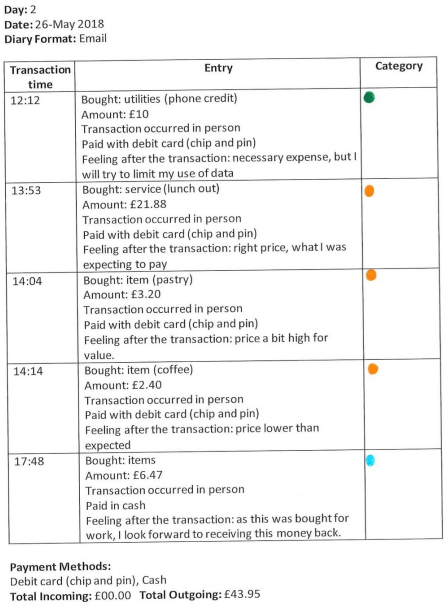
To support participants in capturing their diary entries an information sheet listing the criteria required for each transaction was provided. Diary entries were to be consecutive and should log all transactions. Entries included date, time, description, amount (participants were asked to indicate if the transaction was not GBP), location (including in-person or online), and payment method (e.g. cash, debit card, credit card, gift card, voucher, payment card, store card, money transfer, cheque, or other). Participants were also asked to specify the payment devices used if relevant, such as signature, EMV/ 'Chip and Pin' card, contactless, smartphone (e.g. Apple Pay or Google Pay), or via a wearable (e.g. smartwatch connected to Apple Pay or Google Pay). Finally, participants were asked to describe how they felt about each transaction although the level of detail provided was left at their discretion.

3.2.2 Semi-structured interview

At the end of the ten-day transaction diary participants took part in a follow-up interview with the first author. The interviews were conducted within seven days of the diary completion and averaged 90 minutes duration. Interviews were audio recorded and paper notes were taken. Prior to each interview, the transactional diaries were prepared into a uniform format, as a printed spreadsheet and paper-based dashboard. Their purpose was to present the logged transactions in a form that offered participants an opportunity to reflect on and reference during their interview. The spreadsheet contained ten columns: transaction #, diary day #, transaction date, transaction time, description, in-person or online, payment method, amount incoming, amount outgoing, and 'How did you feel' notes? Participant logs were listed under each column. Following the amount incoming and amount outgoing a total was calculated. The paper-based dashboard was identical to the spreadsheet but presented differently, consisting of ten pages, one for

each logged day, with transactions read vertically (see figure 1 for example).

The interview questions were developed following a review of existing protocols [13,15] for interviewing adults about the role money played in their lives. Interviews began by asking the participant to look at their transactional activities and comment on what they immediately felt about them. Participants could choose to recall their transaction activities from memory or reference the artefacts. The researcher then asked the participants to share positive and negative aspects of their transaction activities, followed by their use and experiences of the payment methods and the devices used. Next, participants were given a categorisation grid, and sticky dots and coloured marker pens. They were asked how they would like to categorise their transactional activities, by creating category names with brief descriptions, then assign them a colour using a sticky dot or marker pen. Participants were then asked to assign a category to each transaction (see for example figure 1). This was intended to allow the participants to identify their own related sets of transactions. As a result, participants created a total of eighty-three categories. The interview ended with questions on how they thought they would use money in the future, and finally participants were compensated with a gift card.



Day: 2
Date: 26-May 2018
Diary Format: Email

Transaction time	Entry	Category
12:12	Bought: utilities (phone credit) Amount: £10 Transaction occurred in person Paid with debit card (chip and pin) Feeling after the transaction: necessary expense, but I will try to limit my use of data	
13:53	Bought: service (lunch out) Amount: £21.88 Transaction occurred in person Paid with debit card (chip and pin) Feeling after the transaction: right price, what I was expecting to pay	
14:04	Bought: item (pastry) Amount: £3.20 Transaction occurred in person Paid with debit card (chip and pin) Feeling after the transaction: price a bit high for value.	
14:14	Bought: item (coffee) Amount: £2.40 Transaction occurred in person Paid with debit card (chip and pin) Feeling after the transaction: price lower than expected	
17:48	Bought: items Amount: £6.47 Transaction occurred in person Paid in cash Feeling after the transaction: as this was bought for work, I look forward to receiving this money back.	

Payment Methods:
Debit card (chip and pin), Cash
Total Incoming: £00.00 **Total Outgoing:** £43.95

Figure 1: Transaction diary for Emma: leisure (orange), utilities (green) and 'refunded for work' (blue).

The audio interviews, diaries, categorisation grid, and artefacts were reviewed multiple times. Potential themes were noted, quotes were transcribed, and scanned copies of the diaries, categorisation grids and artefacts were catalogued. From numerous analytical discussions between the authors, non-fictional financial narratives, comparable to user stories (see for eg. [11,17,25]), were produced of participants transactional activities, experiences, and needs. Affinity diagramming [4] was used to produce the themes that were used to develop the analysis reported in the paper. Throughout the process, we repeatedly returned to the raw data to ensure a clear and trustworthy understanding of events was obtained and that our account of user practices was sufficiently detailed and evidentially grounded in the empirical material.

4 FINANCIAL NARRATIVES

In this section of this paper, we present two summarised examples of financial narratives, illustrating the very different types of personal circumstances, financial activities, and moneywork practices that our participants engaged in, which help to contextualise the empirical material in the analysis that follows. These narratives show a rich picture of transactional context, rather than the often out-of-context, disembodied quotes that are typical of such interview-based research, and in doing so give depth to the constraints and reasoning behind users' financial decisions.

4.1 Sarah, employed full-time

Thirtysomething Sarah is a single mother from southeast England. Her primary concern is Peter, her young son, *"it's all about him and what he needs I try and fulfil it every day"*. Sarah logged £164.47 on items for Peter: these included school activities, toys, clothes and shoes, child fund savings, and Arabic tuition. She categorized her remaining transactional activities into three areas: Personal (£463.12) e.g. homeware, clothes for herself, and restaurants and takeaways, Essentials (£195.63), e.g. groceries, transportation, and healthcare, and Gifts (£243). Sarah uses cash sparingly and prefers to use quick and convenient payment methods such as contactless credit cards, especially those that offer monetary 'cashback' rewards. Although Sarah embraces debit and credit cards mostly for their speed, convenience, and protection she misses the human interaction she receives when she pays for Peter's school activities or makes deposits into his savings account, *"it's not that often that you get it* [paying-in book and cheque book] *now... everything is so like technology based you don't get a chance* [go] *to the bank, you don't need to, and just paying it into my son* [savings] *account, I have to use it, as its completely different, it's like a*

human being touch, you've got the cashier there". Managing spending better is a goal for Sarah, who thinks her recent personal spending (£463.12) and credit card bill (£1014) was too high. Although she is not sure what an acceptable expenditure should be, she believes *"I need to control it* [spending] *somehow, what makes it hard is you've got contactless and you just tap away, and there was when I had the credit card bill come out and it was it was, oh god it was so high … six weeks I spent that much, and the bank balance just dropped … I wasn't expecting it, I was thinking 500, 600 pounds, put everything on the card and everything which is fine but this oh my god and the bank balance just drops. That hasn't been good, what have I been spending? What have I been doing with that?".*

4.2. May, student

May recently finished college and is considering university. She lives at home with her parents in London. May's primary income is derived from her parents, who give her cash in-person every week ranging from £10 to £80 which she calls 'pocket money'. She divided her spending into three categories: Unnecessary (£43.29), e.g. transportation (short distances) and outdoor food and drinks; Necessary (£106.49), e.g. transportation (long distances), accessories, stationary, and groceries; and Being more aware (£42), e.g. saving money on her smartphone bill by paying by direct debit instead of pay-as-you-go. Like Sarah, May's purchases, especially food and drink, frustrated her: *"*[I need to] *stop spending on unnecessary things… I kind of indulge… I see something I like, buy it and I never use it".* During the interview, May whispered to the researcher *"I have been in a problem with overdrafts with quite a bit, so yeah, which I have been told off by my parents".* She finds it difficult to keep track of her spending due to lots of small purchases, and recounted *"spending without knowing how much* [I've] *spent. I have had situation*[s] *where I am out of money and I am out of London and I have no train ticket to go home because I have spent money on lunch or whatever".* As a result, May is often close to or using an unarranged overdraft. She wants to *"save up… because of all the informal overdrafts I have not really been able to save up, for example, I have missed out on opportunities, like I had the opportunity to go to New York. There was an occasion where all girl mates wanted to go on a girl's holiday and I couldn't go because I didn't have enough funds".*

5 ANALYSIS

Following the financial narratives, we now move on to discuss the quantitative and qualitative data derived from the diaries and interviews on how participants use money, identifying the payment methods, gross payment activities, and high-level patterns of individual participants' transactional activities. We then discuss the qualitative data, drawing from across our dataset. This explores in detail what our participants reported moving money around for and how they practically managed their budgeting, borrowing and lending, looking at the management of money alone as well multi-person dependencies in households and across household members, examining their approaches to dealing with savings and investments for themselves and others.

5.1 Transactional logging: use, income and expenditure

Participants logged 367 transactions, averaging 30.58 transactions each. Outgoings (70.7%) accounted for £15,239.24, including money spent, transferred, lent, and gifted. Income (29.3%) accounted for £6,326.35, including money received and borrowed (note: due to the participants reluctance to share their income reported above, this part of the financial data is likely to be under-

Table 2. Participant in- and outgoings, average transaction value (Av), frequency (#) and methods

	In/ Out	Av.	#	Payment methods
Sarah	£3.00 / £2,639.13	£64.44	41	Cash, credit card, debit card, cheque.
Thomas	£00.00 / £948.66	£45.17	21	Cash, credit card, debit card, store loyalty card, direct debit, oyster card.
Claire	£00.00 / £276.03	£27.60	11	Cash, debit card, payment card
May	£146.24 / £286.27	£15.45	28	cash, debit card, gift card, voucher, money transfer
Emma	£1,160.90 / £723.95	£44.32	60	Cash, debit card, store loyalty card, website money transfer, voucher
Sophia	£00.00 / £2,007.41	£71.69	30	Cash, debit card, gift card, voucher, money transfer (mobile), direct debit
Liam	£21.22 / £755.54	£33.77	22	Cash, credit card, voucher, website money transfer, PayPal
Ethan	£00.00 / £1,151.24	£83.82	18	Cash, debit card, standing order, web money transfer
Oliver	£350.00 / £623.51	£22.13	44	Cash, debit card, credit card, web money transfer
John	£76.25 / £143.00	£8.51	27	Cash, debit card, Apple Pay (smartphone)
Samantha	£1,949.54/ £1,267.17	£94.61	34	Cash, debit card, standing order, direct debit, PayPal, oyster card, money transfer, gift card
Charlotte	£2,619.20/ £4,417.33	£140.73	51	Cash, debit card, voucher, money transfer (mobile), direct debit, standing order

reported and incomplete in our dataset.) The transaction average was £59.85; the maximum expenditure was £1,733.00 for household rent and the minimum was 20p for two bananas. The highest income was Charlotte's salary, £2,100.00 and the minimum income was 15p, an online shopping cashback reward. Two currencies were used: all participants logged transactions in pounds sterling (GBP). Ethan recorded two bank accounts, a primary in GBP and a secondary account in Pakistan; he logged three transactions during the study totalling 57,000 Rupees (transactions were converted to GBP.) Figures are reported in table 2. Prior to our study, Oliver, Thomas, and May reported using Euro (EUR), Taka (BDT, the Bangladeshi currency), and two cryptocurrencies, Ethereum (ETH) and Bitcoin (BTC/XBT).

The most common payment method logged was by debit card (n=164) in the form of contactless payment. Participants felt this method was easy to use, convenient, and fast, e.g. Charlotte logged in her diary *"contactless so payment was easy"* and *"easy to tap in at the station"*. However, Emma avoided contactless in favour of EMV/ 'Chip and Pin' cards due to security concerns, as she was *"afraid payments would be mixed up … I could be close to a contactless payment machine that would take money out."* In addition to accidental payments, she was concerned that this could be done criminally: *"I also know of this system of people, actually holding small machine and they sort of stand next to you and they hope to catch the signal from your contactless and they transfer the money"*.

All participants logged the use of physical cash in their diaries. This was the second most commonly used payment method (n=80), although it was commonly reported as inconvenient or problematic. Charlotte, for example, described difficulties breaking cash into change: *"dreaded cash day, I had to get £10 cash out, then I had a right faff because I had cash money for* [a colleague] *£10 note, I had to give him £6 and he didn't have £4 to give me, just £5, so I owed him £1, it's a real faff"*. As reported in Ferreira et al [9], many participants were also frustrated by the requirement to source physical cash by finding a bank or ATM: *"I don't use cash because I have to get it from somewhere, it is not something I carry around, if you know what I mean, naturally with a card it is with me 24/7, whereas with cash I have to get it from somewhere"* (Thomas). Furthermore, Charlotte, Sarah, and Thomas worried about the safety of their money held in public and their consumer protection rights, fearing physical cash could not protect them if it was lost or stolen: "*card, it is a preferred method, also as a security physical thing if I get mugged, I don't have money to lose, if someone takes my wallet it's that but also then the protection of the purchase"* (Thomas). Conversely, Claire's transactional activity was different to the other participants as an exclusive user of physical cash, withdrawing up to £70 at the beginning of the week to last her the rest of the week, and only using a debit card to 'top up' when low on cash.

In their transactional diaries, participants logged the use of credit cards (52), money transfer (30), direct debit (13), PayPal (7), gift card (5), standing order (5), voucher (3), store loyalty card (2), payment card (2, such as PayPoint.co.uk), cheque (2), and transportation 'Oyster' (RFID) card (2). Participants also described using their contactless debit cards for transportation. Transactions were mostly carried out in-person (272) at supermarkets, local corner shops, transportation hubs, fast food and restaurant establishments, and leisure and entertainment facilities. Eleven participants logged online transactions (22) using smartphones apps, e.g. ordering food using Deliveroo and supermarket groceries, booking holidays, paying car park fines, and online retail (e.g. Amazon). Oliver logged visiting clothing websites on his home computer, whilst Sarah clicked on advertisements sent to her email or shared by her friends on Facebook. While participants mainly paid for purchases using debit cards, credit cards and PayPal, prior to completing transactions, where possible, many of the participants searched for discount vouchers and/or gift cards or store loyalty cards, which were used to reduce checkout totals. Claire, Oliver, and Samantha logged four debit card transactions through automated telephone services, paying utility bills and purchasing transportation and personal healthcare. Overall, the participants' broad view of digital payments was positive, and that this mode of transaction was now their default expectation for the vast majority of financial operations they undertook.

5.2 Managing Debt Between Peers

Other than direct purchases of goods and services, transfers of money between peers were one of the most prevalent reasons for using digital financial services, although cash was also sometimes used for this purpose as well. There has been some commercial interest in designing technology solutions to share payments (e.g. Venmo.com, PayPal.com) for restaurant bills and events, but the kinds of practices seen with these applications (e.g. [1,5]) were not reported by our participants. However, other non-transactional peer-based financial interactions were encountered of various kinds. We report on these below.

5.2.1 Borrowing and Debt Repayment

In addition to institutional lending such as mortgages or bank loans, our data shows that borrowing and the subsequent repayment of that debt between family and friends was commonplace. Charlotte, May, Samantha, Emma, Sophia and Thomas all logged borrowing money to purchase household items and outdoor food and drink from partners, family and close friends, as well as retail banks.

Loans between peers occurred for a number of reasons, from the failure of technological solutions to bridging short-term needs, but in most cases, the sums covered were small (usually a fraction of the participants' daily income). The arrangements and approaches to repayment were diverse, but the social and emotional bonds that backed these debts meant that expectations and interactions around these loans were especially charged. Loans were always paid back quickly, allowing the participants to offload their accompanying social obligations (we might call this a compound *social* interest rate), but also attempting to do so before the borrower forgot about making the repayment. Digital technology facilitated this because it allowed repayments to take place remotely, and without recourse to having the correct denominations of money at hand. In one such example of a peer-based loan, Charlotte described how her attempted payment at a dinner restaurant failed and led to the need to borrow from her partner, "*I was having a nightmare with my card. I changed bank and I just can't remember my PIN, I don't know why, I just can't. I use four digit codes at home, to get into our* [apartment] *and car park and stuff, and I cannot get another four-digit number into my head.... I had to give James the money back because I said let's go out for dinner and I would pay and then 'Oh no my card doesn't work, you'll have to pay'*." Following her recall of this in the interview, she scanned her transactional dashboard on the wall in the interview room and pointed out an online money transfer and confirmed that she had reimbursed James the following day. Here, there is a clear social obligation visible in that Charlotte had made a promise to pay the restaurant bill in advance, failed to be able to do so, and had to fall back on her dinner companion to pay instead, reimbursing him at the first opportunity using her mobile phone to transfer it.

Charlotte's description of her obligation to make a timely payment and avoid social embarrassment, and other participants' accounts of expectations on them for making a reciprocal form of payment (such as a gift or favour) stands in an interesting parallel to our participants' descriptions of instances in which they reported borrowing from retail banks. In these cases, extra vigilance was taken to reduce the probability of incurred interest or fees. May, for example, described her recurrent unarranged overdrafts and the measures and practices put in place to safeguard against incurring cost or penalty payments: *"sometimes I know I have only got this much ... if I put the balance up by 3 pm before end of the day then it won't cause an overdraft, my bank sometimes allows us go into overdraft ... I have had a lot of times ... but I will put this back by then"*. Here, digital access facilitated repayment speed so that there would be no charge. Interestingly, Samantha also borrowed money from a friend during the study and similarly reported making her repayment quickly digitally because she believed her friend had other money commitments and she did not want the unpaid loan to harm their relationship due to a loss of not just financial, but also social capital.

5.2.2 Turn-taking in Making Payments

Rather than sharing or direct lending to cover bills, our participants reported a variation on these when making payments within a social setting. Turn taking commonly occurred between partners for food and drink, e.g. snacks, and takeaways, when items were shared by both parties for small amounts (less than £15). Oliver, Samantha and Charlotte discussed 'turn taking' in making recurrent payments, although only Charlotte explicitly logged these events in her transactional diary. We found that while other aspects of turn taking were loosely regulated, participants felt an obligation that the amount spent should be balanced over time. For example, Charlotte and her partner James watch TV shows and films together at home, taking turns to purchase snacks from their local corner shop. During the categorisation activity, Charlotte noticed James had spent more on these shared items and explained to the researcher in a hushed voice that the imbalance was due to her inactivity: "*I like to get home and stay set at home and he goes down the shops to buy stuff*". As the interview proceeded Charlotte described that as the month advances, she always tried to ensure that her spending is equivalent to James'. In this respect, turn taking is rather similar to the reciprocal aspects of gift exchange [20], where the gift-debt requires some form of repayment. Similar forms of mutual payment in turn taking can also be seen in the moral economy of pub drinking 'rounds' (e.g. [2]) that emphasise communality and shared experience, although in our participants' cases, the timescale that this unfolds over lasts longer, and in social contexts that have different cultural expectations

and behaviours than a visit to the pub. However, the features of digital payment described by our participants are reportedly different to cash: digital payments often have no material record and do not require counting out change. Recalling (or showing) how much was spent is therefore harder to determine at the time from a card-swiped transaction, while on the other hand, transactions on bank statements (as in Charlotte's case, on her transactional diary) are potentially more easily traceable to support reconciliation or sharing with the other turn taker over longer time periods.

5.3 Saving and Investing Money

Sarah, Liam, and Charlotte reported frequently saving and or investing money for future planning, with the primary means of accessing and monitoring these services being through digital media. This might be for a 'rainy day' event, property purchase, home improvement, or for a young child or themselves. As seen in her financial narrative, Sarah is 'building up' Peter's savings and during the study, she deposited £25 into his savings account. Liam is also an enthusiastic saver: he has a fintech 'Chip' app [getchip.uk] which automatically 'skims' his bank account and transfers unused funds to an account that earns a higher interest rate. Liam commented that the Chip app was his preferred format as "*it kind of forces you to save and track your patterns*". The nature of this process is that calculations and deposits are made on behalf of the saver but also meant that while Liam did not need to initiate savings transfers, he had to track the current state of his balance and learn these patterns of automated activity so that he always had sufficient funds in his bank account to cover his needs. Nevertheless, this was a method that Liam found convenient, and he especially valued the visibility of what was happening online, as it showed the reasoning behind what was taking place and the actions that had occurred: *"what I love about financial services are that it is very transparent like they tell you upfront what is the issue"*. This transparency (similar to what Vines et al [31] describe as 'confidence through awareness'), not just of reporting the act of saving, but of the explanation, seems to be an important one in developing Liam's trust in the system, by supporting a set of working practices that made the automated skimming process function for him.

Charlotte also had a practice of regular saving, depositing between £200 to £300 multiple times throughout the month. Her incentive for saving was to become a first-time property buyer with her partner James, but she would also like to build a strong investment portfolio for her future. During the study, Charlotte logged her first online investment (*"stocks and shares, £100")* which she reported making her excited yet nervous because she wasn't sure if she understood the rules and process involved and was relying on this being protected because it was invested in a UK government-regulated institution. This access to the process of investing, and its reliance on an institutional regulatory infrastructure to assess its suitability for her was different to Liam's description of the value of transparency in the Chip app, which functioned on its transactional visibility and transparency. However, her experience was not unique; in other examples, we found that our participants demonstrated saving and investing behaviours if the process appeared to involve limited financial complexity, required minimal effort, could be carried out on their smartphone, was connected to a dependent or partner (e.g. Sarah's young son or Charlotte's need to apply for a mortgage with James), or involved preparing for events (e.g. May's wish to travel). In these, we see a role for the procedural simplification that digital media and systems can offer, as well as social and planned saving that can be visually tracked using digital records.

5.4 Managing Spending in Households

Household, rather than personal, spending was reported by all participants. While Sophia and Liam lived alone as individuals, logging rent, council tax, utility, Internet, satellite television, TV license, and regular small grocery purchases, it was the shared households that demonstrated more complex household financial arrangements and practices. Sarah, Thomas, Claire, May, Ethan, Oliver, John, and Samantha lived in small households of two or three individuals, and these households exhibited much more socially complex and interdependent financial interactions.

Charlotte and Emma lived in larger shared households of four or more individuals, where a trusted individual calculated, collected, and made household payments on the behalf of everybody, although grocery spending was undertaken on an individual basis. In Charlotte's case, she was in a long-term relationship with partner James and for the last year they have rented a 3-bedroom apartment costing £1,733 each month. To spread the cost, she shared the apartment with two housemates, Kerry and Monica. In her house, Charlotte was the trusted person and has to track expenditure and income to ensure that everyone is contributing equally. While this might be seen to be a relatively simple process of logging household payments in, costs, and enforcing contributions, the pervasive

nature of the digital systems required her to monitor and interact with a variety of digital systems to co-ordinate this, and to ensure that her housemates did the same. So that she was not personally left out of pocket or penalised by the bank with overdraft costs, she had had to develop a set of practical and social mechanisms to check on and coerce her housemates to meet their financial obligations. As an example, Charlotte reported recently pursuing Kerry to give her money for household payments:

"It's annoying … I always say I need it by the first because that's when all the stuff going to come out and I don't really want to have to check. Each month I'm going to have to go in [to my bank account]. *Kerry said she tried it but sometimes* [the online payment page] *will come up with all the details but then you have to press confirm for it to go through, so she got to that point and thought "oh I've done it" and switched it off, so it's annoying, but at least I checked. So, I always check it just at the end of the month, see if* [payment] *has actually come in or not because we all get paid on different dates. I think Kerry in particular gets paid on the last day of the month, James gets paid on 25th and I get paid on 27th and Monica gets paid on 27th as well, so she's always the last, that's just part of sharing*".

So, what we see here is an artificial deadline being set up (payment '*by the first*') in order to force housemates to electronically transfer money so that Charlotte can check its receipt online in time for a collective electronic bank payment to the landlord. Kerry seems to find this difficult to manage, blaming interface problems making these payments (although given UK banking, this could easily be automated with a direct debit), so monitoring these transfers by Charlotte is necessary, a fact that is complicated by the late timing of Kerry's payday. Charlotte has a practice of checking the account at the end of the month, at a time when the other housemate's salaries are debited to their accounts and can then be transferred to Charlotte's account. That Charlotte is resigned to this ("*that's just part of sharing*") is interesting, recognising that payment is reliant on a mixture of social and technical constraints, but also that the overall risk and effort of co-operation is beneficial and necessary for their collective living arrangements.

Most of our participants kept some record of their household spending, regularly viewing bank statements, and keeping track of pending spends such as standing orders and direct debits. Manging the often-large amounts of money in shared households, the complexity required to handle multi-person, and multi-event payments over an extended period of time, and the significant financial responsibilities meant that an auditable record was usually necessary to understand and account for expenditure. However, in Liam and Charlotte's situation they also maintained detailed online spreadsheets to track household spending which they shared (read only) with the other people in the house. These spreadsheets had to be manually updated with new payments as they happened, as data from their bank accounts was not available in a format that could be directly imported, and which required additional effort by these individuals to ensure cross-system fidelity.

5.5 Budgeting and tracking spending

In the categorisation exercise, participants all reported some dissatisfaction with their budgeting, and reflected on their existing practices and possible solutions. Many found the diary and categorisation exercises to be valuable and informative, and some even considered continuing this beyond the study; e.g. in Sara's categorisation session, she pointed to a takeaway breakfast, saying *"Now I look back at it, it's frustrating… when you look at it after 10 or 12 days…. Did I really need that? Did I really need to spend on this thing? or that thing? especially like breakfast or lunch, you know or like going out with friends or stuff like that"*. This frustration with her seemingly unnecessary spending led Sarah to discuss her intention to confer on her financial activity more with her parents, believing what she described as their frugality might help her to question the importance of any potential spending. Similarly, to maintain motivation, acquire advice, and set spending limits, May also considered getting parental support with her budgeting: *"I would like my parents to see but I am also a bit hesitant because they would be like "Oh Na Na Na", they would tell me off but I guess that would be good because it's like when I am told off, I am just like "OK like get a grip", so yeah, sometimes it is good to have someone that you are a bit like scared of"*. As a student, May received spending money from her parents, so felt that they had some more rights over what she did with it– something that was not reported by the other participants.

Charlotte reported an intention to set limits on her spending by using a way of paying that limited her access to funds. However, unlike other studies where people reported moving from cards to cash (e.g. [15,31) she reported disliking using physical cash, and was considering signing up to a digital 'wallet' (Monzo or Starling), allowing her to keep her retail bank account for income, savings and debts, but to send regular payments to a digital wallet for specific purchases [cf. 34], hoping that this would help her to track and reduce spending. In

contrast to Charlottes' approach to restricting expenditure, May was also considering reducing her outgoings by obtaining paper receipts for every purchase to help with her budgeting. She believed that collecting physical receipts and regularly reviewing them would help her understand and therefore reduce her spending. May had been trying to do this digitally but found this problematic: she had recently activated notifications on her mobile banking app, as it *"shows me what I have spent on that day … the transactions I have done with the contactless method, yeah it is quite good because like if I were to go online banking, go on my statements … it's like, it's a huge amount … it just makes me confused so I don't tend to look at it"*. While she could see that this practice had potential value in changing her understanding, this turned out not to have been practical; indeed, she had turned off real-time notifications in favour of an end-of-day summary because the information was too overwhelming. In a similar way to this, the act of undertaking the diary study itself has also helped expose our participants' transactional activities for inspection in a valuable way for them: "*it has made me realise how transactions can stack up quickly! It has been interesting to keep a record*" (Charlotte), something that was also noted by Vines et al [31] in their study of low-income households. Sara elaborated on this process, describing it as being: *"Helpful, as in where I am spending, how I am spending and thanks to you, you have given me like breakdown otherwise I would never have explored or looked at it… I find it good in terms of the total, transactions and the amount spent is really helpful but I* [points to transactional dashboard] *I like the breakdown of how much I have spent and the outgoings and incomings".* This dashboard-like visualisation differs from real-time smartphone notifications that are intermixed with other content and avoids the problems that May reported in overwhelming her ability to follow notifications.

6 DISCUSSION AND IMPLICATIONS FOR DESIGN

Our analysis points to a noticeable shift from previous work in the broad area of personal financial management, and a comparison of prior research to our own findings is worthwhile here. With regards to its similarities to previous comparable studies, our participants engaged in extensive record keeping to manage their finances and plan ahead for the future [15,31], had an awareness of important financial dates [31,32], partitioned or categorised money for designated spending [15,31,32], controlled or co-managed other people's money [15,32], appreciated large scale, easily manipulable visual representations of their finances [15,32], and had to do extensive co-ordinative work to map between their financial systems and their values and relationships [15,31,32]. However, set against this, we observed some very different patterns of activity and practices in our analysis of managing money to this previous research. We highlight a number of novel findings from our participants' financial challenges and practices, from payment of debts to friends and family, loan management and turn-taking, and issues of control and awareness arising across physical and digital systems. We also identify tensions arising from cashless modes of payment, including the trade-off between convenience and security and their resolution, so that while our participants expressed wariness of the privacy and security of financial technologies [cf. 31], they also used them extensively. Unlike previous studies, spreadsheets were not used by our participants' in their personal money management practices, although they were used by two participants for communicating about shared spending. This may be an anomaly within our participant selection process but could be due to their financial and transactional data being held and managed almost entirely through digital media, making spreadsheets (as a common platform for representing content from different financial media) unnecessary, and/or harder to extract content into. Overall, participants in our study made fewer physical payments (e.g. cheques, printed vouchers and gift cards) and used fewer analogue financial management tools (e.g. paper-based bank, investment and pension statements and records) than have been seen in these comparable studies of financial management practices.

The shift in our participants' financial behaviour from previous studies indicates that they are less reliant on physical media for managing and manipulating financial data, and making more use of digital media and records. However, as we have found, gaining access to this data is not always simple, and it is often not in a format that our users find suitable for their needs. The lack of personal financial information that our participants held and their difficulty of accessing it lies in contrast to the institutional knowledge that is beginning to be held about their financial activities. While commercial organisations now possess a huge amount of information on our financial lives as consumers in online personas (e.g. Google or Amazon), as users, we have only limited ways to scrape, combine or interrogate our own data, and although the information and interconnectedness of our financial activities is increasing through the emergence of new

digital systems, as users, our ability to combine and interact with this has not kept up. Moreover, our findings suggest that this digital deficit impacts not just on understanding our own financial circumstances, but also on our interactions with other people we might want to know about our financial activities. Drawing from our data, we identify possible design opportunities that offer some solutions to this set of problems below.

Leveraging metadata. The participants heavy use of digital technology in payments and management of their finances has meant that tangible interactions with money are infrequent. This loss of physicality seems to have resulted in making its users less aware of their spending. There are opportunities here in the presentation of financial technology that can support users to better understand their transactional activities, and thus support decision making that is more suitable for their needs. One possibility to help users to make better sense of their transactional activities is by leveraging transactional metadata (such as cost, time, location, item type, transactor, etc.) in visualising patterns of spending, or in guiding them into making different forms of decisions, for example, following a social navigation [8] approach that exploits the knowledge and experience of peer users in assessing alternatives, The Venmo social awareness stream [5] offers some peer spending insights, but the feed content is unstructured free text and poorly organised to support social navigation. The value of structured and abstracted data might be useful in getting direct financial advice on patterns of spending, or partially anonymised items from trusted individuals (parents, or partners) in supporting its users' budgeting.

Socio-financial debt records. Loans between friends, family and colleagues are very different to commercial debt, in part as lenders' knowledge of the default risk due is high and because there is no interest rate; difficulties are more often in the social embarrassment of making requests, difficulties in making appropriate repayments in small change, and the need to make repayments as soon as possible. Unlike commercial debt, this record may be of as much or more value to the debtor so that they pay back the money and avoid the social obligations that come with it–something our participants reported as carrying more importance than the value of its repayment to those lending it.

Turn-taking balances. Although turn-taking is not strictly a form of debt, there are social obligations towards maintaining a null-balance between parties as one party is likely to 'owe' money to others at some stage. In this case, it may be useful to have a lightweight representation of the balance. This needs to be sensitive, as to make this a direct financial obligation between parties would be to make this into an accountable financial responsibility, something that our participants did not report; rather they viewed this as a social and moral obligation that was bound up in their personal relationships. To prioritise this a primarily financial relationship would be to overemphasise an imbalance as a repayable debt and skew the social element of the relationship towards this aspect.

Automation, transparency and trust. Saving involves moving money between accounts–money that may later be needed for everyday spending. As the process of investment undergoes automation [26], giving users an awareness of what is happening, an understanding of what is likely to happen, and why (e.g. in the case of Chip's account 'skimming'), will make this kind of automated financial management less likely to result in transactions that incur bank charges. Transparency, not just into the system's action, but into its process, therefore seems a useful way to build trust in these kinds of automated financial operations.

Collective money management. Household management can involve individuals working on behalf of others to administer large amounts of money. The provision of shared visibility (in Liam and Charlotte's cases, using spreadsheets) is a useful way to record payments in and out of the house, but these require manual data entry, and expose everyone's payment data to everyone else, which may be inappropriate under some household arrangements. A shared payments system, giving suitable access and notification to other users to see, sanction, and if necessary fix problems would be a useful and practical solution. Privacy, trust and transparency was important to our participants, who were concerned about who could see their transactional metadata, a concern also raised by Venmo users [5]. However, these concerns were reduced when information was required for budgeting purposes, especially where household members could see the impacts of their actions on others.

Retaining personal relations: It is useful to see the work of financial management as a multi-sided activity, going even beyond Zelizer's [34] argument for the need for economic actions to be viewed from both sides of the transaction (i.e. both transactors, in that each brings interpretive value to understanding financial life), extending this to cover other parties (such as friends, family or housemates) that may be asked for input or advice–as a normal part of being in a relationship. This

move from understanding money as impersonal and arithmetic [29], to considering its role in extraeconomic [34] activities is critically important in understanding financial interaction and informs how we can account for it when supporting users to deal with their personal finances. Smart contracts might be one way to enable external engagement, allowing third parties to have differentiated levels of permissioned access to view or even be licensed to act on behalf of the account holder.

Following Pritchard et al's [24] findings on digital payments in public transport going 'cashless', our participants' moneywork activities across a wide range of financial management activities also illustrate how going digital requires additional effort in mapping information within and across digital, physical and social resources–an observation that is at odds with the banking and financial services' rhetoric of digital money being faster, easier, more convenient, manageable and flexible [23]. However, as well as its function in payment, money allows individuals to keep track of exchanges they wish to calculate and as a source of economic record–something that we see our participants repeatedly returning to as both key to their practices, but also as being problematic in its digital formats. This is reminiscent of Hart's [12] claim that one of money's chief functions is *remembering*, not just by individuals, but a broader community, striking a strong chord with our own data and analysis even when it dematerialises from a physical into a digital medium.

7 CONCLUSION

This study reports on insights into the everyday spending behaviours and experiences in the UK, examining the financial relationships, responsibilities, and concerns that surround transactional activities. As we followed the trail of money that our participants used, we became aware of just how pervasive digital systems were in their financial lives and its impacts on their ability to engage in everyday activities, how these digital systems supported (and failed to effectively support) the financial activities that they were engaged in, and how they tried to work around these limitations to manage their everyday finances.

ACKNOWLEDGMENTS

We thank all the participants who took part in this study, and gratefully acknowledge the 'Smart Money-Precision Data Management for Distributed Ledger enabled Central Bank issued Digital Currencies' grant [EP/P032001/1] from the EPSRC.

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