Recipes for Programmable Money

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ABSTRACT

This paper presents a qualitative study of the recent integration of a UK-based, digital-first mobile banking app — Monzo — with the web automation service IFTTT (If This Then That). Through analysis of 113 unique IFTTT 'recipes' shared by Monzo users on public community forums, we illustrate the potentially diverse functions of these recipes, and how they are achieved through different kinds of automation. Beyond achieving more convenient and efficient financial management, we note many playful and expressive applications of conditionality and automation that far extend traditional functions of banking applications and infrastructure. We use these findings to map opportunities, challenges and areas of future research in the development of 'programmable money' and related financial technologies. Specifically, we present design implications for the extension of native digital banking applications; novel uses of banking data; the applicability of blockchains and smart contracts; and future forms of financial autonomy.

CCS CONCEPTS

• **Information systems** → *Digital cash*; • **Human-centered computing** → *Empirical studies in HCI*.

KEYWORDS

Money, Automation, FinTech, IFTTT,

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1 INTRODUCTION

Money has taken many forms, across many cultures, throughout history: from material objects, to credits and debits, through to current digital virtual and cryptocurrencies ([20, 21]. In the shift towards today's more cashless societies, for instance through demonetisation [30], new payment infrastructures (e.g. [31, 32] and mobile money (e.g. [1, 16, 22] everyday financial transactions are becoming increasingly digital. As a consequence, a growing range of consumer-focused digital financial services are emerging that bring money and data together in new and often innovative ways. This includes applications that present visualisations of spending (e.g. Mint[1]), those that provide money management and advice (e.g. Yolt[2], Chip[3]), those that save digital 'spare change' (e,g, Acorns[4], MoneyBox[5]), and digital loyalty cards (e.g. Yoyo[6]). Such services exemplify the ability for individuals and organizations to manage and program their money, their financial data, and their banking services in new and often autonomous, yet infinitely reconfigurable, ways. Moreover, they point to more diverse, specific and complementary representations and usages of money which are increasingly automated, or otherwise strongly dependent upon algorithmic calculation. The European Union has even introduced

[1]https://www.mint.com/
[2]https://www.yolt.com/
[3]https://www.getchip.com/
[4]https://www.acorns.com/
[5]https://www.getmoneybox.com/
[6]https://www.yoyowallet.com/

regulations to support 'Open Banking'[7], requiring banks to relinquish sole control of customer's financial data, including transaction histories and spending patterns. Relatedly, the emergence of blockchain technologies [10] has led to the proliferation of alternative currencies and tokens, governed by 'smart contracts' — immutable and 'unstoppable' applications that can support new forms of autonomous financial agents and organizations (e.g. [5, 28, 29, 33]). As such, data-driven products and automated operations with money that were once the preserve of high finance (see [19]) are now increasingly in the hands of individuals.

Motivated by these developments, we have set out to investigate a subset of new financial services through a specific case study — the conditional automation of a mobile banking application. In 2018 the UK-based, digital-first bank Monzo announced an integration with the web automation service IFTTT (If This Then That) [25]. This now allows Monzo customers to connect their bank account with a range of other web accounts and services and create automated rules or 'recipes'. Such recipes can be bi-directional and use data from one's Monzo account (e.g. spending data) as a trigger for other actions (e.g. play a song on Spotify); or use data from other services (e.g. a weather application) to trigger actions within one's own Monzo account (e.g. to move money to a savings pot).

In this paper, we present a study of this novel integration of financial transactions with everyday web-services to gain an insight into the future of automated and 'programmable' money [8, 14]. Collating a novel public dataset, we analyzed over 100 unique recipes developed by Monzo and IFTTT users on public forums to understand their effect and purpose, and how they are achieved through different kinds of service integration and automation. Through this case study we demonstrate how such recipes can be used not only to extend and personalize existing banking services, but also potentially to develop new services and functionalities based upon creative uses of banking data.

We use our findings as a platform to reflect on opportunities, challenges and areas of future research in the development of programmable money and related financial technologies. Specifically, we reflect on the ever-closer union of money and data, which will see money and finance proliferate across digital services. Following in the steps of previous HCI research there is the opportunity for digital monies to become more playful and expressive, rather than simply a matter of convenience. As such we surface how programmable money could provide much greater individual control and configurability of one's money, but only if users are supported in realizing the meaning and opportunities of one's financial data. However, we also point to areas of concern if money that is programmed by others can be used as an instrument of power and compliance. We conclude that HCI research in this context should therefore be sensitive not only to individual interactions with new forms of money, but the infrastructures of which they are a part.

[7]https://ec.europa.eu/info/law/payment-services-psd-2-directive-eu-2015-2366_en

2 RELATED WORK

HCI and Financial Technologies

There has been a growing body of work in HCI exploring the interactions and experiences that different forms of money provide. Much of this work has highlighted how the ways in which money is designed, and represented, has consequences for its situated use [12, 13, 17, 31, 32]. Given that finance is a topic that is often starkly rationalized and quantitatively driven, HCI research has — in contrast — done much to recognize the emotional, qualitative, personal and social aspects of money and has included a call to "*design financial systems that fit in with existing everyday practices rather than idealized notions of optimizing financial affairs*" ([15], p.530). Vyas et al.'s ethnographic study of household finances [42] for instance, noted the *"artful and creative ways people incorporate their social lives into financial activities"*. The work of Kaye, Vyas and Vines [15, 40–42] among others working across cultural contexts [2, 17, 23] also highlights how new technologies can often flatten out or overlook many of these important distinctions and nuances in how money is actually used. Zelizer [45] offers a conceptual framing for such reflections. She rejects the dichotomy between economic and social forms of value, or the view that either economics or social structures are a bottom line that trumps the other. Instead, through discussing several cases of money and intimacy, she argues that different socio-technical infrastructures for payment and exchange support 'differential ties' and demarcate all manner of social arrangements. Following Sunstein [36], there are *"qualitative differences between different kinds of money"*, or what Zelizer calls *'special monies'* [44].

The evolution of financial infrastructures and services that are data-driven, conditional and automated offers opportunities and challenges in this regard. In studying mobile payment services and wallets, Kow et al. [16] envisage how *"special digital monies [that allow], users to alter and define their transactional rules and pathways, could vastly expand the potential of digital monies to support users beyond standard retail contexts."* The authors go on to examine two forms of mobile money, Alipay and WeChat Wallet, and describe how they afford specific meanings, such as *'ceremonial'* or *'play'* money, drawing on gift-giving traditions. Caraway et al. [4] illustrate the design challenges of social sharing of transactional data in Venmo, a peer-to-peer payment app. They

highlight the appropriation and value of playfulness and ambiguity, when negotiating the public perception of sensitive data. In a study of households managing low-incomes, Vines et al. [41] point to budgeting practices of separating and dedicating money to particular 'pots' for particular purposes, and argues for their value in supporting better predictions and control of expenditure, by humans or machines. In the same study, the authors propose features and conditions that might support delaying or obscuring particular payments — quite in contrast to the desire of banks and creditors to support ever more immediate, accountable and seamless payments.

More recently, attention has turned to cryptocurrencies and particularly 'smart contracts' that enforce specific rules around transactions, and can grant non-human agents new kinds of financial autonomy. Nissen et al's 'GeoCoin[28]' illustrates the potential of tokens or currencies with specific rules embedded. A simple concept where a balance can be credited or debited upon entry to specific geo-fenced locations leads to the envisaging of applications for taxation, temporary marriages and participatory voting. The BitBarista [33] employs smart contracts to grant an individual coffee machine financial autonomy that supports voting mechanisms and rewarding maintenance by those interacting with it. While the semi-autonomous machine could allow users to dynamically engage in the provenance and economics of their cup of coffee, it clearly complicates existing social practices and routines. Further, where trust in the value and good economy of such a machine might traditionally be placed in a server, barista or company, users are expected to trust the machine, its lines of codes, and the wider network infrastructures with which it interacts, or what Lustig identifies as *'algorithmic authority'* [18]. Indeed, programmability, automation and conditionality are based on a logic that is predictable, machine legible and routinised in a way that may struggle to account for the vagaries and nuance of everyday life. It is the opportunities and challenges of such programmability that this paper explores.

IFTTT (Trigger-Action) and Automation

If This Then That (IFTTT)[8] is a web service that provides a *"free way to get all your apps and devices talking to each other"* and demonstrates end-user programming at scale. It does this through the use of Triggers and Actions, each based on the capabilities of the different apps integrated into IFTTT. Users can create 'recipes', that take a specific Trigger and a specific Action, and combine them to make an automated process. Recipes have a standard format that uses a conditional statement, hence the name of the site: If <this thing happens>, Then <do something>. An example of this: If <I receive a delivery SMS from Domino's Pizza> Then <Switch on my Philips Hue lights> . IFTTT has over 600 apps available to be used within the recipes, each with their own Triggers and Actions. Users can select between pre-made recipes (as in the example above) or create their own to suit their needs. These recipes thus allow for the automation of tasks between multiple services, which are often not available through an original application's design, or indeed where no service exists at all. Such modularity and interoperability leads to a remarkable, even nonsensical, diversity of potential recipes.

Ur et al. [39] studied nearly half a million IFTTT recipes, providing a detailed description of the most popular triggers and actions, and the way in which users had configured their recipes. They found users often duplicated recipes, preferring to create their own, despite IFTTT's interface channeling users towards those that are pre-made. They also note the different ways users name their recipes, some being purely functional ("Sends post to Twitter"), whereas others are more personal ("Get an umbrella!"). In examining how and what each recipe is doing, they identified that IFTTT allows users to fill gaps in the functionality of apps they already use, by creating recipes to specifically address an absent function. While several studies examine the potential of end-user programming such as IFTTT in the home (e.g., [24, 27]) , and have alerted the research community to the privacy and security risks inherent in user-created recipes [37], there have thus far been no studies of its application to financial services.

IFTTT is part of a wider growth in automation technologies that specifically aim to remove the burdens of potentially repetitive and time-consuming activities. As such, money and finance has been seen as a rich site for automation, with services like Pegg[9] and ANNA [10] promising automation of record keeping and processing of regular payments, and Cleo which provides automated reporting of spending habits and progress towards saving goals. Such applications claim to bring AI to consumer financial services, benefitting from increasing volumes of financial and transactional data. Although less sophisticated, the diversity possible with IFTTT and its core functions of conditionality and automation, open up a space for us to consider how end-users can actually make sense of and interact with algorithmic logic in financial services.

3 MONZO AND IFTTT

Monzo is a UK based, digital-only bank, founded in 2015. Initially providing prepaid cards, Monzo gained its UK banking license in 2017, subsequently replacing their prepaid cards

[8] https://www.ifttt.com

[9] https://www.sage.com/en-gb/products/pegg/

[10] https://anna.money/

with a current account (also known as a checking or transaction account), which remains their only product. Monzo users interact with their account through a mobile phone app, with no physical bank branches or telephone banking possible. All interaction with Monzo is through their app, including the signup and support processes which uses in-app chat. A support telephone number is available, but not widely publicized, and in July 2018 Monzo introduced a basic web interface to enable emergency access to one's account. Monzo includes many technological features that are not often offered by the large UK banks, such as real-time spending push notifications, and highly granular spending analytics, allowing users to see categorized spending over a specific period. It also has a number of benefits when used abroad, and thus has attracted nearly 1 million customers.

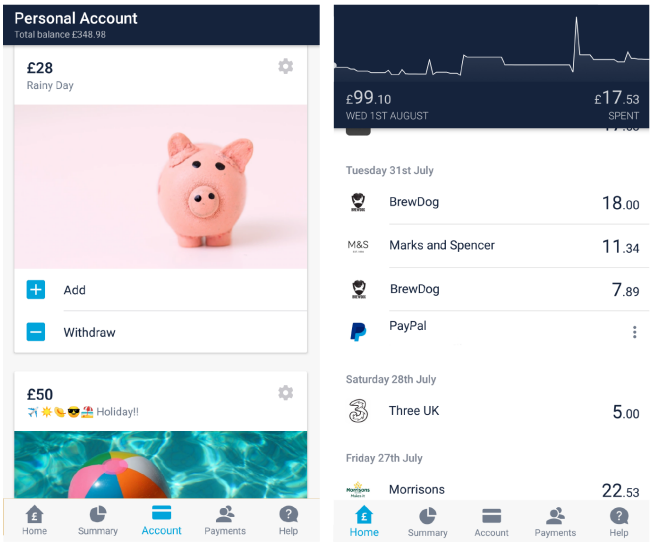

Figure 1: Screen captures of Monzo's mobile interface a) A 'rainy day' fund and holiday pot b) A spending summary.

An important feature of Monzo is the ability to create 'pots' of money that can be separated from the main balance of the account, and given a user-defined name. Figure 1, illustrates two pots, one titled 'Rainy Day'containing £28, and another the 'Holiday' pot containing £50. Pots cannot function separately from the main Monzo account (i.e. they are not savings accounts), and are merely a way of separating money under a specific name. When a transaction is made, money is always withdrawn from the main account, and so pots were envisaged by Monzo primarily as a feature to support saving money.

In June 2018, Monzo announced they were now integrated with IFTTT and that Monzo account holders could now use IFTTT to automate functions of their account. Once an authentication process is completed, the integration is enabled,

	Trigger	Action
a	If I make a card purchase at 'Central Perk' coffee shop	Move transaction amount out of my 'Coffee' pot in Monzo
b	If my mobile phone registers within proximity of my gym	Move £5 to my 'Gym Treat' pot
c	If spending over £50 with Monzo card	Play 'Loadsa Money' playlist on Spotify
d	When I enter the geo-fenced location of the weekly park run	Move £5 out of my penalty pot

Table 1: Examples of Monzo & IFTTT Recipes

with all automation occurring securely between only Monzo and the IFTTT service. Several specific 'triggers' and 'actions' are available. Triggers (i.e. data that Monzo sends to IFTTT) include: 'Any card purchase (above a certain amount)'; 'Any card purchase at a specific merchant'; 'Any new attachment added' (e.g. a picture of a receipt); and 'Any new blog post from Monzo'. There are two Actions possible within Monzo, to move money into and out of a pot. Therefore, one could create an IFTTT recipe that would move money into a pot based on your spending, as seen in Table 1a. When I buy a coffee at 'Central Perk' using my Monzo card for £2, it would trigger the IFTTT recipe, which would perform the action "Move £2 out of the Coffee pot". This action would be performed as soon as the spending trigger occurred. Given the large range of apps available on IFTTT, these can be used in recipes alongside Monzo triggers and actions. An example of this is given in Table 1b. IFTTT can use the GPS location of a user's a mobile phone to trigger an event action to move £5 from their main balance to a pot called 'Gym Treat'. Alternatively, spending data from Monzo, can trigger actions in other applications, such as playing music in Spotify. This demonstrates the highly customizable and personal nature afforded by the integration.

There are some current limitations to the integration between Monzo and IFTTT. Money cannot currently be moved outside a user's account (i.e. bank transfers or payments are not permitted), and it is not possible to query the balance of the account automatically. Helpfully, however, any action to move into or out of a pot will fail if there is no sufficient balance, rather than cause the user to become overdrawn Despite Monzo's heavy use of spending analytics, there is no granularity of spending, such as what type of spending a transaction is. For Monzo, the integration with a mature service platform such as IFTTT affords users the ability to fill gaps in Monzo's functionality using a vast range of existing

apps and platforms. Monzo have described the integration as a feature that will please early adopters who have supported the service, and allow them to push the service in new directions [26]. Giving users the ability to automate aspects of their finances, using their bank account as both a trigger, and something to be acted upon, opens up a large number of opportunities to customize and tailor a user's finances to fit their own personal practices.

4 METHODS

Generating a Corpus

In order to investigate the integration of Monzo with IFTTT and the potential of automation in regards of banking more generally, we set about generating a corpus of examples of 'recipes' that involved Monzo as either a trigger or action channel. Monzo themselves maintain a set of highly-active community forums as a space for help and support, as well as a platform for general discussion of the future development of the Monzo platform. The integration of Monzo and IFTTT was announced on one of these forums, and Monzo members were invited to *"Share Your Creations Here"*. Monzo also provided a feedback 'megathread' where new ideas, queries and issues were engaged with by Monzo developers and the wider community. Both of these forums provided many examples of recipes or 'applets' generated by users and Monzo themselves. Finally, Monzo curated a list of their favorite creations on Twitter and a selection of user-generated applets are also visible on Monzo's IFTTT home page.

From these four primary data sources, over the course of four weeks we developed a corpus of unique Monzo and IFTTT recipes in a shared spreadsheet. For each recipe we included the text description of the recipe provided by the user (either on the forum post, or as part of the recipe itself); the trigger channel; the trigger; the action channel; and the action. In total this resulted in 113 unique recipes. Our corpus included no personal data of any of the users who publicly posted their recipes, besides their description of the recipe itself. We concluded adding new recipes to the corpus on July 31st, 2018.

Data Analysis

We sought to code all of the text in this corpus to understand both the different purposes and character of each recipe, as well as the kinds of automation that supported its function. Drawing on Braun and Clarke [3], we performed a two-part thematic analysis, the primary codes consisting of the purpose of each recipe. For example, the recipe in Table 1d was coded as a 'Reward'. For the secondary codes, we coded the role of both trigger and the action in the recipe. In Table1d the trigger was coded as 'Monitoring an Event' and the action was coded as 'Release Funds'. From the primary codes, we could then analyze what users hoped to achieve through automation; with the secondary codes we could analyze how particular platforms, triggers and actions gave effect to these aims. The first two authors undertook coding collaboratively. Each took a subset of the recipes and coded these as above, before comparing and discussing codes to resolve any divergence, creating new codes if necessary, and combining others.

We then sought to thematically analyze our codes to establish relations between the general purposes of the recipes. Using post-it notes for each code, we began to group similar codes in an effort to construct initial candidate themes. We then wrote short descriptions of each theme in order to share them with the wider research team. Subsequently we used these initial themes to reorder the original corpus, and then closely re-examined the recipes now contained in each theme, as a means to validate both the original coding, and the coherence of the themes themselves. We then sought to expand the description of each of the themes, in relation to the original data. The resulting themes and analysis are presented in the second section of analysis 'Recipe Functions'.

We followed a similar process for the secondary coding of the role of different actions and triggers for each recipe. Our secondary coding focused on what kinds of automation were sought and achieved in each case, and how these related to the overall aim of recipe — or more simply, why they worked. Through this analysis, we were able to map the generalized functions of triggers and actions, and as such, various patterns of conditional automation. As lower level actions, these results are reported first.

Limitations

Before we discuss our findings, it is important to highlight some specific limitations of our corpus. Monzo users could be characterized as 'early adopters' in regards of financial technologies and Monzo themselves have described the IFTTT integration as a 'power user' feature [26]. As such, the recipes captured here likely stem from a particularly motivated, enthusiastic and inquisitive group. Further, what we capture here are examples of recipes, and *proposals* for their use rather than their *actual* use. Further work is required to investigate how such recipes are appropriated and experienced in the course of everyday life. It is therefore important that we take care in drawing out general implications for the use of such technologies, and consider the potential for more critical, and diverse views or use-cases. However, in prior work in related contexts, 'extreme users' [6] and early-adopters have offered valuable insight into the possibilities of emerging technologies. Therefore, we view our sample as a forerunner from which we can identify opportunities, challenges

and trends for the future of programmable money and automation in financial services. It's also important to note the relative simplicity of 'trigger-action' programming, in comparison to financial products that may include much more complex and calculative algorithmic functions or machine learning. However, as an end-user programming interface, this simplicity supports our inquiry into how programmable money may be made to fit with people's everyday lives. Indeed, although envisioned for power users, many of the recipes speak to very familiar and widespread uses of money — to pay bills, to save money, or to account for one's spending. We now turn to our findings in detail.

5 RESULTS

Our results report a range of recipes that serve to describe our thematic analyses. In the first section (Uses of Automation), these concern the lower level automation that participants made use of via the integration of Monzo with IFTTT; in the second section (Recipe Functions) we describe the broader aims and purposes of different recipes.

Uses of Automation

Triggers. We identified four broad functions of triggers within our corpus:

(i) Connecting Alternative Inputs: Several recipes were simply a means to connect alternative or additional inputs with Monzo. For example, to execute specific transactions via a voice command or email. The immediate effect of this might be to make it easier to manage and configure Monzo beyond the application. However, this integration can also empower the meaning of the initial trigger itself. Consider this recipe: *"Create a pocket money pot for your child / children in Monzo and then integrate IFTTT / Monzo / Alexa. Now I can say "Alexa, Childs name has been good" and £0.50 is added to the pocket money pot and the reverse for "Alexa, Childs name has been naughty"*. This recipe is not only for making the organization of pocket money easier, more than that, a single voice command is empowered and extended with an immediate financial consequence.

(ii) Enforcing Regularity: These recipes used triggers related to a time, date or predictable event, to ensure regularity. Several recipes were used as a form of reminder or scheduling — for example, to avoid missing bills. *"Move money into my Petrol pot on the last day of every month."* Alternatively, a time or date trigger could be used to enforce a regular commitment such as saving or drip-feeding an allowance. *"Take on the Weekly Savings Challenge. On Monday save £1. On Tuesday £2. This goes up to £7 on Sunday and then starts again on Monday. Save £1500 a year!"*

(iii) Defining Events: Many recipes were based upon defining certain events or occurrences. For example, 'eating out' for lunch, being lazy, and failing or succeeding in meeting certain goals. Several of these recipes relied on data from the Monzo app (especially spending at certain locations or merchants). Others drew upon data from other apps and services: e.g., *"[Put] money in pot anytime you ring a certain person (an ex, for example!!)"*. In all cases, users required an understanding of how to define an activity or event through the applications being used, in order to create a rule that sufficiently and fairly accounts for it. In their descriptions of recipes, several users recognized the challenges of this. For example, one recipe established a penalty for buying lunch out from a supermarket. *"If I spend money at Tesco or Sainsbury's then the equivalent amount goes into a Naughty Lunch pot."* However, the user also realized that this rule should only apply during routine working days where they lived: *"This is where I'd love some more granularity on IFTTT. It should really be these places in London. But not doable right now."* This user is eliciting the challenge of relating personal informatics to real-world phenomena. Basing conditions upon such data and assumptions requires greater certainty about the fidelity of the data stream, and the routine and predictable nature of the event — for example, that every purchase made at Tesco or Sainsbury's with a Monzo card will in fact be a 'Naughty Lunch'.

(iv) Measurement and Categorization; Relatedly, a subset of those recipes that define events and occurrences, involve a degree of measurement or categorization. In particular this related to efforts towards behavior change and self-tracking. Categorization was useful to support the allocation of money to specific pots and uses. Measurement could support recipes that were more dynamic and go beyond binary conditions, to create, for example, penalties or rewards that scaled with metrics such as steps or fuel consumption, or for example: *"Each day add to a pot the number of pence equal to the day's highest forecast temperature."* In many cases, the data to define, categorize or measure an event provides a value judgement on the activity, which can then be matched by an appropriate financial judgement.

Actions. There were broadly four kinds of actions supported by the recipes in our corpus that empowered these triggers:

(i) Moving Money: Save; Withdraw; Allocate: The primary IFTTT action available within Monzo is to move money into, or from, specific pots. By moving money between pots, users could effectively: save money by setting it aside; withdraw money in order to spend it from one's main balance; or allocate money for particular kinds of budgeted spending (e.g. bills, petrol money, lunch money etc.).

(ii) Informing: Several actions entailed informing the user or others about their transactions, often through alternative interfaces or media. For example: *"When you spend at Amazon, blink your lights as confirmation"* This typically supported greater awareness, and included reminders and

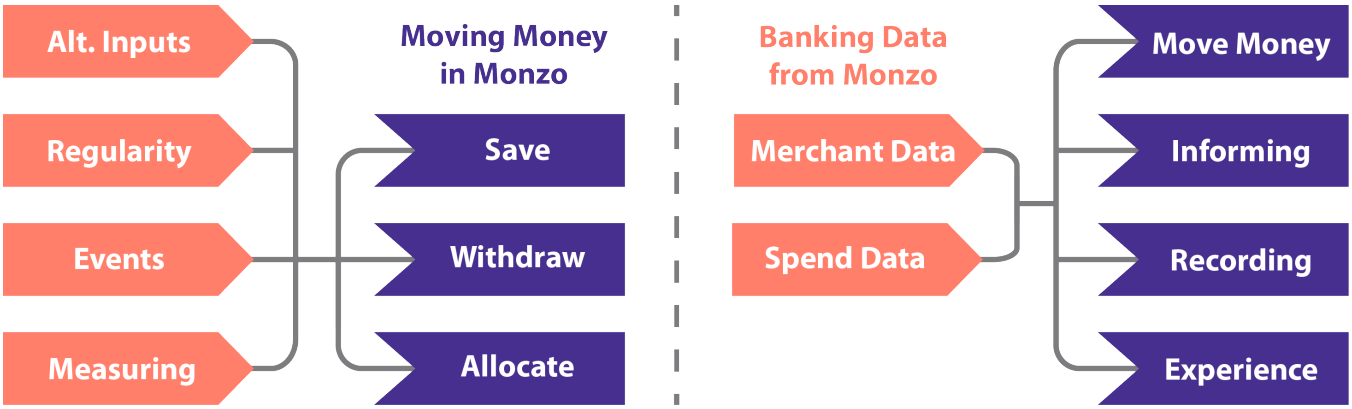

Figure 2: Summary diagram of 'trigger-action' pairs: using a range or triggers to move money in Monzo, or using banking data from Monzo to trigger a range of actions.

forms of notification that were tailored to or more effective in particular settings.

(iii) Recording: Beyond informing users, some actions served to automatically document transactions beyond the Monzo app. This might allow the automatic creation of specific records, or to help a user keep their records across several apps in one place e.g. *"Send my receipts to Expensify"*.

(iv) Experiencing: Finally, many actions triggered beyond Monzo were to foster a certain experience or aesthetic, for example, to celebrate a large purchase by playing certain songs or sending amusing messages to oneself or others. These could be personal and expressive in a way that typical banking actions could rarely support: "Just created an applet that sends [scary image of Terry Crews] in a rich notification any time I spend money."

Trigger-Action Pairs. Drawing on these analyses, in Figure 2 we map the triggers and actions described above to illustrate the potential pairs supported by the current integration of Monzo and IFTTT. In the first case, the range of triggers described can be used to automatically move money between pots in Monzo — to save, withdraw, or allocate funds to particular ends. In the second case, banking data from Monzo — specifically spending at a particular merchant, or a particular amount of spending — can be used to automatically trigger the various actions described.

Though particular pairs were more prominent in our corpus than others, our effort here is not simply to categorize, but to show how this mapping could be viewed as patterns to generate and consider new recipes for programmable money. For example, we can consider what range of *alternative inputs* could support saving money. Many recipes in our corpus connected conversational interfaces with Monzo, but we could just as easily envisage that turning on a light, playing certain songs, or tweeting certain phrases could be triggers to automatically save money into particular pots. Similarly, many examples in our corpus *informed* others of spending at a *particular merchant* through custom notifications. Variations of this could range from sharing with friends when drinking at a particular bar, to informing an employer of meals eaten out on expenses.

In this way, we suggest that the mapping in Figure 2 provides both an overview of what is possible with this particular integration, and a starting point for the ideation of alternative recipes, and design towards new forms of programmable money. Having established the underlying patterns of triggers and actions in the integration of Monzo and IFTTT, we now consider what we understood to be the broad purpose and intentions of the specific recipes recorded in our corpus.

Recipe Functions

There were four broad functions to the recipes in our corpus. First, to encourage and automate saving money; second, to create rules around spending and accounting; third, to support better financial and account management. Finally, there were recipes that were distinctly creative and playful, or were an effort to change behaviour. While the first three themes are broadly extensions of traditional banking services, this final theme in particular relied upon novel integrations of banking data.

Automatic Saving. Many recipes sought to encourage saving money. In the context of Monzo, saving is achieved by withdrawing money from one's current account, or main balance, and moving it into a specific pot. Saving could be towards a specific purpose (e.g. a holiday fund), or general savings (e.g. a 'Rainy day' fund).

Several recipes supported saving on an automatic or scheduled basis, sometimes as a 'savings challenge', where small amounts were regularly moved into savings pots: "Take on

the Reverse Savings Challenge. A savings challenge that gets easier every day! Gradually decrease the amount you're saving each day to a pot of your choice. On 1st January, you'll save £3.65. On 2nd January, you'll save £3.64. This goes right down to £0.01 on the last day of the year! Feel free to jump in part way through the year, and see how far you get!"In other examples, automatic saving could be connected to sporadic or random real-world events — e.g. *"If the [International Space Station] passes over my house, add 10p to a pot"* — which might make saving more playful, or to accumulate in an unpredictable way. In both these cases, automation serves to take the actual act of withdrawing money into savings out of users' hands, such that they might not notice the money being withdrawn and can maintain a commitment to save money.

Other recipes connected saving to specific personal activities that could be recorded, for example, one recipe *"puts money into a 'Cycling Kit' pot every time I complete an activity on Strava"*. While automatic or random saving was most often directed to a general savings pot, this particular recipe is compelling because it relates the actual activity of cycling towards saving for cycling.

A final set of recipes supported instantaneous saving that was on-demand, particularly through voice interfaces such as Alexa or Siri — *"Just set mine up to add some money to my Florida 2019 pot every time I say 'Hey Google, it's Florida time!'"*. By extending the available interfaces and opportunities for saving (particularly small amounts), a fleeting desire to save money can be made immediately actionable.

Managing Spending. Recipes related to spending primarily sought to enforce rules around spending money, or to improve users' awareness of how money was spent. Many had established spending pots as a means of budgeting for specific regular expenses, such as groceries, lunch, or coffee. However, when paying with a Monzo debit card, money is withdrawn from a main balance rather than specific pots; therefore, to manage this spending, a user must move the equivalent amount out of the relevant pot, back into one's main account. For example: *"Move my travel card money from my travel card pot, after purchase."* Clearly, this could be burdensome or easily overlooked by a user if done manually. Therefore, by identifying and categorizing particular kinds of spending (e.g. at specific merchants, locations or times), users are able to allocate their funds as they wish.

Other spending rules included drip-feeding money on a recurring basis into one's main account from a specific pot. For example: *"When in the Office, give me lunch money"* uses location to move a specific amount of money from a defined pot to one's main account. While this example reflects a routine, and potentially an effort to limit or budget for expenses such as lunch, other examples were forms of rewards or treats: *"If Daily calorie burn goal achieved, then move £5 out of my Coin Jar pot as a reward."*

Finally, some users created recipes to generate greater awareness of their spending, often taking data from Monzo as a trigger, and presenting this through another medium or platform. Among the simplest included: ' *'If I spend money using my Monzo card, then tweet where, and how much!"* Yet, it's clear that this recipe would completely transform the use of one's Monzo account, if all transactions were subsequently made public via Twitter. Other recipes were more tongue-in-cheek, for example through an integration with Spotify: "If I spend more than £100 on my card, then play 'Shirley Bassey - Big Spender"'. Other examples used automation to confirm transactions via blinking lights, or simply via a weekly email digest.

Account Management. A series of more pragmatic recipes focused on easing or extending account management with Monzo, particularly the maintenance and allocation of pots to regular payments or bills. For example: *"Every Monday at 7AM move £40 out of my Investments + Savings pot, ready for MoneyBox collection"*. Others would augment the account in other ways, for example creating means to top up one's account from a pot in an emergency where one had lost access to their phone: *"Lost Phone: If Send trigger@applet.ifttt.com an email tagged #lostphone from my email, move £50 Pot."* There is currently no emergency top-up function like this provided by Monzo, hence the integration with IFTTT supports an extension in functionality, which otherwise may be challenging for Monzo themselves to implement and support.

Recipes also sought to make record keeping easier and more consistent through automation. Some recipes took all, or only specific, transactions and automatically stored them to a spreadsheet or as a calendar event to catalogue spending, going beyond the self-tracking offered natively in the Monzo app. Record keeping also extended to attachments made to transactions (for example a receipt), with recipes created to automatically upload to a cloud storage service. While record-keeping is a basic functionality of nearly all banking services, the integration with IFTTT offers users the opportunity to specify particular records, and maintain these in the most relevant or appropriate cross-platform format.

Creating Novel Financial Applications. Finally, there were a large number of recipes that went beyond managing finances. There were primarily expressive and playful or attempts to promote personal behavior change. Many of these examples pushed the boundaries of what a banking service like Monzo is intended for, and achieved distinctly novel interactions.

Many users created automatic rules and connected other apps as an opportunity to support behavior change. Several recipes sought to penalize the purchase of goods from specific merchants (especially fast food vendors): *"If I spend*

money at Domino's Pizza, McDonalds [sic], KFC or the local pub , then move £5 to my penalty pot." Recipes like these therefore imposed penalties, or a form of tax, on certain purchases, to be held in a specific pot. Other recipes established some kind of self-chastisement, through communicating a misdemeanor to oneself, or one's social circles: *"If I spend at Nando's, email my wife and tell her I've been bad and don't deserve dinner."* Though distinctly playful, this example highlights the potential power of social integrations related to financial data. In these cases, automation is being used to create and enforce some further consequences to what is categorized as a 'naughty' or negative behavior.

Other recipes took data from Monzo (such as buying a coffee) as a trigger or record for other behavior change efforts (e.g. to trigger a notification to drink more water). The financial data in such an example is not concerned with managing money, it is simply a reliable means to identify a behavior.

Drawing upon other non-Monzo data as a trigger, several recipes sought to establish both penalties and rewards based on one's behavior, for example, meeting or missing a step target, taking part in a 'Park Run' event, or swearing on social media. By setting up a penalty pot or a 'treat jar', funds could be effectively withheld from, or made available to, users. For example: *"Using my Withings smart scales, if my Body Fat increases, move £1 to my penalty pot. If it decreases then move £1 out of the penalty pot."* Clearly, some of these recipes were more serious than others. One recipe suggested: *"If I spend more than £60 on my card, then play Lady in Red"*. Presumably, the playing of this well-known — though often derided [43] — song is intended as a punishment or to encourage awareness of spending, but is hardly a strict budgeting measure.

Beyond examples of behavior change, other playful recipes included: *"If Trump tweets the words 'war' or 'Rocket Man' then empty all pots into my main account and alert me that I should spend it all before the end of the world."* The resulting financial implications here (emptying one's pots) are arguably secondary to alerting or acknowledging their triggers. While users here are clearly testing the boundaries of the integration, and sharing humorous recipes, we can see how connecting these events to a financial action, however small, can give the event an elevated status. What distinguishes many of the recipes in this theme is that they are not primarily about banking. Instead, data about financial transactions, or the movement of small amounts of money itself are used to change or reflect upon other aspects of everyday life.

6 DISCUSSION

We conducted an analysis of the novel integration between Monzo and IFTTT in an effort to identify the future direction and potential of user-programmable money. In our discussion, we reflect on findings about how automation works for Monzo customers, as a foundation to identify areas of required future research and development in this design space.

Reflecting on how automation is configured within our corpus of recipes we can elicit some basic motivations for automation in managing finances. Most evidently, automation is envisaged to provide **efficiency** in supporting better account management, instantaneous calculations or reporting, replicating actions (e.g. splitting money between several pots), or actions and intentions that can be set up once and forgotten. Further, automation can be a means of **enforcing intentions and providing consequence**. Setting up a rule with an automated action for certain triggers preserves an intention, and without relying on further decision or human intervention that intention can be enacted. This is especially resonant in efforts to save or to budget better, or to change habits through the experience of consequences (or a punishment) for certain behaviors. Also evident, in the diversity of applications that might act upon Monzo data, is that automation supports **proliferation** of that data, i.e. being able to simultaneously push data and actions across multiple platforms and channels. As part of this proliferation, automation would also support the **changing of modalities** of data, be that for convenience, to raise attention or create an experience, for example transforming a significant purchase into the visceral experience of hearing the song 'Big Spender'.

With these reflections in mind, in the following sections we suggest specific design and research directions for connected banking applications, and consumer financial technology in general.

Programmable money across services

Some of the most intriguing recipes in our corpus were those that integrated Monzo with applications that ordinarily have little to do with banking. This proliferation of financial data across different platforms, and channels, highlights the way in which programmable money may cut across services. In essence, we are seeing how money and transactions are potentially just another form of data, to be pushed and pulled around integrated services.

There are two design possibilities here. First: data about financial transactions could resonate and cascade across a range of other services. While this might simply provide novel forms of reporting and awareness of one's transactions — as in blinking the living room lights for every purchase at Amazon — there could be more consequential actions, such as shaming oneself on social media for buying fast food. Second: what happens when data from these other services now has real implications for your money? By creating a rule to put money in and out of a 'treat jar' based on walking 10,000 steps, suddenly, a Fitbit is gaining a form of financial autonomy, and may even start to make payments. While Monzo's integration with IFTTT is limited to moving

one's own money around, projects such as the BitBarista [38] demonstrate how the use of smart contracts might grant devices financial autonomy on an even greater scale.

For interaction designers there are clearly opportunities to envisage programmable money that extends the services across which 'banking' can be done and communicated. However, in turn, we ought to consider the wider implications when users are able to 'financialize' data streams from other services. What does it mean if the use of a games console could determine pocket money for instance? Or if brushing your teeth automatically earned you an ice cream? How would these activities themselves change as financial value might be increasingly attached to them?

Programmable money as expression

The playful and expressive tone of many recipes in our corpus was unmistakable. This is resonant of much previous work on money in HCI, in that these interactions surrounding money can be 'artful' [42] and go beyond an assumption that programmable money might solely be used to optimize one's financial affairs. This observation also resonates with a collection of work in HCI that recognizes 'Lived Informatics' [34], the way that self-tracking data is *"enmeshed in everyday life"*, and is about more than becoming 'fitter, happier and more productive' [11]. A recurring theme across this work, is the need for tools and applications that support interactions with data that support expressivity, and articulating an identity [9]. Caraway et al. [4] show just such interactions with money in the way transactions are shared in Venmo, a mobile money application.

We see this as a critical counterpoint to research and innovation on digital financial systems that is often focused upon better security, regulatory compliance and easier ways to pay, rather than granting users more control, configurability and expression. As we move towards cashless societies, retaining the deeply embedded interpretive flexibility of cash within digital financial products seems vital. Although many of the recipes saw entirely novel uses of a financial data and banking applications, many of the underlying motives and heuristics were commonplace experiences and uses of money: for example, creating rewards and penalties, and using money to place greater importance on particular actions or events. This reflects the central position of different forms of money in social interactions [44]. For example, making silly bets with a friend can be as much about one-upmanship, as it is the money to be gained. Swear jars are a longstanding example of using money to enforce, penalize and draw attention to certain behaviors. In short, it's about more than just the money. However, prior to this, banking infrastructure could rarely explicitly support such distinctions and behaviors with money. The integration and automation across IFTTT demonstrated the potential to embed and program much more human actions and nuances around digital money.

Programmable money as control

Many of the recipes that users posted illustrate the ways that programmability can be used to take greater control of one's money. Some of the creative uses of IFTTT highlighted gaps in the current provision of banking services. Recipes were created to top up, and access, accounts across different devices, and across different modalities, in particular through conversational agents. This might also support opportunities for instantaneous saving, or saving as a practice that is better situated within daily routines. Similarly, several recipes sought to enact certain priorities around spending by allocating and moving money around different pots.

In prior work, with the 'older old', and those working on low incomes [7], greater visibility and control over one's money is a recurring concern. From the recipes we have discussed, it is clear that in theory, programmability supports this. However, at the same time, poorly directed automation can be disempowering, and could remove the skill, nuance and even enjoyment people gain from how they cannily manage their money.

Further, while the value of transactional data is already quite apparent to banks and financial services, this value is arguably yet to be made transparent to customers. As this data becomes more accessible through software APIs [11] we ought to consider how such programmability can be leveraged to help users feel in control of their money.

In the first case, we should consider how users can be appraised of, and understand, the richness of their own financial data beyond a bank statement with a bottom line. Automated spending analytics scratch the surface here, but beyond simply informing users of their habits, we could imagine systems that, for example, identify possible savings by integrating one's bank with a service providing coupons or cashback on purchases. Importantly, this also requires carefully communicating the potential limitations of such data, in terms of its quality and granularity, in order to develop trust and set appropriate expectations with users as to how 'smart' any system can be, and on what terms it should be trusted.

Programmable money and autonomy

Our study also highlights the use of conditional automation as a way to enforce additional consequences to certain transactions. In many cases, IFTTT rules are a way of formalizing existing or desired practices into a protocol. But while IFTTT

[11] https://ec.europa.eu/info/law/payment-services-psd-2-directive-eu-2015-2366_en

is a platform where savvy users can manually set their own rules, in many cases, using programmable money will mean playing by rules and systems set, or even imposed, by others.

It is quite possible to envisage the potential value of programmable money on a societal scale; for example, through forms of mutual insurance and localized collective agreements around money and transactions. But we must also consider how this automation might be used as a form of control. For example, how might an employer, parent, bank, creditor or donor use their positions of power to create and enforce rules around the use of the money they disburse? The combination of credit-scoring, and payment monitoring is already being used to control access to vehicles: devices that disable a vehicle's ignition if repayments are late are already being imposed on those with poor credit scores in the US [35]. It may well be that it becomes commonplace to engage with multiple complementary forms of programmable money — but how might these interact? Will some kinds of money be privileged ahead of others?

Finally, the 'programmability' of IFTTT and other 'trigger-action' systems is relatively simple in comparison to many other algorithms or protocols that might underpin autonomous financial agents and systems. Recent technological developments, particularly in the areas of machine learning, automated financial advice, blockchains and smart contracts foreground the delegation of significant financial power to automated systems and agents. There is an urgent need to investigate new interaction paradigms and patterns for how to interact with such conditional agents that may be the bearers and makers of programmable money. Ultimately, what do users need to know in order to have faith, and trust, in machines with financial autonomy? And to what extent is the logic of actions and triggers, and end-user programming, as exemplified in this study, an appropriate means to have oversight over the ramifications of such systems, or to ensure they fit into people's everyday lives?

7 CONCLUSION

In this work, we took the integration of UK-based digital bank Monzo and with IFTTT as a timely opportunity to consider the future of increasingly automated and 'programmable' money. We analyzed over 100 unique recipes developed by Monzo and IFTTT users on public forums to understand their effect and purpose, and how they are achieved through different kinds of service integration and automation. Our findings follow in the footsteps of prior work on money and finance and HCI that recognize the emotional, personal and social aspects of money. The recipes in our corpus clearly show the opportunity for programmable money to deliver more nuanced and contextualized forms of digital money that better fit existing everyday social practices. However, looking to the future, we identify the need for HCI and design research that supports users in orienting to the vast array of data and services that are now becoming financial affairs. Lastly, we see the need for future research to look beyond the individual end-user programmability made possible with IFTTT, to consider the wider social infrastructures and regimes within which financial systems inevitably operate.

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