

Building a Social Machine: Co-designing a TimeBank for Inclusive Research

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ABSTRACT

This paper discusses the construction of a Social Machine, a socio-technical system in which people achieve new, creative goals enabled by automated processes that are handled by technology. Specifically, the Social Machine is an online TimeBank, a time-based way for people to give and receive services; it is designed for use in the context of inclusive research (initially) with people with learning disabilities.

We describe the use of physical and digital (online) focus groups to gather inputs to drive the construction of the TimeBank, and the processes by which we analysed the data to inform the design of the TimeBank. Our goal is to create an online community with a sense of connectedness, and we discuss this work through that lens, presenting insights gained towards: building the TimeBank itself; methodological implications of related but separate physical and digital focus groups; and building Social Machines.

Categories and Subject Descriptors

K.4.m [Computers and Society]: Miscellaneous.

General Terms

Measurement, Design, Human Factors.

Keywords

Social Machines; Inclusive Research; TimeBanking.

1. INTRODUCTION

This paper describes a Web Science approach to addressing the longstanding problem of involving marginalised, usually unsalaried, groups in inclusive research by the co-design, development and study of an online TimeBank.

Inclusive research requires collaboration between academics and people outside the academy: the latter are usually from marginalised groups, such as people with learning disabilities. Inclusive research involves the people who are usually objects of

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research undertaking more active, powerful roles as advisors or leaders. Significant inequalities nonetheless emerge, because academic researchers are salaried and collaborators are not; there may not be funds to pay for collaborators' time, and payments can interfere with receipt of state benefits.

TimeBanking involves matching people who need skills with those who can offer them. It addresses problems associated with payment by involving the reciprocal give and take of services, not money.

We examine the possibilities afforded by web technologies, specifically Social Machines, as a foundation for supporting the exchange of time and resource transactions in inclusive research, taking a co-design approach with community partners. While focusing on the specific context of inclusive research, this project also addresses the wider challenge of democratising the research relationship and facilitating co-production, via the web, between those inside and outside academia. The goal of the work described in this paper was to gain sufficient design inputs to help us design a prototype TimeBank, to be evaluated by end users.

The work described in this paper results from collaboration between academics from inclusive research, education, geography, computer science and web science working with experts in inclusive research and communication based at the Barod Community Interest Company.

To date, two focus groups have been held with stakeholders from across the community. The first focus group consisted of a physical meeting, while the second was held via an online, digital medium. We describe the procedure and results of these focus groups, along with the implications of those results. This interdisciplinary work sits at the cross-section of inclusive research, Social Machines and user-centred design.

Section 2 of this paper offers a discussion of background and related work, focusing on inclusive research, TimeBanking, Social Machines and user-centred design. Section 3 describes the research procedure for the physical and digital focus groups, as well as the approach taken to data analysis. In Section 4 the results of the two groups are presented, while Section 5 discusses the implications of these results, considering implications for the inclusive research TimeBank, physical and digital focus group methodology, and Social Machines.

2. BACKGROUND AND RELATED WORK

This section sets out the landscape for this interdisciplinary research. Section 2.1 introduces the field of inclusive research and is followed by Section 2.2, which explains TimeBanking and its value for inclusive research. Section 2.3 introduces Social Machines, and finally Section 2.4 describes user-centred design, the approach used to design our Social Machine.

2.1 Inclusive Research

Seale, Nind and Parsons [34] describe inclusive research as: ‘...an umbrella term encompassing participatory, emancipatory and community/peer-led research. This is research in which those...who tend to be the objects of other people’s research become agents in the conduct of research, ensuring that such research addresses issues that are important to them and includes their views and experiences’.

At the heart of inclusive research, then, is a commitment to balancing, reducing, minimising, or disrupting existing inequalities in how power and reward are distributed within research. Specifically, it has been (and indeed, continues to be) argued that it is researchers at universities who benefit the most from undertaking research involving members of communities from outside the academy. Inclusive research has sought to change research dynamics by involving people from traditionally excluded groups (in particular, people with learning (intellectual) disabilities, but also children and young people) as more equal partners. Often, this involvement is as co-researchers responsible for different elements of the research such as design, implementation, analysis, write-up and dissemination (e.g. [20] [28]). Such research has provided rich insights into the lives and experiences of people with learning disabilities, as well as critical reflections on the practical and conceptual challenges involved [26] [27].

Inclusive or participatory research has been well represented in the field of human-computer interaction. Researchers have increasingly recognised the moral, ethical and epistemological imperatives of involving ‘end users’ in the design and development of technology [2] [29]. There is recognition that involving people for whom the technology is intended (representative users) in its design, development, evaluation and implementation may result in more appropriate, acceptable and usable prototypes or products [9]. Consequently, many creative methods have been developed, reported and discussed to support the more equitable involvement of users in pursuing this goal (e.g. [10] [25]), although not without critiques of the inherent tensions and challenges [12] [30]).

One of the thorny issues that persists in inclusive research is how research collaborators from outside the academy can be appropriately remunerated for their time, effort and skills [22]. Addressing this is important for redressing inequalities within the inclusive research relationship. Despite advances in understanding the methods and processes that can be utilised for managing inclusive research, significant inequalities remain because while academic researchers are salaried, collaborators may not be. Important decisions need making collaboratively before a research proposal receives funding, and even once funded there may not be funds to pay for collaborators’ time; casual payments can interfere with receipt of state benefits. This project therefore explores a potential solution to this problem by developing an online TimeBank (see below). The long-term goal is to examine how a TimeBank might support the exchange of time and resource transactions for community members and how those community

members can co-design and develop the web-based tool to be accessible and economical. Within the specific context of inclusive research, this work also addresses the wider challenge of democratising the research relationship and facilitating co-production of a technological artefact, via the web, between those inside and outside academia.

2.2 TimeBanking

Bretherton and Pleace [4] describe TimeBanking as ‘a community-led innovation that uses time as currency’. In practical terms, it involves being paid in time for the giving and receiving of services. ‘For every hour participants ‘deposit’ in a TimeBank by giving practical help and support to others, they are able to ‘withdraw’ equivalent support in time when they themselves need something doing. In each case the participant decides what they can offer’ [39].

Exchanges can be person-to-person, person-to-agency, and agency-to-agency [15]. In terms of social purpose, TimeBanking is also about generating other social or democratic goods, such as reducing social exclusion and generating social capital and social networks. Importantly, everyone’s time is equal in a TimeBank, helping to reduce hierarchies of status and power associated with money. It is a ‘regime of recognition’ [13] in which interdependence is central.

While TimeBanks have been growing steadily in the UK since 1998, TimeBanking as a concept is attributed to Edgar Cahn in the USA in the 1980s [6]. TimeBanks now span 40 countries and 6 continents [4]. Cahn, in a published conversation with Coff [7] described TimeBanking as ‘a medium of exchange that invites creativity, invites the creation of new enterprises and new organisations and a fundamentally different relationship between community and government and between the community and public professionals’. The principles underlying TimeBanking include seeing people as assets with every person able to contribute, redefining work as doing the things that communities need, creating reciprocal relationships through two-way transactions of meeting each other’s needs, and building the social infrastructure of social capital and social networks through ‘trust, reciprocity and civic engagement’ [6].

TimeBanks have developed in towns and localities, and in communities where people are homeless, unemployed or marginalised. We know of no published accounts of their use in research contexts, nor do we know of TimeBanks that transcend local geographic boundaries by using the internet: websites such as Fiverr¹ can do this, but involve the exchange of money for services and as such as not true TimeBanks.

Aspirations for TimeBanks are great, including boosting individual well-being, self-esteem, social capital, inclusion and employment prospects, as well as providing benefits for the community from stronger networks and for society from saving on costs and co-producing services. Research evidence supports the realisation of some of these outcomes, though the evidence base lacks detail and rigour [4] and, it has been claimed [36], ‘is not well researched’. Nonetheless, some of the implementation challenges are known, including: investment in set-up [5]; risk management [4]; enabling factors of a skilled time broker; strong community and technological support [24]; the need for local adaptation [37].

¹ <https://uk.fiverr.com/>

2.3 Social Machines

Social Machines are a socio-technical construct in which a human-machine collective achieves greater things than would be possible of the individual ‘parts’ working alone. Berners-Lee [3] defines Social Machines as ‘*processes in which the people do the creative work and the machine does the administration*’. Classic examples of Social Machines are typically ones wherein people collaborate to produce content (i.e. Wikipedia and Galaxy Zoo), but Social Machines also include tools and counter-tools (i.e. spam networks and reCAPTCHA [1]) and subsets of social networks such as Twitter bots [33].

Social Machines offer the ideal construct for building a digital TimeBank: as observed in Section 2.2, TimeBanks themselves involve the generation of social networks, and at their heart is a network of human interactions. Any attempt to move a TimeBank online must involve ‘porting’ those human networks and interactions to a digital context (whether purely digital, in the case of a TimeBank where online-only goods and services are exchanged, or physical-digital hybrids, whereby a digital TimeBank facilitates digital and physical exchanges). In either case, at its heart an online TimeBank *must* rely upon the building and maintenance of a social network, with properties including identity, trust and provenance.

2.4 User-Centred Design

User-Centred Design (UCD) involves the user of a product or service through all the stages of the design of that product or service. Some of the roots of UCD can be seen in the work of Gould and Lewis [14], who describe three principles of system design which allow production of a useful and easy-to-use computer system:

1. Early and continual focus on users.
2. Empirical measurement of usage.
3. Iterative design whereby the system (simulated, prototype, and real) is modified, tested, modified again, tested again, etc.

Although these principles are straightforward, the evidence suggests that the principles are not always intuitive: 447 designers were asked to list five major steps in developing and evaluating a new system. Only 16% mentioned all three items, and 26% mentioned none.

UCD offers a toolbox including various approaches. Among these, perhaps the most famous are scenarios and personas [8]: here, designers identify characters (called personas) that are representative of groups who will use the future system, and scenarios are written concerning how those personas would use the envisioned system.

More recently, the growing field of User Experience (UX) reflects increased interest in user-focused approaches within software engineering [16], as do discussions of participatory design [31] and reflective design [35]. Issues of accessibility are particularly relevant. Previous work has discussed UCD in this context: Wiley [40] applied UCD in designing a message centre for elders living at home, while Keyani [21] applied the paradigm to design an augmented dancing environment for elders.

The extent of inclusive design of spaces and technologies for disabled and older people has been mixed. For example, despite efforts by disabled people to promote ‘universal design’, designing built environments for the needs of disabled people has never been a significant feature of the development process [19].

The ‘ideal’ nondisabled and fit body still permeates the design industry. Similarly, in the field of product development, despite the growth of an ageing (and disabled) population, industry still continues to produce products that are primarily aimed at the able-bodied youth market.

One exception has been in the long history of self-building and technological experimentation of some augmentative and alternative communication (AAC) devices for people with speech impairments [32]. AAC design has tipped away from international companies and towards hobbyists, with the family often creating a type of maker space.

Some work has also examined the user-involvement of ICTs including ‘smart homes’ and assistive telecare technologies (e.g. security pendants and ‘smart pets’) for frail older people within the home [11]. The development of these remote care systems runs in parallel with policies aimed at ‘ageing in place’. Work by Milligan et al [23], however, raises important questions over the implications of rolling these products out in terms of how they re-order the places and responsibilities of care-work as new actors and materials become enrolled within the care network. Care preferences often remain rooted in orthodox person-led care provision.

3. METHOD

The process of UCD in preparing a prototype online TimeBank for inclusive research comprised continuous collaborative working by university and community partners. Drawing upon Druin’s taxonomy of the different roles that users can take in UCD [10], the community collaborators were very much *design partners* on the project. We needed to research the idea, functionality and design issues with potential users of the TimeBank; we therefore opted to exploit the exploratory and confirmatory potential of focus groups [38], bringing communities into solution-focused dialogue in person and online. Thus, some users undertaking inclusive research were also involved as *informants* via the focus group, and we also plan to involve a small number of users as *testers* of the prototype that we plan to develop (cf. [10]).

This section first describes the procedure for the physical (in person) focus group (Section 3.1), then the procedure for the digital (online) focus group (Section 3.2). Finally, the approach taken to analysis of the data from both procedures is described (Section 3.3).

3.1 Physical Focus Group Procedure

The face-to-face focus group was important for finding out how members of the inclusive research community would respond to the idea of a TimeBank for inclusive research, whether they could see the potential, the needs it could serve, and the practical challenges that would need to be met. Focus group participants were recruited firstly using an opportunistic sample of established contacts and secondly using a snowballing technique in which interested participants were asked to bring along one or two co-researchers. In this way the focus group population comprised small communities rather than individuals, with support for participation therefore built-in rather than needing to be added on.

Participants were provided with information leaflets and consent forms in advance, with the information presented in simple, easy to read text supported by visual symbols based on photographs. This was followed by an agenda for the day, which clarified the mix of participatory workshop and traditional focus group that participants should expect. The venue was accessible and

presented a positive image of disability. On the day, an informal but purposeful atmosphere was generated during the welcome over refreshments. The purpose of the research was reiterated, consent forms were collected and additional verbal permission was gained to take photographs and audio-record the discussions.

The 2-hour focus group was structured into four parts: introduction and ice-breaker (15 minutes), workshop activity (45 minutes), small focus group discussions (45 minutes), and closing plenary (15 minutes). Each part was led by different (pairs of) facilitators from the team of five, helping to reinforce our understanding of research as a collaborative endeavour involving researchers with different skills to offer. A self-advocacy facilitator with experience of supporting people with learning disabilities using TimeBanks brought additional support.

In the workshop activity, we asked participants to:

- 1) identify 'needs' by considering what problems they individually might face when conducting inclusive research, that a TimeBank could help with (participants discussed, then wrote these on red cards);
- 2) identify 'offers' by considering what they could offer other TimeBankers (same process, with green cards);
- 3) create a low tech model of their TimeBank by matching a participant with a need to a participant with an offer and so on, physically connecting each person with a ball of wool that demonstrated the knotty connections.

Through plenary discussion, we clarified what we learned about the nature of people's needs and offers and what we learned about how TimeBank exchanges might work in a small community.

In the focus group discussions, we asked participants to consider how the low-tech version of the TimeBank could translate to a web-based version. Following a briefing, the participants and facilitators worked in three small groups to address questions of accessibility, communication and security and trust with respect to brokering needs and offers online. Ideas were recorded on post-it notes and posted on the walls.

In the closing plenary, a facilitator identified some key messages from the focus group, clarified next steps for the study, and thanked the participants.

3.2 Digital Focus Group Procedure

We chose to run a second focus group online, via Twitter. Our community partner, who co-organised the online focus group, has previously found Twitter highly effective for democratising the engagement, discussion and generation of new ideas. Although Twitter requires a degree of digital literacy, it does not require the ability or means to travel, making it more accessible than face-to-face focus groups for many disabled people.

The opt-in nature of Twitter means that discussions have the potential to reach a wider audience than otherwise. Effort was made to reach parties known to our community partner to have interest in issues of power, participation, user experience and accessible design. In addition, people who had already engaged in Twitter interactions with the project Twitter account² were invited to join the conversation.

To ensure the informed consent of participants, we tweeted prior to and during the group with a link to the study webpage³, which included a description of the study, its goals, the impact of participation, and how the data would be used. The webpage text as well as the text of our tweets made clear that inclusion of the study hashtag (#pricestudy) with a tweet denoted consent for the content of that tweet to be used as research data.

The digital focus group was scheduled for 90 minutes on a Monday morning. It was scheduled during office hours to encourage a broader range of contributions than might have been gained by an evening event. In particular, it meant that any organisations tagged by participants might be able to respond to comments, rather than see these belatedly, after the event.

The event was framed around three questions, mirroring those addressed in the physical focus group:

- 1) What would participants give and take from a TimeBank?
- 2) Would they have worries about trust, accessibility, and communication?
- 3) What website functions would they want?

To capture the data, we used the Twitter Archiving Google Spreadsheet (TAGS) v.5.1 application⁴. This saved tweets annotated with the study hashtag (#pricestudy) into a Google spreadsheet, capturing tweet content, user name, time of tweets, and embedded URLs.

3.3 Data Analysis Procedure

Here, we describe the process by which the datasets from the two different focus groups were analysed.

3.3.1 Physical Focus Group Data

Analysis of the workshop component was designed to identify the kinds of needs and offers that a TimeBank serving an inclusive research community would need to accommodate. The items written on the (red and green) cards were listed and then organised sequentially in terms of the research process as: preparation; conduct; and sharing of research. Needs and offers were then matched and unreciprocated items listed separately. The matching process involved interpreting the different ways in which approximately the same piece of work could be communicated: for example, the need 'expertise in accessible information' was matched with the offer 'doing easy read'. Items were also organised into bands of: central to the research process; peripheral to the research process; and beyond the research process.

The post-it notes relating to the core principles of accessibility, communication and security were first transcribed verbatim and then thematically analysed. Key questions for the research team to address in the next focus group were identified.

3.3.2 Digital Focus Group Data

The digital focus group yielded a total of 240 tweets. The first step of analysis was to remove non-relevant material such as retweets and general inquiries to the research team, yielding a dataset of 108 tweets. These tweets were coded thematically in

² <https://twitter.com/pricestudyuk>

³ <http://wordpress.it-innovation.soton.ac.uk/price-project/2013/12/26/twitter-chat-monday-2-march-10-00-11-30-gmt/>

⁴ <https://mashe.hawksey.info/2013/02/twitter-archive-tagsv5/>

terms of their relationship to the three specific questions asked of the group. Participants also posted general comments and resources, which were recorded separately.

4. RESULTS

This section describes the results of the two focus groups.

4.1 Physical Focus Group Results

21 inclusive researchers participated. The mixed age/gender group came from various parts of England and Wales, including 8 academic researchers and 7 researchers with learning disabilities or autism. The group had considerable experience of inclusive research and varied experience in using and designing technology.

During the initial workshop activity, the participants identified their needs and offers, 25 needs for research skills or activities were written on cards and 45 research offers were similarly volunteered, perhaps reflecting greater levels of comfort with giving than taking. (An additional 7 needs and 7 offers fell outside the focus on research.)

Among the needs, 5 items were duplicated across up to 4 people, and there were 16 clusters of overlapping or similar needs. Among the offers, 4 were duplicated and there were 19 clusters. There were many more matches of needs and offers (14) than unmatched (5). On sorting these, more were about planning and preparation than doing or sharing research but this probably reflected the natural inclination to start one's thinking at the beginning of the process with planning and preparation.

The activity of demonstrating connectivity through potential brokering of exchanges was met with considerable enthusiasm within the group. The questions arising from this focus group for consideration include:

- 1) If a group of only 21 could meet most of its needs in principle, how small can a functional TimeBank be?
- 2) How many of these 'in principle' matches would fall down when it came to the realities of time and place?
- 3) How many of these matches could not be realised if an online TimeBank failed to deal with the different ways needs and offers were communicated?
- 4) How much training would be needed for the people involved to be able to use an online TimeBank for brokering?

Three main themes emerged from the discussions about the principles of accessibility, communication and security.

Firstly, participants were clear about the need for *fairness and reciprocity* within the TimeBank. Some of this was related to accessibility concerns, for example, ensuring that people with different communication needs can access the site using assistive technology and ensuring that it can be accessed across a range of platforms (including tablets and smartphones). Related was the important point about how inclusive the site could be in terms of supporting people with more severe learning disabilities and those who may not read, verbally communicate or have access to technology. In addition participants wanted to know that the offers being made in the TimeBank were current, real and appropriate, and that people registered on the site were *giving* as well as *taking*.

Secondly, participants were concerned about *trust and security* and this related to general online safety as well as how users of the TimeBank would know whom to trust. Having a code of

practice, as well as short video clips and examples of successful exchanges were considered features that would help to demonstrate trustworthiness.

Thirdly, participants discussed different *ways of interacting* (with the site and each other). The main message was that the TimeBank needs to support different communication preferences, including the option to access it via social media (e.g. login via Facebook).

4.2 Digital Focus Group Results

There were 108 relevant contributions from 38 Twitter accounts (excluding the researchers' own accounts), including individual accounts and organisational accounts (public, private and third sector). Individual accounts included descriptions of involvement in inclusive research, activity as patient experts, TimeBanking and involvement in public policy work.

The first question ("what would you give/take?") received the least amount of responses (6 in total). However, this question was asked during the first 30 minutes of the focus group, when people were tweeting general comments and queries. Responses identified example offers (such as: transforming text to make it accessible, also known as 'easy read'; providing information and explanation about ways of doing inclusive research; introductions to relevant experts) and needs (such as: time to off-load work when relevant; wisdom; a different perspective; accredited training; and attending a local theatre!)

The second question ("what would be your worries?"; three themes of trust, accessibility and communication were suggested) received a larger range of responses (23). These consisted of a) expressed worries and b) suggestions for reducing worries. People confirmed the importance of trust that was raised in the physical focus group, with one comment noting that most online safety information about social media says never to meet up with people you have only met online. In addition, the significant digital exclusion of people with learning disabilities was raised. Ideas for minimising the worries included: clear parameters and transparent working; genuine exchange, not 'payment'; regional meet-ups where people have the opportunity to meet others in the network and overcome issues of trust; a developer 'hack day' to help build or fine-tune the software; and importantly, enabling clear user control of design decisions at the outset to build confidence.

The third question ("what website functions would you want?"), received the most responses (67). Suggestions included: good entry-level information explaining TimeBanking simply (i.e. cartoons, short videos); use of social media for community building to fit with TimeBanking ethos; user profiles; examples of good practice; badges; and the ability to unlock achievements. This latter point was relevant to how much gamification we incorporate into our final Social Machine design.

5. DISCUSSION

In this section, we consider the implications of our results for building the envisaged TimeBank, what has been learned from the methodology, the wider implications for Social Machines, and open questions for future research.

5.1 Towards a TimeBank

Our goal in running the focus groups was to gather inputs to drive development of the prototype online TimeBank. It was notable that even with only 21 participants, it was easy to match needs with offers, implying that TimeBanks can start small and grow organically.

We note, however, that our matching of needs and offers was not automated. A computer system may struggle to match offers with needs when these are phrased in different ways (i.e. a request to “help write accessible text” can be matched with an offer to “do easy read”, but neither phrase uses matching words). We intend to deal with this potential issue in the first instance by offering TimeBank users a dropdown menu of services from which to choose when selecting needs or offers; this list will be based on the needs and offers identified in the two focus groups. This dropdown list approach also resolves the issue of moderation of free-text inputs to the system.

Participants, particularly but not only from the digital focus group, expressed an interest in gamification, with mention of badges, rewards and clear visual feedback. We plan to experiment in this area, but with great caution: the central ethos of TimeBanking is the reciprocal sharing of skills, and the inclusion of a heavy emphasis on attaining badges, levelling up and the like could be at cost of this. Nonetheless, we are aware that people with and without learning disabilities enjoy the sense of reward that can be given with gamification, and will investigate how we might include such aspects without damaging the core of the system.

As well as providing insight into the *process* of TimeBanking and the list of *offers and needs* relevant for inclusive research, our focus groups helped us understand potential issues. These included the tensions which may arise when some TimeBank participants provide many services while taking few or none, while other parties take many services and provide few or none: our prototype system will enforce a positive and negative limit on how many ‘credits’ a user can have.

We also gained insight into specific desired functions, with people requesting: multiple ways to login (bespoke username and password as well as login via a social network); multi-modal access to the tool (i.e. via tablets and smart phones as well as laptops and desktops); a code of practice; tutorials and examples; support for different communication preferences (i.e. push vs. pull notifications); profile pages; badges; security. Relatedly, we gained insight into overall values that were key to our participants. These were: online safety; an established community; trust and fairness; reciprocity; accessibility and inclusion (especially for those with learning disabilities).

The TimeBank will not be a purely digital system, since at least some of the services to be exchanged will require physical proximity. For this reason, it is important to build geographical aspects into the interface, and our prototype will let people list counties within the UK that they can access, and in which their offers and needs can be met. (There will also be an option to mark an offer or need as not associated with any geographical region, if no physical proximity is required.) Geographical aspects are rarely straightforward in computer systems: although we can access a list of UK counties, a more advanced system might let people denote their location with a postcode, or in terms of a town or region. Such things often overlap in unpredictable ways. Similarly, people’s travel abilities and requirements are unlikely to fit neatly into a list of counties: for example, someone with certain physical needs may only be able to use particular trains and be unable to manage unassisted access to certain towns altogether. We will further investigate matters of geography in our upcoming, follow-up focus groups.

5.2 Methodological Insights

We are unaware of previous work conducting dual physical and digital focus groups to investigate the same question. The findings

of the two focus groups are corroborated by their similarities, particularly the significant focus on the importance of establishing trust, and of ensuring inclusion and digital safety.

We nonetheless observed some differences. The physical group took a more discursive approach with a lengthy dialogue. They gave more heed to ways of interacting and types of technology used to access the website. In contrast, the digital group seemed more oriented towards problem solving and making practical design suggestions, with numerous suggestions made in a short period of time. These differences are largely complementary, with the digital focus group serving as a worthwhile additional study following the more exploratory focus of the physical focus group.

Of course, these differences could have arisen between two focus groups that were run with different participants but using the same medium, and the numerous suggestions of the digital group could simply reflect the greater number of participants. One core difference between the two groups is that the members of the digital focus group clearly have a base level of digital literacy as well as comfort interacting online, while the physical focus group participants exhibited a greater range of (dis)comfort with online tools but a stronger understanding of the inclusive research context.

The use of Twitter was particularly important for this research because of our focus on issues of inclusion and equality. Although Twitter requires digital literacy and hence excludes some potential participants, it offers certain advantages:

- Participation in a focus group on Twitter requires less commitment from participants and makes fewer demands upon them;
- A much wider pool of participants is available than for a physical focus group;
- Social rules and restrictions that would apply in a face-to-face focus group are relaxed, supporting people with social anxiety or disabilities that impact on social interactions;
- Participants have an equal number of characters to use per statement (tweet), and multiple conversations can continue simultaneously, meaning that domination of discussion by any one participant is less likely;
- The networked nature of Twitter means participants can easily invite others who they feel may be able to contribute;
- It does not involve hiring a venue, travel time and costs for researchers and participants, or other logistical infrastructure – it is thus somewhat simpler to organise, and also cheaper.

The disadvantage of using Twitter as a medium is that its lack of constraints and the facility to leap in and out of a conversation means there is no guarantee of who will participate. It is also harder to moderate and steer the conversation than it is in person.

This relinquishing of control is a valuable experience both in terms of inclusive research and building a Social Machine: in many respects, the success of the TimeBank will depend on the research team being able to relinquish control and allow the TimeBank to operate according to the social rules of the digital sphere rather than the social rules of the physical world.

5.3 Implications for Social Machines

As noted in Section 2.3, creating social networks is at the heart of TimeBanking, and for that reason an online TimeBank must be a

Social Machine. In this subsection, we discuss the implications of our work in the context of Social Machines.

As discussed in Section 5.1, the focus groups yielded insight into specific functions (such as ways to login, tutorials, profile pages etc.) but also overall *values*, such as community, trust, reciprocity and inclusion. It is arguably the latter insights that are most important to us for practically building the TimeBank, but also in the context of Social Machines: different aspects of functionality can be provided in response to identified needs, but the *experiences* and values associated with these are what is key [17]. Of course, it is a straightforward matter to empirically verify whether a function exists and is in good order, but understanding whether a value is present requires much deeper work [18]: for this reason, we intend to evaluate our prototype TimeBank with a qualitative analysis of people's experiences of using this. Our evaluation criteria will be grounded in the identified values from our initial focus groups. We argue that values and experiences are an essential factor in the success or failure of Social Machines in general, and as such these values and experiences should be treated as first class citizens.

Trust was a central theme in the focus groups, and in practical terms we intend to bolster trust of our TimeBank in two ways: i) By taking a snowball approach to user recruitment, thus building on existing trust via friend-of-a-friend networks; ii) with regional launch events at which TimeBank users can meet fellow users from the locality, if not from further afield. We also plan to investigate the possibilities offered by 'vouching' for one's peers on the TimeBank. All of these techniques are applicable for other Social Machines.

Indeed, trust is clearly just as much a key part of fostering connectedness online as it is a key part of fostering connectedness offline. For this reason, we will very closely monitor the impact of our design decisions on trust within the TimeBank. We note an analogy with the Freecycle network⁵, a Social Machine by which people can give unwanted items free of charge. This network shares some properties with TimeBanking: both processes involve trust of unknown people and, at times, meeting unknown people. We hope to publish a comparison of Freecycling with TimeBanking in the future.

Other experiential aspects include *fun*: participants requested gamification of the TimeBank, and aspects such as visible badges on profiles can build not just trust of others (verification of their participation in the community) but also fun in the sense of competition and achievement.

We note the aspects of geography discussed in Section 5.1, which will also apply to some Social Machines (for example, Freecycle). The granularity of geographical regions, sharing (and updating) of such data and – importantly – guidelines for meeting up with strangers who have been met online, are all aspects to be heeded when building a Social Machine. This is even more applicable to Social Machines that build fully on the Internet of Things and other cyberphysical systems.

Like geography, time is also an important aspect in the building of a Social Machine. In the TimeBanking case, certain offers and needs may expire after a particular date (for example, a request for support at a specific research event, or an offer to review text where the person making the offer will soon leave for a holiday).

⁵ <https://www.freecycle.org/>

Other Social Machines, such as those for reporting crime or sharing breaking news, may offer more complex cases. In any case, the granularity and recording of aspects relating to time is, as with geographical aspects, clearly important.

Another point relating to Social Machines and time is the question of managing the impact of changes to a Social Machine over the course of time. This is certainly relevant to our own Social Machine, which we plan to start with a small community and grow organically. The impact of a major change in scale and potentially a change in the composition of users is yet to be seen.

We noted in Section 5.2 that the relinquishing of control is valuable and necessary for a successful Social Machine, in that its success depends on uptake of that machine by its users, not on tight control and direction from its designers. This lesson is key, of course, across all Social Machines.

The key questions for building a Social Machine are:

- How does one ensure and also convey to users experiential aspects such as fairness and reciprocity, trust and security online?
- How does one foster connectedness and community in a Social Machine?
- How may the rules of a Social Machine need modifying over the course of time, as that Social Machine grows in size or changes in cultural composition?

Techniques for experiential analysis such as TAPT [17] [18] are part of the toolkit for answering these questions. We intend to present further insights based on our on-going work in the near future.

5.4 Open Questions and Limitations

This work has raised several longer-term research questions.

The physical focus group clearly showed that 21 people was a sufficient number to produce a functional TimeBank for inclusive research. This prompts the question, how small can a functional TimeBank be? This presumably depends to some extent on context: it is surely the case that an inclusive research TimeBank will function differently to a TimeBank to provide support with household chores, which would function differently again to a TimeBank for support with tasks in the manufacturing industry.

Trust and security were key themes that reoccurred throughout this research, and the question of how to handle miscreants is currently unanswered. Current law enforcement approaches are both disproportionate and poorly tailored to the online world, and so research questions exist regarding what digital law enforcement might involve.

A TimeBank has potential to be a purely digital construct, for example considering a TimeBank for the exchange of digital goods and services online. In this paper, we have focused on the design of a physical-digital hybrid TimeBank: the TimeBank brokering mechanism will be purely online, but the inclusive research services to be exchanged are a mix of digital (i.e. proof reading, translating text into 'easy read' format) and physical (i.e. facilitation of a face-to-face focus group, introductions at a community workshop). An interesting avenue for future work is the study of the functioning of 'pure' digital TimeBanks compared with 'pure' physical TimeBanks, and of course hybrid physical-digital TimeBanks such as our own.

Another lens by which TimeBanks can be analysed is their organisational typology, that is TimeBanks that allow person-to-

person exchanges, person-to-agency exchanges, and agency-to-agency exchanges. At this time, our TimeBank is primarily set up for the first kind of exchange, though inclusive researchers rarely work as individuals, and people are likely to be brokering on behalf of bigger networks. As such, a move to the other kinds of exchanges is not difficult to imagine; however, this has multiple implications in the context of inclusive research, and is beyond the scope of this current discussion.

Finally, we can consider the limitations of our approach. The focus groups presented in this paper took place in the context of inclusive research in the UK, with relatively experienced inclusive researchers and with a particular focus on people with learning disabilities. The generalisability of their methodological and substantive findings to broader contexts is yet to be tested. Longer-term developments of the project could involve extending the application of the TimeBank to other groups for whom participation in research raises similar issues, such as patient involvement in health-related projects and autistic self-advocates.

6. CONCLUSIONS

In this paper we have presented an interdisciplinary, Web Science approach to designing a Social Machine. The Social Machine, designed for the inclusive research community, takes the form of a TimeBank, a tool to facilitate the giving and receiving of services without monetary payment.

The dual physical and digital focus groups yielded insights into the process of TimeBanking, what offers and needs are relevant for inclusive research, potential issues with an inclusive research TimeBank, and desired functions of that TimeBank. Importantly, they revealed what values and experiences that participants expect of such a system. We also gained insights into the processes of TimeBanking, such as the ease with which we could match offers with needs from even a relatively small group of participants.

The dual approach to physical and digital focus groups yielded methodological insights of its own, particularly relating to the advantages and disadvantages of Twitter as a platform for an online focus group. One particular insight relates to the importance of relinquishing control, which relates not only to the use of Twitter to run a focus group, but also to designing a successful Social Machine.

We have uncovered further implications for the design of Social Machines, particularly the primacy of *values and experiences*, suggesting one method for evaluating a Social Machine's success in fostering these. We have raised the importance of presentation and granularity of spatial (geographical) and time data, and we have offered mechanisms to facilitate trust and fun within a Social Machine.

Section 5.1 describes the insights that will drive on-going design and development of the TimeBank. Those insights will also drive its evaluation, providing as they do valuable criteria about the key values and experiences that the TimeBank needs to provide. The same section has described our near term plans for future research with respect to work on the TimeBank prototype, while Section 5.4 describes longer-term research questions. We now plan to proceed with the design and development of the inclusive research TimeBank, facilitated by mechanisms to foster a sense of community and trust within that community. We plan to start small and grow organically, evaluating the prototype with follow-up focus groups.

The future focus groups will allow investigation of the prototype's efficacy at fulfilling the values and experiences that were identified in the initial focus groups. We will also investigate participants' feelings about aspects such as gamification (i.e. exploring such concepts as 'long service' awards or badges), although we keep in mind that a core value of the TimeBank is to treat all participants equally, and are aware that gamification brings a risk of drifting from this value if implemented without care.

Issues of marginalisation and inclusion in inclusive research have motivated our work to design a TimeBank for inclusive research. Having followed a co-design process with community partners and potential users, we are now in a position to create and evaluate the prototype TimeBank.

In this paper, we have described insights gained into the design of the TimeBank, into the use of dual physical and digital focus groups, and into key factors and mechanisms to consider when designing a Social Machine. The potential for addressing some of the perennial problems of inclusive research using such a Social Machine is only just beginning to be explored.

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