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RESEARCH ARTICLE

Understanding Help as a Commons

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Online communities contribute to weave the social fabric of the Internet. Practices, norms, and governance arrangements emerge out of individual behaviours and interactions. This paper analyses the case of computer-mediated communities of mutual help within the framework of the core design principles of common-pool resources (CPR) as initially proposed by Elionor Ostrom. First, we suggest conceptualising the notion of help as a human-produced, commons-based resource that can be enjoyed within a community. Second, we present u-Help, a mobile application supporting mutual help for social networks. Third, we examine Ostrom's design principles and assess the extent to which u-Help aligns with them. We then transform the core principles into requirements for a computer tool that can be used to support CPR groups such as time banks or bartering communities. Finally, we conclude by outlining future development plans to make the application fully aligned with Ostrom's design principles.

Keywords: help; mobile technologies; digital platforms; artificial intelligence; common-pool resources; design principles

1. Introduction

Since Elinor Ostrom (1990) first formulated the eight design principles for sustainable governance of common-pool resources (CPRs), research on commons-based, self-governing institutions has been flourishing in different cross-disciplinary domains. The principles drew from previous empirical research by Ostrom and colleagues on a myriad of case studies where effective and sustainable management of natural resources (e.g. forests, fisheries, irrigation systems, etc.) challenged both the inevitability of the "tragedy of the commons" (Hardin, 1968) and the failure of collective action in large groups sharing a common interest (Olson, 1965). Ostrom's principles have been successively revisited (Cox et al. 2010), extended (Wilson et al. 2013) and adapted (e.g. Stern, 2011), and they remain a reference framework for the analysis of commons-based communities across geographical areas and domains.

The advent of digital technologies has opened up new avenues for commons-based peer production of knowledge, information, data, software, genetic information, etc. (e.g. Benkler 2006; Benkler 2011; Hess and Ostrom 2007; Lucchi 2013; Frischmann et al. 2014; Bollier and Helfrich 2014). Platforms and mobile applications now enable both existing and emerging communities to self-organise at different scales. In a number of cases, Ostrom's principles have been used as a template for designing digital tools that effectively promote sustainable self-management of online communities and resources (e.g. "genomic stuff" (Pálsson and Prainsack 2011), digital commons (Dulong de Rosnay and Le Crosnier 2012), innovation commons (Allen and Potts 2016), patent pools (Raghavan et al. 2013), standard-setting organisations (Simcoe, 2014), socio-technical systems (Pitt and Diaconescu 2014).

In this paper we propose to focus on help as a form of socio-technical commons, broadly defined as a human-made resource created and exploited by participants interacting with each other through technologically mediated interfaces (e.g. digital, AI-powered, blockchain-enabled, etc.). From a socio-technical perspective, help can be quantified in units, such as the time units of time banks. The noun "help", in this regard, admits the plural "helps", as in Shakespeare's Coriolanus: "I know you can do very little alone; for *your helps* are many, or else your actions would grow wondrous" (Coriolanus, Act 2, Scene 1). Section 2 provides an overview of computer mediated help systems leveraging different types of crowdsourcing. Section 3 situates the concept

of help in the theoretical framework of the commons and reviews several developments through this lens. In Section 4 we introduce uHelp, a digital platform that facilitates requests for and offers of help — for both existing and emerging communities. Section 5 analyses Ostrom's principles in the context of computer-enhanced mutual help. Section 6 suggests how the next stages of uHelp should be developed to align the platform with Ostrom's principles. Finally, Section 7 discusses open questions and future work.

2. Computer Mediated Help Systems

In recent years, an ever-growing number of digital platforms and mobile apps have enabled different forms of crowdsourced help in different socio-technical contexts. While they largely vary in scope, scale, objectives, and procedures, we can classify them depending on the type of goods they manage and the outcomes they produce:

- Disaster management help: This is a broad area of practice that has generated a significant number of digital tools over the last two decades. Notably, platforms and apps that enable online volunteers to sign up and contribute to different tasks connected with the different phases of the disaster and emergency management cycle (preparedness, response, recovery, mitigation) (Poblet et al. 2017). Ushadidi[1] or Sahana[2] are well-known examples of open source, widely used platforms in this space. Volunteers can work either in teams (coordinating through instant messaging and chat services) or individually (microtasking).
- Citizen science: In a similar vein, citizen science platforms and apps enable users to individually perform tasks related with scientific or environmental projects (e.g. classifying or tagging images of galaxies, spotting different elements in an image, monitoring wildlife behaviors as recorded in webcams, transcribing handwritten historical texts, etc.). Popular platforms in this space are Foldit,[3] Zooniverse[4] and SciStarter.[5]
- Monetised help or "crowdwork": Platforms and apps enabling participants to sign up for a vast range of remunerated microtasks (tagging images, transcribing texts or audios, checking and evaluating web applications, filling surveys, participating in research experiments, etc.). Amazon Mechanical Turk (AMT),[6] Clickworker,[7] Microworkers[8] and Appen[9] are some examples in this space. Platforms connecting freelance labour with online demand such as AirTasker[10] or TaskRabbit[11] can also be included here. Yet, unlike the previous examples where the location of microtaskers is largely irrelevant to the assigned tasks, the latter examples require proximity of participants for the tasks to be performed (e.g. plumbing tasks, cleaning tasks, gardening, etc.).
- Monetised mutual help: The sharing economy has also penetrated areas such as childcare. In Australia, Gobi,[12] for example, is an app offering on demand babysitting. KidNest[13] connects parents in the same local area to create "nests" at their own homes for rotating childminding (paying a flat rate of AU$100 per month). Participants have similar profiles and interests (e.g. parenting) the positions of requesters and helpers might be exchangeable.

The domains above present different altruistic or paid work models. Yet, none of them is designed as a free, peer-to-peer system for mutual help. For every platform, or every deployment of a platform, there is at least one individual, group, organisation, or institution requesting help by designing specific microtasks and providing top-down instructions on how these tasks need to be fulfilled. In that sense, systems are unidirectional: from requesters (of tasks) to microtaskers (completing those tasks). Both roles (requesters

[1] https://www.ushahidi.com/.
[2] https://sahanafoundation.org/.
[3] https://fold.it.
[4] https://www.zooniverse.org/.
[5] https://scistarter.org/.
[6] https://www.mturk.com/.
[7] https://www.clickworker.com/.
[8] https://www.microworkers.com/.
[9] https://www.appen.com/.
[10] https://www.airtasker.com/.
[11] https://www.taskrabbit.com/.
[12] https://gobi.net.au/.
[13] https://kidnest.com.au/.

and microtaskers) are not easily exchangeable (except for childminding). In contrast, the uHelp model presented in this paper designs a transaction protocol where anyone in the community can be both a requester and a microtasker depending on the task at hand.

3. Help As A Commons

Mutual help as a form of social action and reciprocal relation within groups and local communities has been extensively analysed by long-established traditions and schools of thought in anthropology, sociology, legal studies, and economics (for example, see Mauss 2016 [1925]; Gulliver 1997; Laville 2014; Utting 2015). Research has highlighted modes of exchange such as the gift economy, the informal economy, and the social economy that stand removed outside formal state and market relationships. As Bauwens et al. (2012) suggest, a ternary formation comprised of differentiated and overlapping spheres of market, state, and peer sectors (also the social solidarity economy) emerges. In a similar vein, Bernholz defines the social economy as a domain that reclaims the market for social ends (2016). These new models of networked production and financing are facilitated by ICTs and support styles of mutualisation and collaborative practices that lead to a variety of products that are open access and participatory (Kostakis and Bauwens 2014).

More recently, a new wave of research has connected findings in these areas with the new paradigms and economic models that digital technologies now enable. For example, the emergence of the online "sharing economy" —large-scale, platform-mediated transactions over goods such as vehicles, accommodation, or services— has triggered a vast amount of management and consumer research literature focusing on its potential for disruption, creation of new markets, and new forms of collaborative consumption (Belk, 2014). The question of whether the sharing economy can also enable the emergence of sustainable, self-organised communities, in contrast, remains highly contested (Martin 2016, Plewnia and Guenther 2018).

Framing the notion of "mutual help" within the broad umbrella of the sharing economy, nevertheless, raises some conceptual issues since the latter still exhibits a noticeable degree of ambiguity and fuzziness (Plewnia and Guenther 2018). Arnould and Rose also note that notions of "mutuality" or "generalized exchange" differ from "sharing" in the sense that they are actions embodied with a "normative overlay" that enact "the norm of giving, of failing to keep, or perhaps even of generosity" (Arnould and Rose 2016). Instead, we suggest that our concept of "help" as an exchangeable human-made resource can be better aligned with the well-established notion of commons as a common-pool, shared resource (Ostrom, 1990). The reasons are twofold. First, the concept of commons has been applied to an ever-increasing number of cooperative practices (Benkler, 2006; Bollier and Helfrich 2014, 2015, 2019) and shared resources, both tangible (physical or material) and intangible. Examples of the latter are the concepts of "information commons" and "knowledge commons" as developed in Hess and Ostrom (2007) which includes "all intelligible ideas, information, and data in whatever form in which it is expressed or obtained." The "new commons", therefore, may include scientific knowledge, but also "voluntary associations, climate change, community gardens, wikipedias, cultural treasures, plant seeds, and the electromagnetic spectrum" (Hess, 2008). As David Bollier put it, "there is no master inventory of commons because a commons arises whenever a given community decides it wishes to manage" (Bollier, 2011). Help, within this context, is a species of the voluntary, non-profit, and reciprocal action already documented in the commons literature. As Ostrom has shown, reciprocity —together with reputation and trust— are individual-level variables that affect group cooperation in collective action events (Ostrom, 2010).

Second, and more specifically, the commons approach captures with greater detail the normative component that is present in mutual help and voluntary action. Ostrom refers to reciprocity (and fairness) as one of the learned behavioural norms in repeated games and collective action (Ostrom, 2010). As she puts it, "when some individuals initiate cooperation in a repeated situation, others learn to trust them and are more willing to adopt reciprocity themselves leading to higher levels of cooperation" (Ostrom 2010, p. 162). Following this vein, for example, Lohmann has reinterpreted the notion of the commons to include the sector of voluntary action, that is, "a sector of formal and informal associations and assemblies characterized by voluntary participation (association), shared (common pool) resources, and shared purposes (missions), with predictable emergent characteristics of philia (also termed mutuality or social capital) and moeurs (or moral capital and practices)" (Lohmann, 2016). In this regard, Lohmann distinguishes three different types of resources in voluntary action that can potentially fit into our notion of help: (i) the treasury (assets owned or controlled by any voluntary association of people with some shared purpose in mind); (ii) collections (resources deliberately removed from the market economy); and (iii) repertoires (involving

"matters of symbolic —social or cultural— interaction or meaningful behaviour") (Lohmann, 2015). From this standpoint, we can also conceive help as a bundle of intangible (but quantifiable) resources around which a number of cooperative behaviours and community norms emerge.

Third, the connection between the concept of help and the paradigm of the commons can be established by conceiving the act of helping as a contribution taking place within a larger socio-technical system. Socio-technical systems (in our case, the u-Help platform) can be modelled with a three-layered architecture — operational, governance, and knowledge management layers— as proposed by Pitt et al. (2017). Yet, as the use of digital technologies introduces new risks (e.g. uneven distribution of knowledge, manipulation, or black box effects) it becomes important to apply common-based design principles for each layer to mitigate those risks. The governance layer, therefore, is organised according to Ostrom's design principles, the knowledge management layer is conceived as a commons in itself, and the operational layer requires transparency and inclusiveness (Pitt et al. 2017). Within this perspective, the acts of help are human-contributed resources embedded in socio-technical systems where the use of technology requires a commons-based approach to guarantee sustainable self-governance.

3.1. Help As An Hybrid Good

In 1978, Ostrom and Ostrom first proposed a twofold taxonomy to classify goods (Ostrom and Ostrom 1978) where the two key criteria of classification are denominated "subtractability", as the use of the good by one person subtracts the available goods for the others, and "exclusion", i.e. the capacity of preventing someone from using the shared goods, respectively. Thus, under this categorisation, the cost to exclude both private and toll goods is high, as opposed to low excludable public goods and common pool resources. At the same time, both common pool resources and private goods are highly subtractable, while public and toll goods are not.

Our concept of digitally-enabled, human produced help, nevertheless, cannot be easily projected onto the original binary classification. This feature is not different from other 21st century commons such as Do-It-Yourself repair studios or coworking spaces, as described in Bradley and Pagman (2017), that combine physical spaces and tools with skills and know-how for the benefit of local communities. While physical resources in these spaces are highly subtractable, skills and know-know (as part of the collaborative learning process) are not. Likewise, digitally-enabled help exhibits aspects of high and low subtractability. Thus, help contributed through a digital platform can be highly subtractable from a task-completing perspective, but new "units of help" in the system can easily be created with the growth of the community.

With uHelp, the net result will depend on the type of community. On the one hand, if Alice—one of the members of the community—manages to get the time and effort from Bob—another community member—to complete a task, Bob will not be able to help anyone else while helping Alice, and hence the high-subtractability situation. However, any new member of a community will be adding to the common pool of resources from her own capacity to help others, so the addition of new members to the community does not necessarily diminish or deplete voluntary help as a digitally-enabled resource. The caveat here is that uncontrolled expansion of the community could lead to crowding and breakup of the system. Nevertheless, since communities in the system can determine how they want to grow, as long as the need for help and the voluntary help offered remain balanced they can grow in a sustainable way. If that is the case, human-produced help behaves in a similar way to knowledge, or to resolving individual questions in a classroom setting: the more users requesting help, the more help is offered, and thus there is a spillover effect and subtractability remains low. As Bradley and Pagman put it, "many of the contemporary digital commons are—just like knowledge—neither rival nor subtractable but to varying degrees infinitely shareable" (Bradley and Pagman 2017: 235). In our view, digitally-enabled help is a complex good, made of direct help (someone doing something for someone else) plus the knowledge spillover of possible learning by others (on both how to help and how to be helped). While the former component is rivalrous, the latter part is non-excludible and non-rival.

From an exclusion point of view, help within communities, especially self-regulated communities, may oscillate in the tension between easiness and difficulty of exclusion. It is difficult to exclude someone as communities of help are thought to be inclusive and allow in everybody willing to help. However, regulations can be established to exclude those members who do not respect the rules of the community. The peculiarity of mutual help in the type of goods classification proposed by Ostrom and Ostrom (1978) is similar to other types of shared goods such as car sharing or peer-to-peer accommodation. As Corten notes, the resources that such sharing platforms make available could be characterised as "club goods" (Buchanan,

1965) made accessible via platform membership (Corten, 2019). Indeed, Buchanan's theory of club goods as a theory of "co-operative membership" (Buchanan, 1965: 1) applies to many voluntary communities. In our case, nevertheless, adherence to the self-governing rules is a more decisive criterion of inclusion/exclusion, as digital membership (signing into the platform) may remain, at least in the initial stages of community building, widely open.

4. The U-Help Model

Social networks and sharing platforms enable different communities to connect beyond physical borders. Yet, the benefits—and profits—of network effects typically come at the expense of data monetisation and submission to external terms and conditions. In contrast, the examples of platforms supporting the emergence of self-managed local communities—able to enact their own set of norms and conventions and shape their collective expectations on behaviour—are much scarcer.[14] At the time of writing, though, the Covid-19 pandemic may be changing this trend with the rise of locally-led initiatives to respond to the crisis.[15]

The app uHelp has been developed by researchers at the Artificial Intelligence Research Institute of the Spanish Research Council (IIIA-CSIC).[16] The uHelp model focuses on both the needs of emergent communities and the institutional arrangements needed to efficiently meet them. The platform aims at facilitating community creation, growth, and adaptation by allowing its members to shape the way interactions should be conducted. At the time of writing, a two-month pilot project with a local community of single parents in Catalonia has been completed. The parent's community (about 70 families) has expanded to 267 members as parents have brought, on average, 2.6 close contacts to the app. Another 27 local communities—families, co-workers, and members of professional organisations—are currently active in uHelp, which is freely available in seven languages for both iOS and Android users.

Figure 1 below represents uHelp basic functionalities accessible to the initial users of the app, based on state-of-the-art AI techniques such as trust modelling and norm satisfaction. These techniques are required to handle requests for help and to channel these requests to the appropriate potential volunteers. We will focus in this section on the description of the most relevant aspects for the purpose of the paper, which is analysing the tool as an example of help as a commons infrastructure.

4.1. Creating A Community

To become a member of a mutual help community users need to download and sign up with the app. The app will then request access to the phone contacts to identify who is already a member of the uHelp community. Likewise, when a contact registers with the app and becomes a member of uHelp they become visible to contacts that are already members. Registered contacts, therefore, become potential volunteers for requests. There is a specific page in the app to manage communities. The basic functionalities offered for that purpose are to join and create communities, to modify the trust level on a contact, search facilities, determine the privileges of the members, and other similar community management functionalities.

4.2. Asking For Help

To request for help a user needs to introduce: (i) a description of the type of task being requested (see **Figure 1** left); (ii) its deadline, (iii) the community where the request is to be placed, and (iv) the reaching distance within the community (just friends, friends and friends of friends, members that are connected to you via a contact chain, or anyone who is a member). When not all members are to be reached, the minimum level of trust along the chain of contacts is to be selected. That is, those contacts whose level of trust is below the minimum level set by the help requester will not receive the request.

Every new help request in the system generates a propagation of the request across the selected community. Depending on the request, either everybody who is a member of the community will receive the request, or only those members of the community connected to the requester, either directly or indirectly –via a chain of connections, will potentially receive it. The level of trust will be used to select from the requester's contacts only those for whom the requester has at least that level of trust. Trust is measured with a five-point Likert rating scale, from bad to excellent. The level of friendship determines how far the request can

[14] See the projects and programs curated by the P2P Foundation at https://blog.p2pfoundation.net/category/technology-2/p2p-infrastructures.

[15] See the database by Luminary Labs for a curated list of Covid-19 global and local initiatives, https://www.covidx.org/oi-index/.

[16] See http://www.uhelpapp.com.

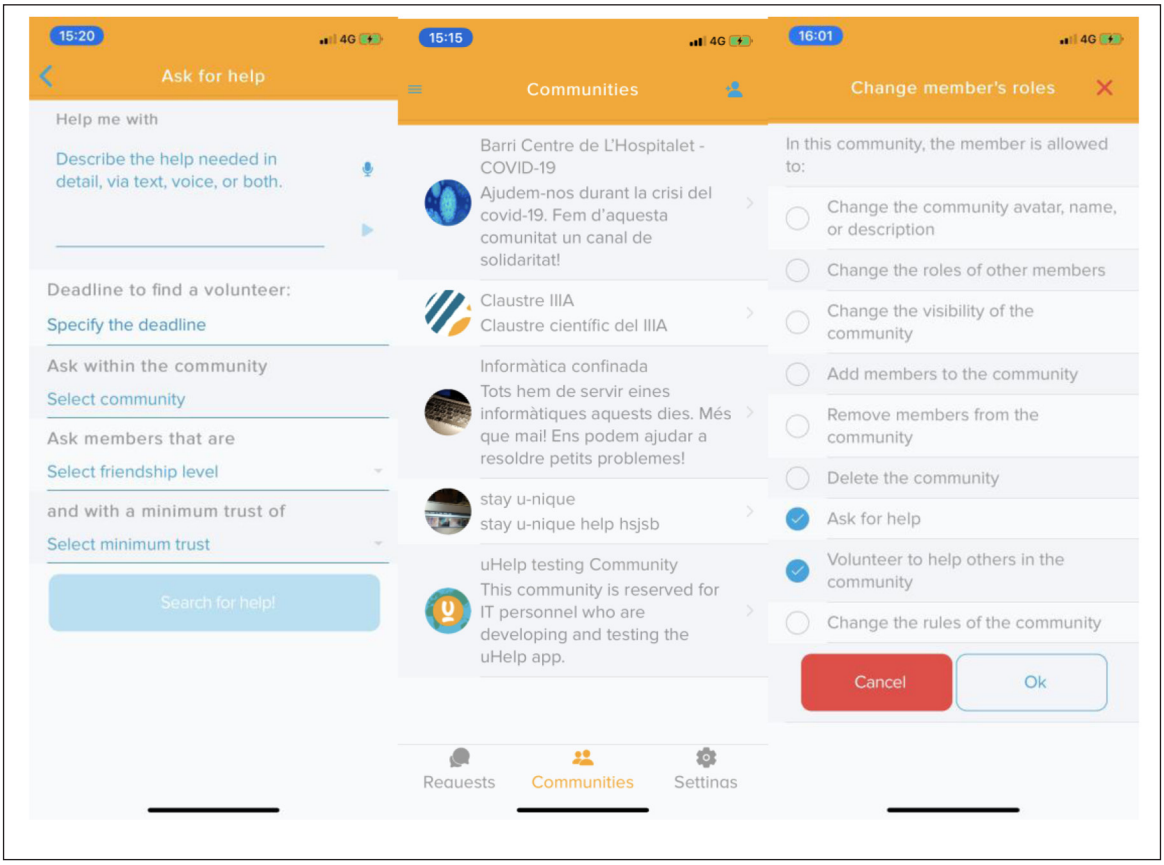

Figure 1: u-Help. (Left) help request page; (middle) a list of communities; (right) view of the privileges of a community member.

travel across the social network (that is, from just friends, to friends of friends, or anyone connected to the requester via a chain of contacts). When traveling the network, the level of trust is used at every hop to determine who receives the request. Only those connections with at least the requested level of trust will be followed. This communication process will eventually stop and only those potential volunteers who satisfy the requested levels of trust and friendship will receive the request. The landing page of the application contains the active and past requests for help with their current state (see **Figure 2** below).

4.3. Volunteering

When a request reaches a member of the particular community selected by the requester they receive a notification and they can then decide whether to volunteer for that task or not. If the task request is accepted, they will need to wait and see if they are eventually selected for the task, as other members of the community may also have decided to step in to help. A chat functionality is available to both requesters and volunteers and, if both have activated a phone call option in the privacy settings, they can also call each other. Note that if someone volunteers for a task coming from someone outside their contact list, they will not have the requester's phone number to call. The platform, therefore, facilitates the phone exchange only if users authorise that option. This may be relevant for sensitive tasks that require discussing further details, such as picking up a child from school.

A requester receiving notifications from different willing volunteers will have to select one of them to perform the task. Accepting a volunteer to perform the task will trigger an agreement. Cancelling an agreement will be always possible and then a new request process might be needed.

4.4. Building Trust

Once a task has been completed by the selected volunteer, the requester can rate the experience if the volunteer is in their contact list. This rating may alter the requester's overall trust on the volunteer and thus affect future requests for help. An increase of trust on a volunteer will make that volunteer receive more requests (from both the requester and their network). Conversely, a decrease in trust will make the

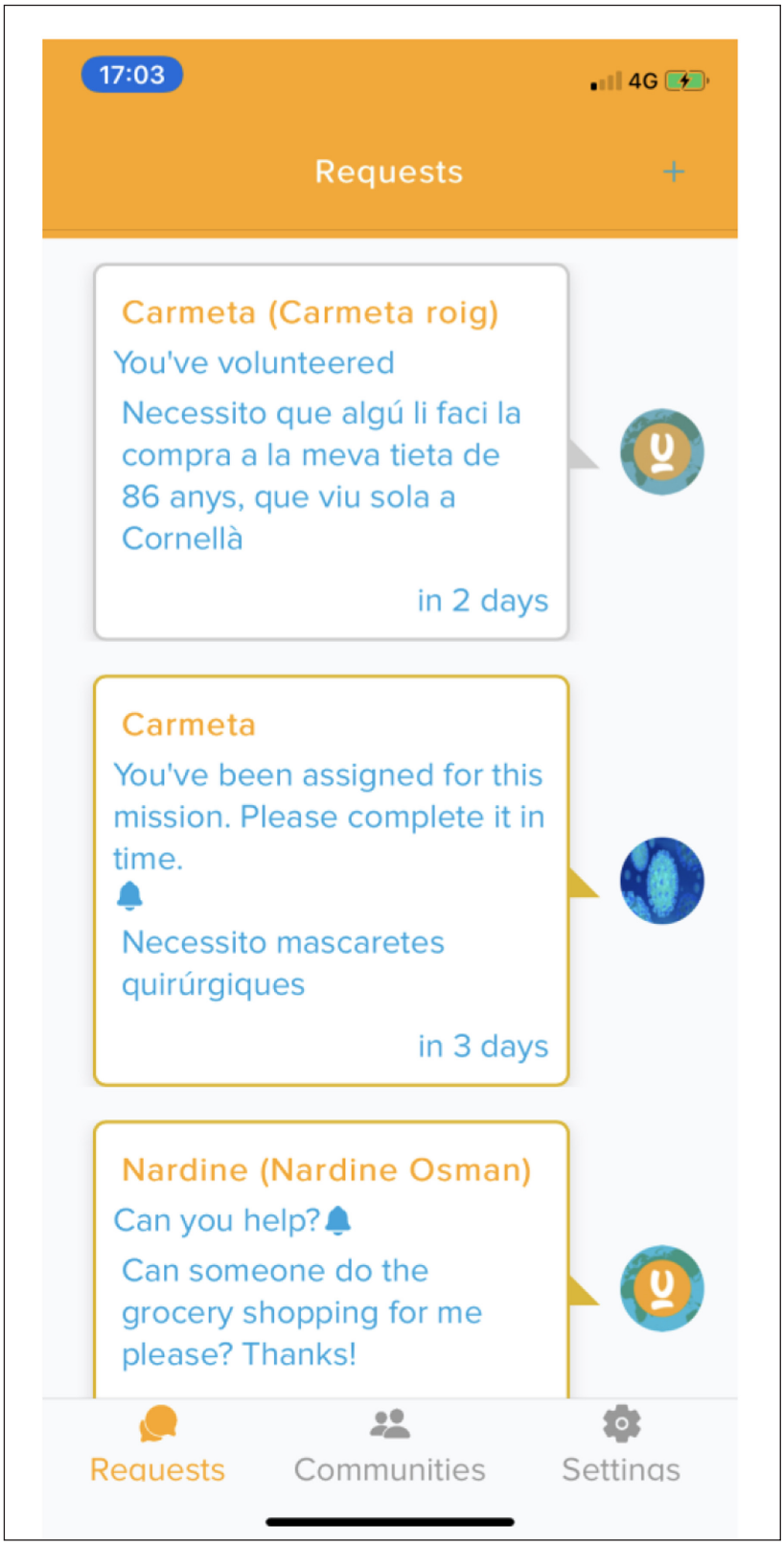

Figure 2: Snapshot of the requests page.

volunteer less likely to receive requests from the community. This aspect is key for the overall functioning of the community: "bad" volunteers will see their trust levels go down for many members of the community and therefore their contribution may diminish by receiving less requests. Ultimately, these community members may become "de facto" ostracised.

4.5. Norms

As any other app, uHelp requires users to abide by a set of explicit norms included under its terms and conditions. These terms usually include clauses such as "The User agrees to use the Service in accordance with the law, morality, public order and these Terms of Use." However, this only encapsulates the outer regulatory framework of the community. Most important, uHelp will enable communities to create and express any specific norms intended to regulate the behaviour of their own members (inner regulatory framework). For instance, it would allow special rules if child minding is involved. Similarly, it would allow users to adopt rules setting specific limits and time frames. An example of such rule would be "any user that has received help more than five times in the last three months and has not volunteered in such period will have its ability to issue requests for help reduced to one request per month". **Figure 1** (right) shows the current set of privileges that can be granted to a community member.

5. Ostrom's Design Principles

Ostrom's design principles for the effective management of common-pool resources (CPRs) are famously drawn from a number of case studies covering fisheries, irrigation systems (e.g. Spanish *huertas*), pastures or mountain commons. Not every CPR in these case studies exhibits those design principles in the same form or intensity, but as such they are considered "an essential element or condition that helps to account for the success of these institutions in sustaining the CPRs and gaining the compliance of generation after generation of appropriators to the rules in use." (Ostrom, 1990). The principles, as initially formulated in Ostrom (1990) are:

1. Clearly defined boundaries: Individuals or households who have rights to withdraw resource units from the CPR must be clearly defined, as must the boundaries of the CPR itself.
2. Congruence between appropriation and provision rules and local conditions: Appropriation rules restricting time, place, technology, and/or quantity of resource units are related to local conditions and to provision rules requiring labor, material, and/or money.
3. Collective-choice arrangements: Most individuals affected by the operational rules can participate in modifying the operational rules.
4. Monitoring: Monitors, who actively audit CPR conditions and appropriator behaviour, are accountable to the appropriators or are the appropriators themselves.
5. Graduated sanctions: Appropriators who violate operational rules are likely to receive graduated sanctions (depending on the seriousness and context of the offense) by other appropriators, by officials accountable to these appropriators, or by both.
6. Conflict-resolution mechanisms: Appropriators and their officials have rapid access to low-cost local arenas to resolve conflicts among appropriators or between appropriators and officials.
7. Minimal recognition of rights to organize: The rights of appropriators to devise their own institutions are not challenged by external governmental authorities.
8. For CPRs that are part of larger systems, nested enterprises: Appropriation, provision, monitoring, enforcement, conflict resolution, and governance activities are organized in multiple layers of nested enterprises

6. U-Help As A Solution To The Tragedy Of The Commons

The analysis of a large number of case studies (Ostrom, 1990) showed that, by following the design principles outlined above, self-organised communities could overcome the tragedy of the commons as postulated by Hardin (1968). Checking the alignment with Ostrom's design principles is key to understanding whether a particular technology favours sustainable development of local communities. We therefore analyse these principles here (Wilson et al. 2013) in the context of help as a particular case of shared good.

1. Clearly defined boundaries in the uHelp app. Help within a community is limited to those who have downloaded the application and become members of that particular community. When describing the request, the user determines the level of trust in the potential volunteers and the maximum distance in the social network (i.e. the maximum number of hops in the network). Nonetheless, since volunteers are to be found within the strict limits of a particular community, boundaries are clearly defined.

2. Congruence between appropriation and provision rules and local conditions. Appropriation is always based on a volunteer providing the resource that is created with the act of volunteering (see previous

discussion on help as a low subtractability good). Moreover, whenever a volunteering task is completed the person who was helped out can assess the volunteer. This assessment takes the form of a trust update. This produces a high congruence between provision and appropriation: good volunteers will be more and more trusted and then will receive requests for tasks that require a higher level of trust, e.g. more sensitive tasks. The reward here is that their status increases, and they may feel that, overall, the community relies more on their competencies. Bad volunteers will be offered less important tasks. Also, the application gives equal chances of being selected for a task to members that volunteer for it (i.e. are proportional in the sense that all volunteers are presented to the person in need who eventually makes the choice). Also, as no one is ever forced to volunteer, the burden is proportional to the willingness to help of the different community members.

3. Collective-choice arrangements. The current version of uHelp does not support collective agreements, but in the next iterations users will be able to participate in modifying the operational rules of the community.

4. Monitoring: One of the advantages of communities mediated by technology is that monitoring can be automated. The norms of the community can be regimented to a large extent so monitoring of free riders is easy and cost-free for the members.

5. Graduated Sanctions: Given that norms can be regimented to some degree, the possibility of transgressions in uHelp is limited. When volunteers do not behave as expected a mild sanction is to decrease the trust that the person in need has of the transgressor. The implication of this is that the number of requests reaching that particular volunteer will decrease and so will be their chances to abuse the system. Someone requesting help very often and not helping in return could be constrained from doing so by appropriate norms that regiment the management of requests as illustrated before. Sanctions are graduated as a single instance of bad behaviour does not have a catastrophic result for the volunteer. Only when bad behaviour becomes frequent the overall trust in the volunteer will decrease to a point where trust recovery will be difficult.

6. Conflict Resolution mechanisms: No conflict resolution mechanisms are in place so far (but See Section 6 below for future plans).

7. Minimal recognition of rights to organise: The platform supports the creation of specific communities. There are no requirements to create a community, each user can start creating communities right after downloading the app. Communities can be private so that new members are only by invitation, and membership is accepted by special members with the appropriate rights, or public, where anyone can become a member without any impediment. If bad behaviour is observed, a member can be removed by other members that hold that power (see **Figure 2** [right] above).

8. Appropriate co-ordination among relevant groups: uHelp has been designed for small communities connected via a social network, e.g. parents of the children in a classroom, single parent families in a town, etc. While this principle tends to apply to larger systems and communities, uHelp will coexist with other tools (often with similar functionalities) in a wider digital ecosystem. Likewise, local communities using uHelp will surely intersect and overlap with other communities, networks, or exchange markets, none of them interacting as a self-contained environment.

From the analysis above, we can conclude that the current version of the uHelp application satisfies very well (1), (2),(4), and (7), reasonably well (5) and there is room for improvement in (3), and (6). In contrast, we find (8) not relevant at this stage for the kind of small communities we are targeting, although it can be relevant in the long term as uHelp communities intersect with other communities.

7. Making U-Help Ostrom Aligned

As Pitt and Dionescu (2014) note, the challenge of ensuring "pro-social behaviour" and mitigating "free-riding" with the provision and allocation of resources in open computing systems can initially be met by devising "conventional rules". In this section we outline the current development roadmap for uHelp that is driven by the need to make the app fully Ostrom-aligned as a path to its sustainability.

7.1 Clearly defined boundaries

uHelp has already clearly defined boundaries. We, as humans, are socially adaptive, can play different roles, work in different groups, and apply different parameters to each of them. The nature of the different tasks and the trust requirements depend heavily on the collective action sought in each community (childcare, for example, being a highly sensitive task requiring high levels of trust; or book exchange requiring much lower trust levels). uHelp allows for the creation of a rich set of communities.

7.2 Proportional equivalence between benefits and costs

The present reward and punishment system—based on trust updates—seems adequate enough. Initial results show that community members who accrue a trust deficit increasingly have their requests for help unmet. This accrual mechanism avoids explicit shaming as trust values are kept private and thus prevents the emergence and propagation of a toxic culture of community members attacking each other. However, when a majority of community members behave correctly it is desirable to complement the private trust modelling with a mechanism for interactive communication that allows requesters to exchange volunteering experiences in order to disseminate their good (or bad) assessment (Conte and Paolucci 2002). In this way, more important rewards could be gained by increasing the scope and impact of one's actions. This functionality will be included in future releases.

7.3 Collective-choice arrangements

This is a key aspect in the next iterations of the platform. uHelp foresees community members proposing or modifying governing norms through collective agreements via the following functionalities: (i) *norm language*. A structured natural language interface to allow members to propose new norms to be adopted (in the midterm, a general Natural Language interface will be developed); (ii) *norm verification*. Automatic mechanisms to verify whether the proposed norms conflict with the community's current set of norms; (iii) *argumentation*. The tool will facilitate the construction of argumentation graphs by members of the community to summarise the pros and cons of every proposed norm; (iv) *voting*. uHelp will provide means for community members to agree by voting on norm updates. These new functionalities will allow communities to register different views and modify governance/operational arrangements accordingly, depending on the particularities of the tasks involved and the composition of the community. Arguably, communities formed by very altruistic members may need less regulation than communities with higher numbers of free riders (Osman and Sierra 2018).

7.4 Monitoring

Automatic monitoring, aligned with CPR principles, is already in place in the current system. Yet, we foresee two different ways to improve it. The first one is via automatic norm suggestion: by analysing the interactions within the platform, the system can propose new norms that improve interaction (for example, new ways of limiting the impact of free-riders or the elimination on unnecessary controls). Also, if volunteers get good ratings even if they violate a particular norm, that norm might need to be revisited. The second option is via simulation: the system may provide feedback using previous data on what would have been the likely consequences of the adoption of a particular norm.

7.5 Graduated Sanctions

Sanctions could go from simple warnings to more severe actions such as banning someone from a community. Our norm language will incorporate the capacity of establishing different levels of sanctions that should be agreed upon, like any other norm, by community members. For instance, overuse of the commons (that is, members requesting an exceedingly large amount of help) can be avoided by norms that limit the number of requests for help, or that balance them with the number of times a member volunteers to help. Likewise, incentives could be implemented to guide volunteers about appropriate norms and CPR principles.

7.6 Conflict resolution mechanisms

We suggest a combination of multilateral negotiation (de Jonge and Sierra 2015) and mediation (Sierra et al. 2016) as the most adequate conflict resolution method in the uHelp environment. As communities are composed of diverse individuals with differing needs and understandings of appropriate CPR norms, multilateral negotiation will be needed to deal with interactions and conflicts within communities and between individuals. Mediation may be needed when disputes involve sensitive issues whose management can be facilitated by a third, neutral party. The horizontal, decentralised, and privacy-friendly dispute resolution methods developing in the blockchain space—as part of a broader institutional governance—may be worth exploring here (Allen et al. 2019).[17]

[17] See, for example the Kleros Court, https://kleros.io/en/.

7.7 Minimal recognition of rights to organise

The organisation and management of each community will be completely under the control of their members that will determine via agreements the rules that will govern their activities. Thus, a flexible mechanism for norm creation is enough to meet this design principle.

7.8 Appropriate co-ordination among relevant groups

At present, messages do not cross community boundaries. Having local small communities makes co-ordination simpler, faster, and in context. Nevertheless, uHelp members are likely to be active in a number of different communities—both online and offline—and possibly in a number of other market networks that may overlap with uhHelp. Anecdotal evidence from emergent Covid-19 networks of local support certainly goes in this direction. Likewise, to scale up the execution to larger communities, decentralised solutions could be devised where specific computing resources would be associated to that particular community. These cases of nested systems, therefore, would require additional coordination mechanisms.

In addition, as part of the automatic norm suggestion mechanism, the system will be able to suggest norms that have proved effective in solving specific problems within similar communities. We do not foresee a multilevel community organisation requiring other coordination mechanisms as the focus of uHelp is on micro communities that act in an independent form.

8. Conclusions

This paper presents a socio-technical implementation of the concept of "help" based on a commons-oriented perspective. Thus, we have argued that "help" constitutes a type of good that cannot easily fit within the dual taxonomy presented in Ostrom and Ostrom (1978). Our implementation develops an app, uHelp, that runs on smartphones and tablets and facilitates the creation and evolution of communities of mutual support. Our stance is that any application of AI techniques that aims at supporting the sustainability of communities should follow Ostrom's design principles. We assess if, how, and to what extent uHelp satisfies Ostrom's design principles, and we lay down a roadmap for future developments heading in this direction and also addressing a remaining concern of algorithmic self-governance, as expressed in Pitt and Diaconescu (2014). In particular, whether community members can self-organise in "fair" institutions by defining their own rules for resource sharing, monitoring, and sanctioning. Developing Ostrom-compliant, AI-enabled communities is a promising step in this direction.

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Competing Interests

The authors have no competing interests to declare.

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