

# Reformulating computational social science with citizen social science: the case of a community-based mental health care research

**Isabelle Bonhoure**

**isabelle.bonhoure@ub.edu**

OpenSystems Research Group, Departament de Física de la Matèria Condensada,  
Universitat de Barcelona, Barcelona, Spain

Universitat de Barcelona Institute of Complex Systems UBICS, Barcelona, Spain

**Anna Cigarini**

OpenSystems Research Group, Departament de Física de la Matèria Condensada,  
Universitat de Barcelona, Barcelona, Spain

Universitat de Barcelona Institute of Complex Systems UBICS, Barcelona, Spain

Internet Interdisciplinary Institute, Open University of Catalonia, Barcelona, Spain

**Julián Vicens**

OpenSystems Research Group, Departament de Física de la Matèria Condensada,  
Universitat de Barcelona, Barcelona, Spain

Universitat de Barcelona Institute of Complex Systems UBICS, Barcelona, Spain

Fundació Eurecat, Barcelona, Spain.

**Bàrbara Mitats**

Federació Salut Mental Catalunya, Barcelona, Spain

**Josep Perelló**

**josep.perello@ub.edu**

OpenSystems Research Group, Departament de Física de la Matèria Condensada,  
Universitat de Barcelona, Barcelona, Spain

Universitat de Barcelona Institute of Complex Systems UBICS, Barcelona, Spain

Accepted for Publication in *Humanities and Social Sciences Communications*  
(20 February 2023). DOI : 10.1057/s41599-023-01577-2

## **Abstract**

Computational social science is being scrutinized and some concerns have been expressed with regards to the lack of transparency and inclusivity in some of the researches. But how computational social science can be reformulated to adopt participatory and inclusive practices? And, furthermore, which aspects shall be carefully considered to make possible this reformulation? We present a practical case that addresses the challenge of collectively studying social interactions within community-based mental health care. This study is done by revisiting and revising social science methods such as social dilemmas and game theory and by incorporating the use of digital interfaces to run experiments in-the-field. The research can be framed within the emergent citizen social science or social citizen science where shared practices are still lacking. We have identified five key steps of the research process to be considered to introduce participatory and inclusive practices: research framing, research design, experimental spaces, data sources, and actionable knowledge. Social dilemmas and game theory methods and protocols need to be reconsidered as an experiential activity that enables participants to self-reflect. Co-design dynamics and the building of a working group outside the academia are important to initiate socially robust knowledge co-production. Research results should support evidence-based policies and collective actions put forward by the civil society. The inclusion of underserved groups is discussed as a way forward to new avenues of computational social science jointly with intricate ethical aspects. Finally, the paper also provides some reflections to explore the particularities of a further enhancement of social dimensions in citizen science.

# Introduction

Computational social science refers to the academic sub-disciplines concerned with digitally-based and computational approaches to the social sciences and focuses on investigating social interactions quantitatively with sophisticated statistical analyses (Salganik 2017; Lazer et al. 2009). The field has been growing with the technological revolution of internet, which has digitized social activities (Hofman et al. 2021).

One of the many options for characterising social interactions (Keuschnigg, Lovsjö, and Hedström 2017) is to build experimental situations in a stylised manner through so-called “social dilemmas”, within the game theory framework (see e.g Osborne (2004)). A social dilemma is a situation in which a group of people (two or more individuals) can work together to achieve some goal that no one could easily reach alone. And game theory provides a mathematical framework that has been developed extensively since the 1950s by many scholars. Both social dilemmas and game theory have been widely recognised as important tools in psychology and economics. In social dilemmas, individual interests of the participants conflict with collective interests thus allowing social behavioural traits to be inferred from empirical data obtained in experiments. The final aim is to stylise, in a quantitative manner, traits such as cooperation, trust, reciprocity or self-esteem (Camerer and Fehr 2005).

Experimental settings are typically placed in universities and research institutes. To complement this work, during the last 15 years, scientists have also started using online laboratories to gather an unprecedented amount of data. These virtual lab data are collected using platforms such as Mechanical Turk or Facebook with the intention of obtaining general conclusions concerning behavioural traits such as human cooperation. The experiments aim at covering broad contexts with a bulk of online recruited individuals (Mason and Suri 2012; Casler, Bickel, and Hackett 2013; Shapiro, Chandler, and Mueller 2013; Buhrmester, Talaifar, and Gosling 2018).

However, there are some concerns related to the fact that people whose data are being used have not fully consented to the data collection (“The Powers and Perils of Using Digital Data

to Understand Human Behaviour” 2021). The data sets are indeed often the private property of commercial enterprises. These concerns and others discussed in this paper can be circumvented by considering participatory and inclusive practices in computational social science research (Galesic et al. 2021), behavioural experiments with social dilemmas and game theory included.

The questions would then be: how can computational social science be reformulated to adopt participatory and inclusive practices? And, furthermore, which aspects shall be considered to make possible this reformulation? These two research questions are addressed by sharing the practice of a particular research project on a concrete social issue and involving specific groups of people particularly affected by the issue under study. By sharing the research practice, we do not intend to draw empirical evidence of the effectiveness of the journey taken. But, instead, we share a description of the research process itself to better identify the ‘hows’ behind the reformulation of computational social science research when participatory and inclusive practices are adopted.

The research practice shared here is the one of the “Games for Mental Health” project. It has been using social dilemmas and digital interfaces to learn about social interactions within the mental health community in Catalonia, Spain. 270 members of this community have played these games. Social interactions are especially important in the mental health context as they are a pillar of the community-based mental health care and the so-called “recovery” model, which is defined as a way of living a satisfying, hopeful and contributing life despite the limitations that experiencing mental health problems can impose (WHO 2022; Anthony 1993). In this context, *“supportive families and carers [...] can be real enablers of recovery for people living with mental health conditions”* (WHO 2022) and social and informal supports (such as peers, friends, and community volunteers) play a crucial role. Behavioural traits such as trust, reciprocity or cooperation among individuals, which can be measured with social dilemmas and game theory, are then key to sustain community-based mental health care.

“Games for Mental Health” can be framed within the so-called citizen social science (CSS) (Albert 2021; Albert, Balázs, Butkevičienė, Mayer, and Perelló 2021; Thomas, Scheller, and Schröder 2021; Tauginienė et al. 2020; Göbel, Mauermeister, and Henke 2022). CSS enhances

the social dimension in citizen science (CS). While CS broadly refers to the active engagement of the general public in scientific research tasks (Vohland et al. 2021), our interpretation of citizen *social* science here refers in part to the reformulation of consolidated *social* science methodology or a set of methods which does not entail active and conscious participation of the individuals involved in the research, as this is the case of social dilemmas and game theory. Our interpretation of CSS also refers to a CS that investigates social issues (Albert 2021). We will continue this discussion when presenting and analysing the case study of “Games for Mental Health”. We will also further reflect on the different issues involved in the conclusions.

## The case of Games for Mental Health

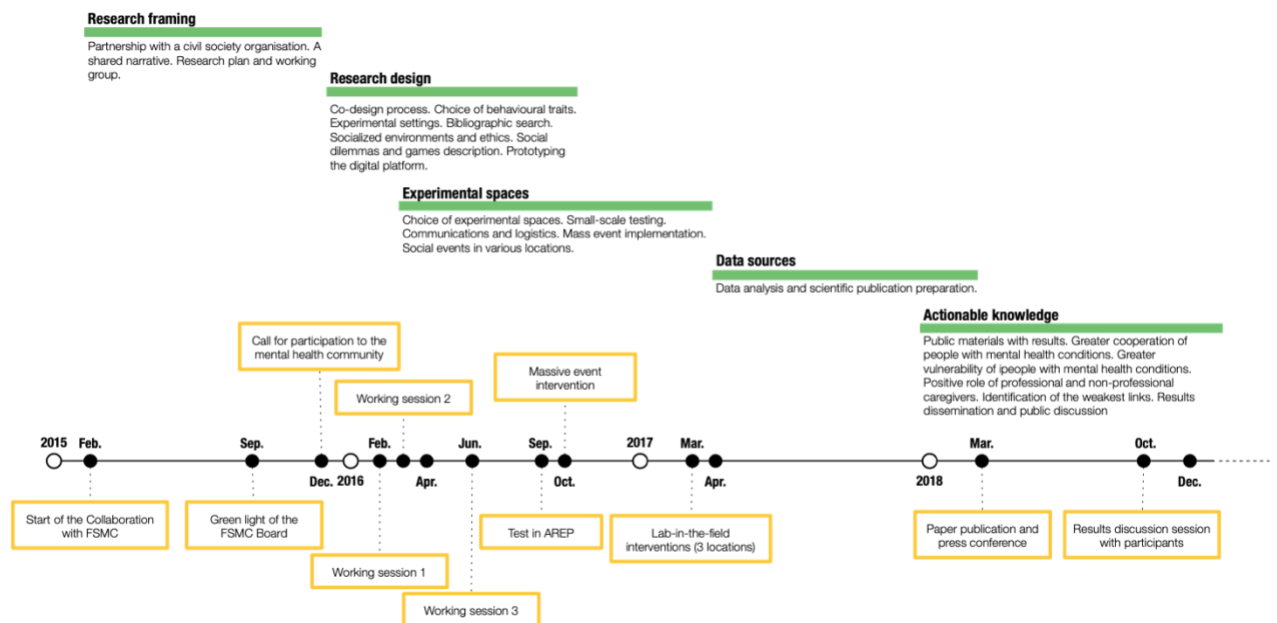
We want here to point out the participatory and inclusive practices related to different phases of the research process. The research consisted in using social dilemmas and games theory to unveil and measure behavioural traits among people living with mental health conditions, family members, professional and non-professional caregivers, friends and community volunteers. Key steps of the research process identified are research framing, research design, experimental spaces, data sources, and actionable knowledge. All these phases are related to the research process. The research process is thus not only understood as scientific results production because it also entails the production of accessible and relevant knowledge to both the concerned groups (the mental health community, here) and the general public. The research process indeed also considers the promotion of social change. The reformulation of computational social science to include participatory and inclusive practices, through a citizen social science lens are synthesized in Table 1. The timeline of the research practice is illustrated in Figure 1.

	Computational social science general approach	Conceptual shift	Reformulation with participatory and inclusive practices	Key Citizen Social Science aspects
<b>Research framing</b>	Stylised, abstract and decontextualised	Shared research question	Related to a specific shared social concern, contextualised	- Place vulnerable groups' perspective at the centre of the research - Partner with CSOs

				and working groups with diverse social actors (civil society partners) - Agree on a shared narrative and research plan with civil society partners
<b>Research design</b>	By researchers, e.g., in behavioural economics or psychology	Co-creation and co-design processes	Jointly with non-professional scientists as competent experts in-the-field (co-researchers)	- Establish inclusive and horizontal research scenarios - Implement ethical supervision and evaluation - Involve experts-in-the-field (co-researchers) and populations in a vulnerable situation - Validate research steps and prototype research devices with civil society partners - Build an experience rather than an experiment
<b>Experimental spaces</b>	Secluded or virtual laboratories in fully controlled settings	Lab-in-the-field adaptive approach	Natural relational spaces (public spaces or community spaces)	- Implement the research in socialized environments - Test the research in small-scale real settings - Upscale the research in mass events or larger scale events - Implement the research in different social contexts and locations - Conceive the experimental spaces as places for self-reflection for participants
<b>Data sources</b>	Passive volunteer individuals, e.g., university students, <i>Turkers</i> or hospital patients	Conscious and active participation	Data consciously collected and directly collected from concerned citizens	- Collectively generate new data, able to respond civil society actors' interests but also valuable for academic research - Open the data and fully document meta-data to enhance reusability and replicability

<b>Actionable knowledge</b>	Long-term. Scientists generally delegate responsibility to other social actors (e.g., policy makers)	Mission-oriented collective research	Civil society actors share interest about the results, strengthening the possibility for short-term social change	<ul style="list-style-type: none"> <li>- Create open and public materials accessible to general audience and concerned group</li> <li>- Write public reports containing solid scientific-based arguments</li> <li>- Disseminate the scientific results through press campaigns</li> <li>- Initiate public discussions about the social issue</li> </ul>
-----------------------------	--	--------------------------------------	---	---

**Table 1.** Computational social science approach and its reformulation when participatory and inclusive practices are enhanced. The last column describes how this reformulation can be incorporated into the research practice considering citizen social science aspects and across different research steps



**Figure 1:** Timeline of "Games for Mental Health". Events and tasks are related to the timeline and the key steps of the research process: Research framing, Research design, Experimental spaces, Data sources and Actionable knowledge.

## Research framing

In computational social science, and more particularly in behavioural sciences, the research framing is very often stylised, abstract and decontextualized from the social issues, in this case the improvement of community-based mental health care.

At the far end, within the health context, CS projects are addressing very concrete issues, ranging from public health concerns to given diseases (King et al. 2019). While these practices, including patient-lead research, are quickly expanding online and offline (Wiggins and Wilbanks 2019; King et al. 2019; den Broeder et al. 2018), a wide range of ethical issues are raised. Such issues include how to value patient contributions (Smith, Bélisle-Pipon, and Resnik 2019) or how to include the needs of underserved populations (Fiske, Prainsack, and Buyx 2019). In any case, worldwide, several authors claim that CS can play a preeminent role in public health and population health science (den Broeder et al. 2018; King et al. 2019; Rowbotham et al. 2019) and environmental health (English, Richardson, and Garzón-Galvis 2018) while focusing on the need of CS projects to achieve a transformative change (Rowbotham et al. 2019). In many cases, these authors advocate for inclusive and participatory practices, such as the need to engage the community through participatory research to achieve an impact in the context of environmental health (English, Richardson, and Garzón-Galvis 2018).

In the case of “Games for Mental Health”, the research framing is contextualized targeting a given social issue related to mental health but also including key research practices in order to implement a more inclusive and participatory research (see Table 1). We now share this process, focusing on the essential role of a concerned civil society organisation (see Table 1). This part of the process took 11 months.

**Partnership with a civil society organisation.** In late 2014, the director of the board of a civil society organisation, the *Federació Salut Mental Catalunya* (Catalonia Mental Health Federation; henceforth, the Federation) approached us to explore the possibility to launch a CS project, based on some of our public experiments on human behaviour developed using digital interfaces and at events such as the Barcelona Board Game Festival or on the streets



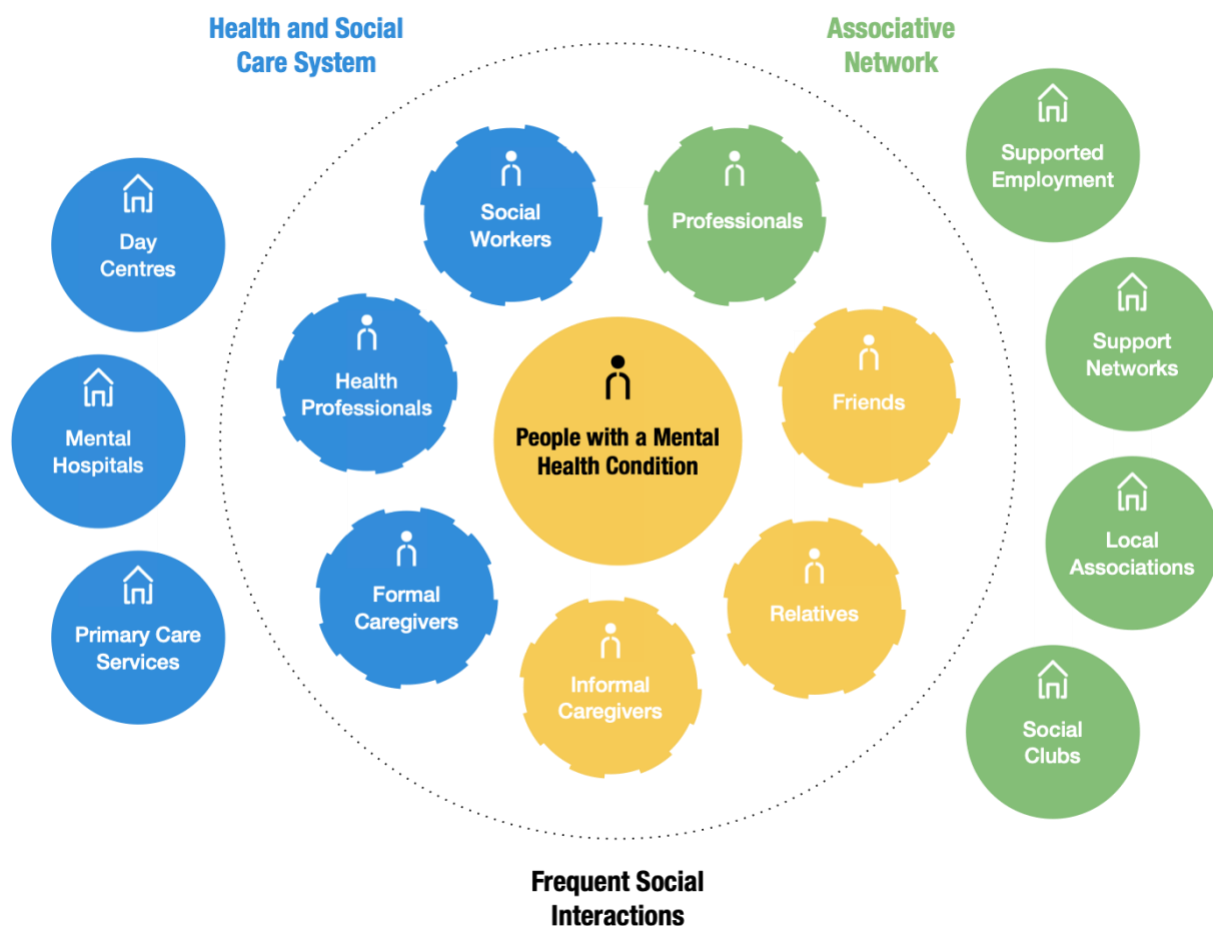
of Barcelona or in the region (Gutiérrez-Roig et al. 2014; 2016; Sagarra et al. 2016; Poncela-Casasnovas et al. 2016; Vicens, Duch, and Perelló 2018; Vicens et al. 2018). The Federation director's initial aim was to provide new evidence in relation to community-based health care, to better defend the civil society demands and to enhance the public debate on providing further financial support on community-based mental health care.

We together guessed that public and collective experimentation based on social dilemmas could also be used to learn about the social interactions that takes place within the mental health community. Dominant paradigm in mental health care research and practice still affords biomedical knowledge a privileged status, but other models bring more holistic approaches to the table, as in the case of community-based mental health care (Thornicroft, Deb, and Henderson 2016), based on the recovery model (as defined in the Introduction; (WHO 2022; Anthony 1993)). To maximize the full potential of the recovery model, it is important to better understand which social interactions are taking place in the mental health community and reinforce the most positive ones such as trust, reciprocity, or cooperation.

The Federation that became a key partner in the research is composed of more than 70 federated associations of families and users of mental health care services. Its main objective is to improve the lives of people with mental health conditions and their families and friends. The organisation was aligned with World Health Organisation framework and define mental health condition as: *"a broad term covering mental disorders and psychosocial disabilities. It also covers other mental states associated with significant distress, impairment in functioning, or risk of self-harm."* (WHO 2022). The board of the Federation is largely composed of individuals having mental health problems and their relatives. Thus, individuals with mental health conditions and their relatives have direct power at all levels of decision within the Federation. Furthermore, some professionals within the Federation also present a double or triple profile, in that they themselves have mental health conditions and/or are relatives of a person with a mental health condition. In this regard, the Federation is acknowledged by the mental health community as one of the legitimate representatives of people with mental health conditions and of their interests in Catalonia. Eiroa-Orosa and Rowe (2017) offers a detailed analysis of the Federation network and of the relevance of the Federation in mental health stakeholder mapping.

**A shared narrative.** This research framing was developed by maintaining continuous dialogue between our academic research group (OpenSystems, from Universitat de Barcelona) and the Federation. During this process, a challenge for the Federation was also to clearly envision the different steps of a research project and the results that it could bring out. Without undervaluing the power relations that any research project intrinsically brings with it, the status of the professional scientists (some of the Authors of this paper) was somehow lowered because they did not initially have much general knowledge concerning mental health conditions, and because the study was partially financed by the Federation, not through standard academic research funding. One Author of this paper belongs to the Federation.

Our initial meetings with the managing director of the Federation and the team members were devoted to understanding our respective practices and conceptual frameworks. On the one hand, the Authors that are professional scientists from the academic world did their best to explain our conception of the research process and our methods in plain language based on CS and collective public experimentation (Sagarra et al., 2016). On the other, the Federation introduced us to their strategic goals: to work towards social inclusion of people with mental health conditions, to increment the well-being of their family members, and to improve and enhance public policies related to mental health care services within a “care in the community” framework. The Federation operates in Catalonia, Spain.



**Figure 2.** Main actors within community-based mental health care model. The three main fields considered are: 1) the Health and Social Care System (in blue), 2) the Associative Network (in green) and 3) the Frequent Social Interactions, represented in the inner-most circle around the persons (people) with mental health condition.

Our first exchanges allowed us to draw up a map of the main actors in the community-based mental health care model and of the social interactions of the people with a mental health condition, as shown in Figure 2. This map was done considering existing maps, such as a map of the components of mental health services (WHO 2003, p10) or the model network of community-based mental health services (WHO 2022, p195). We though changed the perspective by placing the people with mental health conditions at the centre and by including local specificities. We considered three main fields: the health and social care system, the associative network, and the social network. The first of these fields provides care through institutions like mental health hospitals, primary care services and communitarian

rehabilitation centres. In this field, the main actors directly interacting with the people with mental health conditions are health professionals, professional caregivers, and social workers. This mental health care system is complemented by the associative network in that this latter provides other types of support, services, or programs, such as social clubs or activities organised through local associations, as outlined by the WHO (WHO 2003). This associative network even sometimes provides employment to people with mental health conditions through supported employment institutions. Finally, the social network consists of the individuals in closest contact with the people with mental health conditions, such as informal (non-professional) caregivers who are often relatives and friends and relatives that do not consider themselves as caregivers but rather as support agents.

The relevant social interactions we wanted to look at especially occur within the inner-most circle around people with mental health conditions. Within that circle, there is daily or at least frequent social interaction among people with mental health conditions, professional (e.g., social workers) and non-professional caregivers (e.g., family members), and, finally, relatives or friends.

**Research plan and working group.** Based on the map we built up with the Federation, it was possible to draft a specific research plan with the title: “Games for Mental Health”. The project was approved by the board of the Federation for funding. Laying the foundations for the project took approximately 9 months, which retrospectively was necessary to build a common understanding and agree on a preliminary research framing based on shared interests.

To complete the research framing, a group was then formed of the broadest possible set of representatives of the actors involved in community-based mental health care (see Figure 2). Thus, it included a range of people with diverse experiences and expertise: people with mental health conditions, non-professional caregivers, relatives, social workers, mental health nurses, psychologists, and psychiatrists, as well as experts and board members from the Federation. Here, we define this group as “working group” (WG).

All the members were encouraged to contribute based on their own expertise and invited to become involved in the research design, which was to be performed in an open and collaborative way. During this period, the leadership of the Federation was crucial to engage relevant actors from the community, who considered it to be a trustworthy partner.

## Research design

In computational social science, the research design is usually performed by academic researchers. In the current case, they might also have a behavioural economics and psychology background. To foster participatory and inclusive processes, we here propose to shift from research design to research co-design, involving non-professional scientists (but competent experts in-the field, also called co-researchers) in the design phase (see Table 1). We then reinterpreted together the methods and the protocols in human behaviour experiments and, more particularly, in social dilemma experiments.

Involving non-professional scientists from the mental health community and especially people with mental health conditions implies to deeply reflect on the notion of inclusivity. It is also important to consider too the fact that non-professional scientists might be in a vulnerable situation. There is already very relevant expertise from participatory research in the context of social science that shall be acknowledged and can be considered in this research phase. To get a general framework, we considered different perspectives from qualitative social science research. Nind proposes inclusive research as a set of methodologies to maximise inclusion (Nind 2014). Such principles include: 1) disrupting the hierarchy between researchers and co-researchers; 2) maximising participation and competence by co-researchers; 3) enhancing authenticity and insider perspectives; 3) empowerment of co-researchers, both as individuals and as a group/community; 4) accessibility, authorship and readership by co-researchers; 5) acting ethically as a critical issue, connected with accountability, social justice, respect and critical reflexivity.

Vulnerable populations are “social groups who have an increased relative risk or susceptibility to adverse health outcomes” (Flaskerud and Winslow 1998) and thus refer to those who are impoverished, disenfranchised, or subjected to discrimination, intolerance, subordination,

and stigma (Nyamathi 1998). Nyamathi also includes the observation that “people suffering from chronic illness, the mentally ill and the caregivers of the chronically ill are also referred to as vulnerable populations” (Nyamathi 1998). These are precisely the core participants in “Games for Mental Health”.

Liamputtong (2007) also stresses the many aspects that must be reflected on concerning moral and ethical issues in researching people in a vulnerable situation. One of the most important ones relates to the fact that the benefits of undertaking the research need to be measured against the risk of being involved in the research (Flaskerud and Winslow, 1998; Beaver, Luker and Woods, 1999; Cutcliffe and Ramcharan, 2002).

We now share the process of the research co-design with a working group. We however want to mention that complexities discussed in previous paragraphs were just partially addressed in this phase of the research. The effort was beyond the capacities we had to run the project. This part of the process took 10 months.

**Co-design process.** Taking the notions of inclusivity and vulnerability into account, we thus initiated a co-design process with the members of the WG with tools and strategies broadly discussed in other publications (Senabre, Ferran-Ferrer, and Perelló 2018). We here report the specificities of the “Games for Mental Health” research.

First, we reflected on what contributions would be needed from the WG members starting from the initial predefined idea of the use of social dilemmas to study human behaviour in the field of community-based mental health care. All working sessions were organised to make sure that the rights of people with disabilities were respected: a core practice that the Federation has been implementing strictly since the publication of the UN Convention on the Rights of Persons with Disabilities (CRPD) (UN CPRD 2010). In particular, the Federation made sure that the right to freedom from discrimination and to participation were fulfilled, and support was provided to exercise these rights where necessary and to protect the integrity of the participants.

During the first working session (February 2016), two computational social science professional researchers presented the context of the research and explained which social dilemmas in the form of games could be explored. During this session, an open debate started, in which all the participants expressed a constructive attitude and a desire to participate actively in the design phase of the research. The participants of the WG were 20 people with these different profiles: 2 psychiatrists (all men), 2 mental health nurses (1 man and 1 woman), 4 family members (2 women and 2 men), 8 persons with mental health conditions (4 men and 4 women; with different medical diagnosis), 2 social workers (1 man and 1 woman; working as professional caregivers) and 2 women from the Federation technical office (with full knowledge of the whole Catalan network of associations and being the responsible of organising public events of the Organisations). Among the WG participants, 2 family members and 2 people with mental health conditions also belonged to the board of the Federation.

	Questionnaire items	Objective
<b>Q1</b>	Which behavioural traits (e.g., trust, reciprocity, altruism, revenge, responsibility for the common good, following and imposition of norms, culpability in various contexts, optimism and pessimism, justice, envy, etc.) do you think are most important and useful for the study?	Validation and hierarchisation of behavioural traits
<b>Q2</b>	What format (e.g., simultaneous events in several cities, online launching, etc.) is best, in your opinion? What is the best context?	Formalisation and design of the games for the experiment
<b>Q3</b>	We are interested in knowing what individual benefit you could/would like to obtain from the initiative. What do you want to know? What questions would you ask yourself for the information being gathered?	Maximisation of the potential social impact of the knowledge

**Table 2.** Questionnaire with open-ended question for working session participants, associated with the objective of each question.

**Choice of behavioural traits.** The debate helped us to reinterpret with non-academic eyes the behavioural traits that social dilemmas aim to capture. We were then able to focus on possible parameters that we should assess through the games. One important issue was collecting main traits associated with the recovery process. Recovery process is understood here within the frame of the community-based mental health care, where recovery is related to living a

satisfying and meaningful life but not necessarily to the absence of symptoms associated with mental health problems. Participants with mental health conditions further shared their own struggles when dealing with the effort of increasing autonomy and self-dependence (or independence).

At the end of the working session, the participants were asked to answer individually a detailed questionnaire that was sent by email. The open-ended questionnaire items as well as their objectives are detailed in Table 2. The information obtained through this brief questionnaire served us as a guide to decide what our next steps would be. The questionnaire was answered by people with different profiles, some combining more than one, such as people with a mental health condition, relatives of people with a mental health condition, mental health professionals (psychiatrists and nurses) and experts from the Federation. The answers to the questionnaires indicated that trust was the most relevant behavioural trait to look at, followed by reciprocity and guilt. In relation to the format of the games, the respondents agreed that it was convenient to organise a central event that would bring public visibility and then repeat the experience in other smaller events dispersed around several locations in the region.

**Experimental settings.** The questionnaire also showed a broad consensus on using digital platforms for the implementation of the experiment, as this can help to answer individually while maintaining the participant's privacy. In relation to the specific results that were expected, the WG members highlighted the need to increase social awareness of the reality of people with mental health conditions. They also highlighted the fact that they should not be identified exclusively by their diagnoses, in line with local bottom-up associations revindications to avoid deepening social stigma. Thus, the importance of a diagnosis was minimised while enhancing the need to learn about behavioural traits in the community-based mental health care. These inputs allowed us to initiate the research co-design, by validating the initial research agenda, contextualising the research framing, and conceptualising the whole research process in public spaces as an evolution of previous participatory experiments under the form of pop-up experiments (Sagarra et al. 2016).



**Bibliographic search.** An exhaustive bibliographic search was then performed, to identify previous work that had combined mental health and social dilemmas over the last decade. At that time, in 2015, the research that had already examined social dilemmas and mental health together focused on the Ultimatum Game (Pulcu et al. 2015; Clark et al. 2013; Destoop et al. 2012), the Trust Game (Zhang, Sun, and Lee 2012) and the Prisoner's Dilemma (Pulcu et al. 2015). In all these papers, the number of games' participants ranges from 41 (Clark et al. 2013) up to 99 (Zhang, Sun, and Lee 2012).

The literature drew special attention to trust or cooperation. The maximum number of people participating in one experiment was 99 (Zhang, Sun, and Lee 2012). We set this number as the minimum number of participants we would need to involve in our project and improve statistical significance. They were focussed on the behavioural differences between individuals with mental health conditions and experimental control groups. The experiments were carried out either in a computer room at universities or in a hospital environment (clinical study). Mostly, they were linking behavioural traits to certain mental health diagnosis thus implicitly deepening stigma and stereotypes. There was no study including caregivers as experimental subjects.

**Socialized environments and ethics.** No literature analysed behavioural traits in more socialised environments or in more *natural* conditions, by looking at social interactions between all the actors in mental health communities. So, in line with the expectations of the WG aiming to explore socialisation dynamics in more natural conditions, the experimental spaces were no longer projected as in-the-lab spaces but became lab-in-the-field community spaces.

Regarding the format of the experiment, it was presented as an experience in the form of games, rather than as an experiment. It was collectively decided that a collection of social dilemmas would first be implemented on World Mental Health Day, as a mass event. Also, logistics and organisational aspects of the experience were raised. The main target participants were proposed as people with mental health conditions, professional and non-professional caregivers, relatives (including family members not acting as caregivers), social

and health professionals and any person (including friends) engaged in the larger mental health care community.

The different steps in the digital “Games for Mental Health” via electronic tablets were also established: registration, a set of sociodemographic questions defined with the WG but also complying with General Data Protection Regulation (GDPR 2016), a game tutorial, the game itself played in pairs or small groups, and finally the results and rewards. In terms of the research steps to be taken, the WG agreed first to perform small-scale testing, second to implement the games during a mass event and, depending on the initial analysis of the results, in others less crowded events across the region.

Once the main features of “Games for Mental Health” were defined, the project was presented to the Universitat de Barcelona Ethics Committee and received formal approval. An initial draft with a proposal for social dilemmas was then shared with the Federation and discussed. After a process of deliberation with the WG, “Games for Mental Health” finally included 3 different games, in the form of social dilemmas. During all the games, participants belonging to the mental health community would be asked to play with each other in groups of six players. However, they would not ever know with whom they were playing. The games were digital and did not follow the board games format. The instructions consisted of frames with simple text and images. Participants were asked to take strategic decisions during the games.

**Social dilemmas and games description.** The three games chosen were:

- 1) The “Climate Game”, which is a collective risk dilemma, in which the whole group of six players has to reach a common goal to avert a catastrophe that would most probably wipe out their money. This game measures sense of collectiveness based on willingness to contribute to the common good.
- 2) The “Prize Game”, where participants play out, in pairs, the well-known Prisoner’s Dilemma, in which they have to choose to cooperate or to try to benefit from the other’s cooperation (defect). This game mainly measures cooperation.
- 3) The “Investor Game”, where participants play the Trust Game, in which they have to lend money to another player who then obtains a return and has the option of sending some

money back to the lender; players played in both roles. This game measures trust and reciprocity.

**Prototyping the digital platform.** During a third working session, the WG was again invited to participate in the last part of the research co-design. Based on the previous working session debate, an initial experimental design was presented to the WG.

From this working session, several practical and experienced-based measures were also adopted, such as: to limit the duration of the experience to 10 minutes approximately, to better define the sociodemographic questions in order to identify the type of participants in the games and to adapt some answers to possible characteristics of people with mental health conditions (e.g., living in shared or supported housing), to agree on a limited but comprehensive set of mental health diagnoses based on the self-perceptions of participant, to agree on an informed consent procedure, and to limit the participation to adults over 18.

Based on these contributions, a prototype of the digital platform was prepared. For each experience, the digital platform was implemented on electronic tablets, connected through a virtual local server. In practice, Internet was not needed, and the tablets were rented for each experience, which allowed a relatively cheap and versatile experimental set-up (for further details, see Vicens, Duch, and Perelló 2018).

## Experimental spaces

As also mentioned some lines above, experimental spaces in computational social science are secluded or online laboratories that aim to neutralise the influence of the environment. This applies equally to mental health studies reported above that use game theoretical paradigms. Their main experimental setting is laboratories or, in the best of cases, hospital settings (Wang et al. 2015; Clark et al. 2013; Destoop et al. 2012; Surbey 2011).

However, enhancing participation would also necessarily have to deal with the environmental conditions in a different manner (Sparrow 2018). With the aim of maintaining *natural* conditions, much closer to the daily experiences of the participants, the research would have

to take place in community spaces or public spaces, in the form of lab-in-the-field research and collective experiments (Latour 2004).

Situating the experimentation in *natural* relational spaces has also an important implication in terms of inclusivity, as discussed earlier (see Research design section). It facilitates the participation of people that are usually not participating to research projects, as people with mental health conditions and their relatives. As the experimentation is placed in an environment they know and feel comfortable into, the participation of these collectives, often in a vulnerable situation, is favoured. They can also freely take the decision to participate or not, without any constraint.

We now share the process of the different actions required to run the experiment in a *natural* space (see Table 1). The logistics preparation and running the different set of experiments took 6 months.

**Choice of experimental spaces.** The research was embedded in mental health community events, already existing as consolidated relational spaces of the community in Catalonia. These events were one mass event (on World Mental Health Day) and three small informal events, organised by local mental health associations. The reason for this choice was twofold. On the conceptual side, these events had the objective of being horizontal spaces, where all members of the community are equally represented. It was also a way to conceive of the 10-minute experience as a self-reflection exercise, to enhance public discussion among the participants and on their social interactions. However, the researchers had to adapt to the lab-in-the-field setting and to change their way of communicating with the participants, to be understood clearly and trusted by the community.

As the goal of the study was to evidence the social interactions among members of the community and where these interactions occur, the idea to embed the research followed almost naturally. Had we situated the experience in a non-social environment (e.g., at the university laboratory) we would have undermined the scientific value of our results. Situating the research in community spaces was not a straightforward process, rather it consisted of

several steps to be completed in close partnership with the Federation. We describe them below.

**Small-scale testing.** This testing was done in AREP (*Associació per a la rehabilitació de les persones amb problemes de salut mental*, Association for the rehabilitation of people with mental health problems). The goal of AREP is to provide members both individual and group attention to promote their rehabilitation. For one morning, the platform was tested with 18 people who were members of the association (people with mental health conditions) and social workers. The testing helped us to refine the platform contents by reducing the duration of the experiment and by simplifying the language of the games. The need for individual support for some participants for them to understanding the rules of the games fully, also became evident.

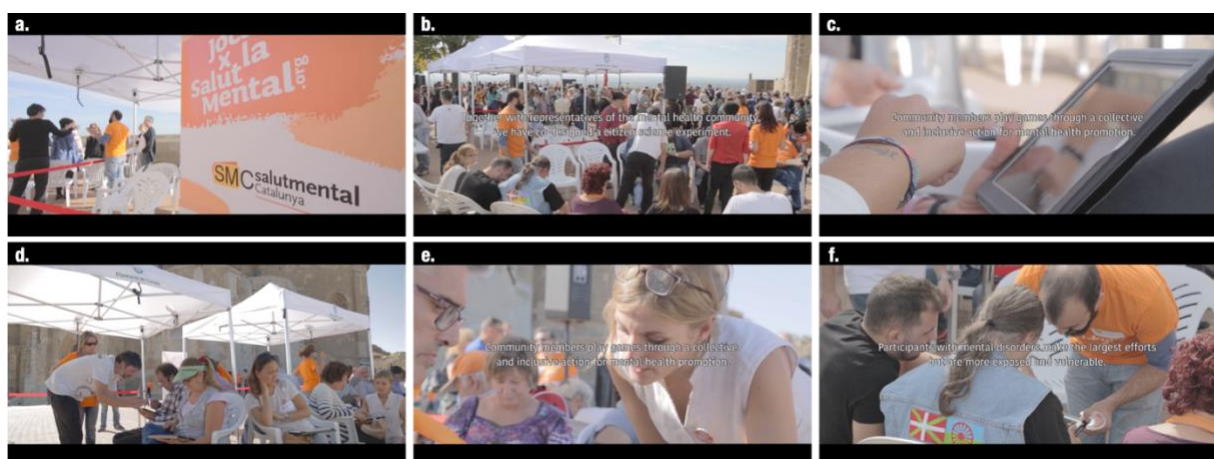
**Communications and logistics.** As part of the set of activities programmed for World Mental Health Day, it was necessary to design a communication strategy to make “Games for Mental Health” visible and attractive, both inside and outside of the community. Some visits were organised to the site where the event was to be physically located, with the aim of choosing the best place in order to guarantee optimum participation. A logo was designed and included in a poster, flyers and pins. All the necessary logistic material (electrical power connection, furniture, tablets and tents) was rented or booked. Some incentives to participate in the games, in the form of vouchers for a large bookstore, were also produced, to be given to participants based on their participation in the games. This is a standard procedure in social dilemmas and behavioural economics experimental settings.

**Mass event implementation.** On 8<sup>th</sup> of October 2016, the Organisation held a mass event in Lleida, the sixth most populated city in Catalonia, coinciding with World Mental Health Day. Some 1,500 people from the mental health associative movement, including people with mental health conditions, their families, and social and healthcare professionals from the sector, participated in the event. It included concerts, different leisure activities and talks or speeches by both representatives of the mental health care community and some politicians, such as the Catalan Minister of Health. Participating in “Games for Mental Health” was one of the proposed activities for the attendees.

The facilitators of Games for Mental Health consisted of 5 researchers from 3 different universities and a social worker from the Federation. A group of 15 volunteers from the different associations participating in the event were trained at the beginning of the day and helped us to recruit and support participants. The whole experience was videoed, and a two-minute video was produced (OpenSystems 2018), a summary of which is presented in Figure 3.

This leisurely atmosphere became an opportunity to include the whole community and to invite all the actors to participate. Before playing, the participants were told about the goals of the research, signed an informed consent and agreed to transfer their image rights during the experiment to the Universitat de Barcelona.

The fact that 120 participants played “Games for Mental Health” throughout the whole day, is evidence of success in comparison to previous studies published (99 participants max.). A rapid analysis of the data and the emergence of systematic patterns suggested, nonetheless, that the rules and dynamics of the games were correctly understood by the majority of participants but not all of them. Some participants further pointed out that “Games for Mental Health” could be implemented in other community spaces.



**Figure 3.** Frames extracted from the video “Games for Mental Health” recorded on 8<sup>th</sup> of October 2016. (a) Aspect of the space before starting the experience. (b) Broad view of the experience and participants within the context of the World Mental Health Day event. (c) Interactions within games were facilitated by means of a digital interface on electronic

tablets. (d) Group of six participants before starting a session with a set of games. (e) and (f) Personalised support for participants, in case they did not understand the rules of any of the set of games.

**Social events in various locations.** The data collected during World Mental Health Day were analysed and delivered to the Federation to gain preliminary insights and discuss replicability, while checking for the reliability of the experimental set-up. Based on this first data analysis, and on the lessons learned during the mass event, it was decided to further embed the games in community spaces, but this time in less crowded settings. We also prioritised events or locations that involved local communities, as opposed to the previous mass event. The reason was to check that the statistical patterns observed were comparable to those obtained over smaller-scale social spaces. In these settings, 150 more people played the games, thus reaching out a total number of participants of 270 individuals.

“Games for Mental Health” were embedded in three more social spaces. The first was an afternoon snack organised by three social clubs (Sabadell, Terrassa and Castellar del Vallès) situated at roughly 30-40 kilometres from Barcelona, at the headquarters of the social club in Sabadell. While the second was a typical regional winter Sunday lunch (*Calçotada*) organised in Valls (Catalonia) and bringing together members of four local mental health associations for people with mental health condition, their relatives and social workers. Finally, the third community space used to embed the game was the Drissa Private Foundation in Girona (Catalonia). This Foundation is a non-profit institution that works with people with mental health condition to ensure the possibility of entering the labour market and improving quality of life, mainly through work. A session of “Games for Mental Health” was organised at their premises with the participation of employees with mental health conditions and social workers of the Foundation.

## Data sources

In computational social science, passive and captive research individuals provide behavioural data which not always are left open to facilitate reproducibility and transparency. Moreover, for a long time, ethics concerns have been raised (Giglietto and Rossi 2012), in which big data

are commonly extracted from users' social media accounts without their explicit permission, and sometimes even after manipulating the feedback users receive (Jouhki et al. 2016).

Enhancing participatory practices in computational social science allows for a more open design of the research and more conscious participation. A wider examination of the ethical issues should take place accordingly, and this needs further reflection in relation to power inequality between academic researchers and research participants. Attention should be then paid to the contributions from participatory action research (Hilsen 2006; Chevalier, Jacques M., Buckles 2013) which promotes participation on equal terms (Kemmis 2014; Rowell et al. 2016). It is however also true that this effort might undermine the computational social science potential to handle records from a very large amounts of people (hundreds of thousands or millions in some cases). Therefore, there is a need to rethink existing methods within the computational social science and citizen social science frameworks if massive data is required within a research project.

The shift towards more participatory and inclusive processes affects how the experimental data is collected and subsequently shared and interpreted (see Table 1). Here, the participants are engaged as active and conscious participants, eager to learn about the research outputs through additional activities that can empower specific groups in a vulnerable situation. On the one hand, their contribution can provide important insight into the interpretation of data. On the other, self-selection issues which apply to standard experimental settings (Henrich, Heine, and Norenzayan 2010; Olteanu et al. 2019) are to be viewed through different lenses when participation is enhanced.

We now very shortly share the process of analysing data to respond the issues raised by the Federation and the WG and that initially motivated the whole research (see Table 1). The analysis was mostly made by the professional scientist and the paper publication took 12 months.

**Data analysis.** Once the “Games for Mental Health” experiments finished, in March 2017, the scientific data were carefully analysed. We want to stress the fact that we were able to create new data. Available data from public agencies or academic public repositories was not able



to respond to the issues raised by the Federation, the WG and the mental health community in general. This unique data and the statistical insights from this data was in turn considered relevant enough in the academic context to deserve scientific publication in an open access journal (Cigarini et al. 2018c). The paper mainly reports the statistical analysis of the data, it does not detail the research practices we are currently reporting in the current manuscript.

**Open data.** The dataset obtained was released through an open data repository (Cigarini et al. 2018a). The main findings of that paper reinforced the idea of community social capital, with caregivers and professionals playing a leading role in community-based mental health care, especially when considering their levels of cooperation in the dilemmas. However, the cost of collective action was mainly supported by the people with mental health conditions, which reveals their vulnerability as we discuss in the next section.

## Actionable Knowledge

Computational social science research does not generally have a straightforward impact on the group concerned which indeed was providing the necessary data to make the research possible. Computational social science dealing with social dilemmas and game theory is most often framed in terms of broad behavioural traits from which is hard to build an actionable knowledge.

The closer involvement with a civil society organisation (CSO) and with the participants themselves helped to foresee more immediate impact in many layers. Since the research is grounded on the issues and knowledge constructed by a given community, there exists a strong sense of ownership of the knowledge produced collectively and it helped to open up spaces for individual self-reflection and each person role within the community-based mental health care. These aspects can accelerate the process of transformation of scientific outputs into new evidenced-based actions and policies, thus promoting social change. Socially robust knowledge (Nowotny 2003) can be assembled through socially distributed expertise including a wide range of actors.

We now share the different outputs to strengthen the possibility for short-term social change actions (see Table 1). The planning and organisation of the several actions took 6 months.

**Public materials with results.** When we were about to close the partnership with the Federation, it appeared the need to transfer the findings into a more accessible format for the community than those present in the academic publication (Cigarini et al. 2018c). After having several conversations with the Federation and some members of the initial WG, we created a video in three languages (Catalan, Spanish and English) and uploaded in a public platform (OpenSystems 2018). It was focussed on sharing the experience of participating in the experiments themselves. We also wrote a specific report that was uploaded in a public repository (Cigarini et al. 2018b). The report puts the accent on different findings which might be relevant for the community and for new policies and that were not included in the academic publication. We list them and briefly comment them below.

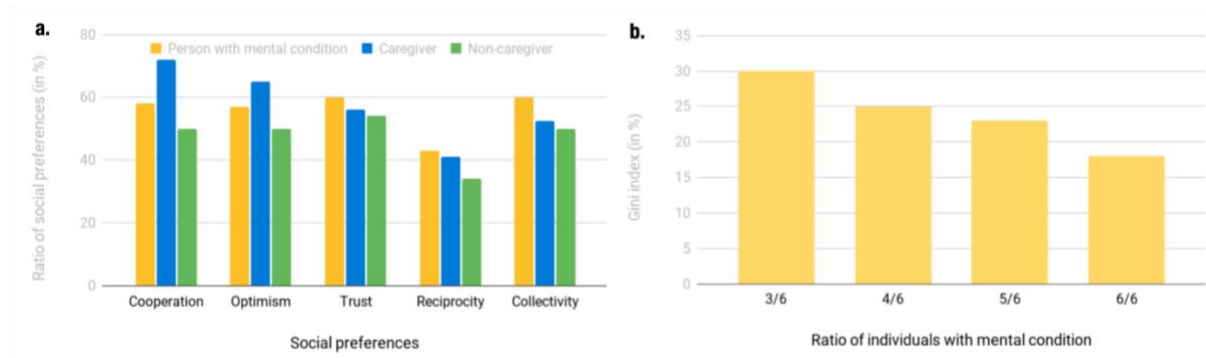
**Greater cooperation of people with mental health conditions.** As shown in Figure 4, participants with mental health conditions show a significantly greater willingness to cooperate with the other players, acting cooperatively in 58% of cases. These are the people who contributed the most to public welfare: they sacrificed 57% of their resources for the common good. They therefore made more effort to achieve the collective goal, thus marking out a prominent role for the proper functioning of the communities. Their greater willingness to contribute to collective action can be seen as a way to claim their place in the community. This feature reinforces the idea that community-based care models can make a difference to well-being and the recovery process. Although increasing the relationship among community actors presents opportunities for people with mental health conditions, it also involves limitations. The fact that they contributed more to the common goal meant less effort was required from the other members of the group.

**Greater vulnerability of people with mental health conditions.** Participants with mental health conditions revealed their vulnerability to exploitation by other participants, which translated into 5% less final gain. In groups where people with mental health conditions make up 50% of the members, the disparity in personal gain is maximum (see Figure 4b). When teamwork is necessary for the collective as a whole to benefit, the composition of the group

must be taken into account to anticipate the inequalities that emerge between the various actors in terms of attitude, capacity and strategic actions.

**Positive role of professional and non-professional caregivers.** By focusing on the environment of people with mental health conditions (family, professional and non-professional caregivers, friends and other community members), relevant differences were detected between the different actors in terms of cooperative behaviour. We found that 7 out of 10 professional and non-professional caregivers acted cooperatively, and in 65% of cases they expected that their partner would cooperate as well (see Fig. 4a). The high degree of cooperation and optimism of caregivers is critical to strengthening ties within the mental health communities, especially when seeking emotional support. Their attitude consolidates the key role that these actors play in providing care. Taking into account the behaviour and expectations of this group is therefore of particular interest when it comes to extending the support they offer, thus improving the effectiveness of their role.

**Identification of the weakest links.** Meanwhile, relatives who do not strictly contribute to care practices turn out to be the weakest links within the collective (see Figure 4a). Only one in three adopted cooperative behaviour during the sessions. Therefore, we propose increasing interventions aimed at enhancing their participation in the community. In return, these interventions will improve the recovery process of the people with mental health conditions, strengthening effective collaboration between the different actors and leading towards a more effective inclusion process.



**Figure 4.** Some relevant scientific results of “Games for Mental Health” from Cigarini et al. (2018c). (a) Degree (in %) of each behavioural trait obtained with the different games. The

results are aggregated depending on the participant's role within the mental health care community. (b) Level of inequality (in %) within the group of participants, by the number of people with mental health conditions in a group playing the games.

**Results dissemination and public discussion.** The summary of the main results described above was presented in a press conference given by the Principal Investigator (a professional scientist) and the former director of the board of the Federation who initiated the collaboration. Different actors from the mental health care community were also present. This press conference led to the publication of 20 local and national press items. The items stressed the crucial role of caregivers to sustain community-based mental health care. This impact could not be anticipated by only publishing results in an academic paper. The Federation also saw scientific-based evidence and solid arguments for continuing to advocate in favour of the strengthening of social interactions within the community-based mental health care.

A few months later, on 5<sup>th</sup> of October 2018, the results were also presented and discussed in Girona, during a local event marking the World Mental Health Day 2018, with old and new participants in the project. The collective discussion evaluated the joint effort positively. The results also served as a trigger for further reflection on their roles within community-based mental health care and enabled dialogue to share individual experiences in relation to other actors, mostly in relation to caregivers.

## Discussion

We have presented the “Games for Mental Health” case with the aim to explore how to reformulate computational social science when adopting inclusive and participatory practices. We have revised social science methods such as social dilemmas and game theory and incorporated the use of digital interfaces to run experiments in-the-field that have been co-designed with a concerned group of people and a civil society organisation (CSO).

We have identified five key steps to be considered: research framing, research design, experimental spaces, data sources, and actionable knowledge. By reviewing the experience through these steps, it is also possible to reflect further on the implications of the reformulation of computational social science.

## Individual experiences

This first reflection stresses the strong connection between the reformulation of the computational social science herein presented and the emergence of citizen social science (CSS) in the citizen science community. CSS brings up the combination of citizen science with social sciences. The “Games for Mental Health” case can be thus framed within to the emergent CSS or social citizen science where shared practices are still lacking.

Albert et al (2021) points out that CSS *“presents an opportunity for opening social science methods up to public involvement, and for a more committed or socially engaged practice that enables citizens to connect private troubles and public histories”*. In CSS, the enhancement of the participation of the public and society is prone to consider individual experiences. In the case of “Games for Mental Health”, participation has allowed to include individual perspectives into existing social methods and into the interpretation of the data collected. In CSS, participants have indeed more opportunities to act as co-researchers than in CS because they can be considered experts based on their daily social experiences. Their contribution needs to become more relevant, not to say essential, compared to CS projects on biodiversity monitoring or galaxy classification.

In “Games for Mental Health”, the contribution from people with mental health conditions could indeed be more extensive in the different phases of a CS research process (Haklay 2013; Scheller et al. 2020; Senabre Hidalgo et al. 2021). Kythreotis et al. (2019) have also underlined the importance of running co-designed research on pressing global issues like climate action. The co-design dynamics with a group of non-professional scientists can be key to coproduce socially robust knowledge while gaining a strong sense of ownership and self-reflection by all actors involved, as already conceptually proposed in other fields such as environmental health (Perelló et al. 2021; English, Richardson, and Garzón-Galvis 2018).

## **Partnering with civil society**

Both in CS and in CSS, involvement can be initiated and coordinated through top-down processes by professional researchers or alternatively through bottom-up processes by actors of civil society (Land-Zandstra, Agnello, and Gültekin 2021). In “Games for Mental Health” we have opted for a hybrid approach (top-down and bottom-up) by initiating research with a civil society organisation (the Federation) that represents the voice of concerned and underserved groups.

Partnering with CSOs however requires time and patience to align interests. It is necessary to find a common language while gaining mutual trust and respect to reach a horizontal relationship (Albert, Balázs, Butkevičienė, Mayer, Perelló, et al. 2021). Despite the addition of more complexity to the research process, these efforts became essential to reformulate computational social science in “Games for Mental Health”.

It is also important to mention that the research was done with a well-established and organized CSO. They funded the research with few thousands of euros to cover logistics and material aspects. In a partnership with smaller and/or less organized CSOs, the planification and implementation of such a project could become much more challenging. Forthcoming reformulation of computational social science with CSS would need to better learn about the mechanisms to favour and enlarge these partnerships.

## **Crowdsourced and qualitative data**

Third reflection is related to the crowdsourcing component. Crowdsourcing has been key in the success of not only computational social science research but also in CS projects with thousands of people involved and contributing (Salganik 2017; Irwin 2018).

“Games for Mental Health” has also developed its own crowdsourcing strategies with digital devices as this is also the case of many other CSS projects. For example, CSS projects explored workplace learning and the interprofessional education of clinicians by utilizing an online

platform (Dadich 2014) or employing sensor technologies to record urban stress and well-being (Pykett et al. 2020).

Some authors have however underlined in the qualitative social science context that it is highly needed to develop trust between researcher and researched (Miller and Tewksbury 2001). This qualitative effort can hinder the crowdsourced component and it could be necessary to invent new methods or reimagine combined methods to better handle qualitative data while still collecting massive data, as already envisaged in the field of population health science and environmental health (Rowbotham et al. 2019; English, Richardson, and Garzón-Galvis 2018).

New CSS methods also need to convey to experimental spaces that provides the right context to make research meaningful for everyone involved. The adequate experimental setting in a *natural* relational space become fundamental as we have done in the mass event or in the social clubs in “Games for Mental Health” to study social interactions. The crowdsourcing-related methodologies provided will surely need to find additional ways to collect more data from a larger number of people. Also, it has been very often said that CS is able to complement existing data (Vohland et al (2021); Irwin (2018)) and new experimental spaces should be able to provide data that can easier interoperate with other data sources.

New strategies and further reflection to facilitate empowerment of each of the participants with the data collected are also needed. CSS in conjunction with computational social science will have to enable collective data interpretation and build digital and non-digital spaces for that. More plural interpretation of the data collected can enhance debate about the understanding of the data collected and favour richer discussions on pressing and controversial social issues.

## **Evidence-based policy and collective action**

CS, and by extension CSS, has created great expectations to help in building new policies and deliver specific recommendations but still there is still a long way to go in this path (Irwin

2018). At the end of a CSS research, the concerned social groups want to see changes due to the joint research undertaken.

Within “Games for Mental Health”, this goal was not fully achieved, and journey was neither monitored. The achievement of impact beyond the scientific publication must be carefully calibrated and participants’ expectations have to be evaluated during the whole research process. Also, CSS vision asks professional scientists in the context of computational social science to work differently and take further responsibility on scientific knowledge delivered while better adjusting the research timing to the sense of urgency raised by the concerned groups about the social issue under scientific investigation.

Finally, by leaving the data open, the groups involved have more possibilities to take ownership of the data they have generated as a community. Ownership would then open a richer and more diverse data interpretation and increase the transformative potential through collective action and policy recommendations.

## Conclusion

The research practices reported in this paper and the reflections related deal with computational social science and behavioural sciences through social dilemmas and game theory. It can indeed be seen as a continuation of previous contribution conceiving collective experiments (Sagarra et al. 2016; Vicens, Duch, and Perelló 2018; Vicens et al. 2018; Cigarini et al. 2018c; Cigarini, Vicens, and Perelló 2020). Computational social science reformulation can however involve many other considerations to study social interactions and social issues in other contexts which could be as diverse as climate action (Kythreotis et al. 2019), health impact (English, Richardson, and Garzón-Galvis 2018) or pedestrian mobility (Larroya et al. 2023).

CSS can represent a powerful way to instrumentalize a conceptual shift from general computational social science approach towards a more inclusive and participatory research practice, in all the research steps. The related key CSS research aspects (see Table 1) point to



an horizontal research and an ethical involvement of different civil society actors, including groups in a vulnerable situation. Among other facets, the research practices also situate the experimentation in socialized environments to generate new and socially-relevant scientific data. These research practices combine robust computational social science methodologies, such as social dilemmas, with citizen science crowdsourcing methodologies. Several critical challenges, such as the necessary deeper involvement of civil society actors in all research steps, the implementation of collective data interpretation processes or the transformation of scientific results into social changes have still to be addressed. But this effort could open the path to new global projects addressing a variety of social issues with the final aim to produce transformative changes at the societal level.

## References

- Albert, A. 2021. "Citizen Social Science in Practice: The Case of the Empty Houses Project." *Humanities and Social Sciences Communications* 8 (1). <https://doi.org/10.1057/s41599-021-00755-4>.
- Albert A, Balázs B, Butkevičienė E, Mayer K, Perelló P (2021) Citizen social science: new and established approaches to participation in social research. In: *The science of citizen science*. Springer, Cham. pp. 119–138
- Anthony, W A. 1993. "Recovery from Mental Illness: The Guiding Vision of the Mental Health Service System in the 1990s." *Psychosocial Rehabilitation Journal* 16 (4): 11–23. <https://doi.org/10.1037/h0095655>.
- Beaver K, Luker K, Woods S (1999) Conducting Research with the Terminally Ill: Challenges and Considerations. *Int J Palliat Nurs* 5(1):13–17. <https://doi.org/10.12968/ijpn.1999.5.1.9926>
- den Broeder L, Devilee J, van Oers H, A. Schuit AJ, Wagemakers A. 2018. "Citizen Science for Public Health." *Health Promotion International* 33 (3): 505–14. <https://doi.org/10.1093/heapro/daw086>.
- Buhrmester MD, Talaifar S, Gosling SD (2018) An evaluation of amazon's mechanical turk, its rapid rise, and its effective use. *Perspect Psychol Sci* 13(2):149–154. <https://doi.org/10.1177/1745691617706516>
- Camerer CF, Fehr E (2005) Measuring social norms and preferences using experimental games: a guide for social scientists. In: *Foundations of human sociality: economic experiments and ethnographic evidence from fifteen small-scale societies*. Oxford University Press
- Casler K, Bickel L, Hackett E (2013) Separate but Equal? A comparison of participants and data gathered via Amazon's MTurk, social media, and face-to-face behavioral testing. *Comput Human Behav* 29(6):2156–2160. <https://doi.org/10.1016/j.chb.2013.05.009>
- Chevalier JM, Buckles DJ (2013) Participatory action research: theory and methods for engaged inquiry. Taylor and Francis
- Cigarini A, Vicens J, Duch J, Sánchez A, Perelló J (2018a). "Dataset. Quantitative account of social interactions in a mental health care ecosystem: cooperation, trust and collective action". In *Scientific Reports*. Zenodo. <https://doi.org/10.5281/zenodo.1175627>
- Cigarini A et al. (2018b) "Jocs x La Salut Mental: Resultats de La Recerca Amb Salut Mental Catalunya." In *Scientific Reports*. Zenodo. <https://doi.org/10.5281/ZENODO.1186978>

- Cigarini A et al. (2018c) Quantitative account of social interactions in a mental health care ecosystem: cooperation, trust and collective action. *Sci Rep* 8(1): 1–9. <https://doi.org/10.1038/s41598-018-21900-1>
- Cigarini, A, Vicens J, Perelló J (2020) Gender-based pairings influence cooperative expectations and behaviours. *Sci Rep* 10(1):1–10. <https://doi.org/10.1038/s41598-020-57749-6>
- Clark CB, Thorne CB, Hardy S, Cropsey KL (2013) Cooperation and depressive symptoms. *J Affect Disorder* 150(3):1184–1187. <https://doi.org/10.1016/j.jad.2013.05.011>
- Cutcliffe JR, Ramcharan P (2002) Leveling the playing field? Exploring the merits of the ethics-as-process approach for judging qualitative research proposals. *Qualit Health Res* 12(7):1000–1010. <https://doi.org/10.1177/104973202129120313>
- Dadich A (2014) Citizen social science: a methodology to facilitate and evaluate workplace learning in continuing interprofessional education. *J Interprof Care* 28(3):194–199. <https://doi.org/10.3109/13561820.2013.874982>
- Destoop M, Schrijvers D, De Grave C, Sabbe B, De Bruijn ERA (2012) Better to give than to take? Interactive social decision-making in severe major depressive disorder. *J Affect Disorder* 137(1–3):98–105. <https://doi.org/10.1016/j.jad.2011.12.010>
- Eiroa-Orosa J F, M Rowe M (2017) Taking the concept of citizenship in mental health across countries. Reflections on transferring principles and practice to different sociocultural contexts. *Front Psychol* 8:1020. <https://doi.org/10.3389/fpsyg.2017.01020>
- English PB, Richardson MJ, C Garzón-Galvis C (2018). From crowdsourcing to extreme citizen science: participatory research for environmental health. *Ann Rev Public Health* 39(1):335–350 <https://doi.org/10.1146/annurev-publhealth-040617-013702>
- Fiske A, Prainsack B, Buyx A (2019) Meeting the needs of underserved populations: setting the agenda for more inclusive citizen science of medicine. *J Med Ethics* 45:617–622. <https://doi.org/10.1136/medethics-2018-105253>
- Flaskerud JH, Winslow BJ (1998) Conceptualizing vulnerable populations health-related research. *Nurs Res* 47(2):69–78. <https://doi.org/10.1097/00006199-199803000-00005>
- Galesic M, de Bruin WB, Dalege J, Feld SL, Kreuter F, Olsson H, Drazen P, Stein DL, van der Does T (2021) Human social sensing is an untapped resource for computational social science. *Nature* 595(7866):214–222. <https://doi.org/10.1038/s41586-021-03649-2>
- GDPR (2016) General data protection regulation (GDPR)—official legal text. General Data Protection Regulation. <https://gdpr-info.eu>
- Giglietto F, Rossi L (2012) Ethics and interdisciplinarity in computational social science. *Methodol Innov Online* 7(1):25–36. <https://doi.org/10.4256/mio.2012.003>
- Göbel C, Mauermeister S, Henke J (2022) Citizen social science in Germany—cooperation beyond invited and uninvited participation. *Humanit Soc Sci Commun* 9(1):1–11. <https://doi.org/10.1057/s41599-022-01198-1>
- Gutiérrez-Roig M, Gracia-Lázaro C, Perelló J, Moreno Y, Sánchez A (2014) Transition from reciprocal cooperation to persistent behaviour in social dilemmas at the end of adolescence. *Nat Commun* 5(1):1–7. <https://doi.org/10.1038/ncomms5362>
- Gutiérrez-Roig M, Segura C, Duch J, Perelló J (2016) Market imitation and win-stay lose-shift strategies emerge as unintended patterns in market direction guesses. *PLoS ONE* 11(8):e0159078. <https://doi.org/10.1371/journal.pone.0159078>
- Haklay M (2013) Citizen science and volunteered geographic information: overview and typology of participation. In: *Crowdsourcing geographic knowledge*. Springer.
- Henrich J, Steven JH, Norenzayan A (2010) The weirdest people in the world? *Behav Brain Sci*. 33(2-3):61–83. <https://doi.org/10.1017/S0140525X0999152X>
- Hilsen AI (2006) And they shall be known by their deeds: ethics and politics in action research. *Action Res* 4(1):23–36. <https://doi.org/10.1177/1476750306060539>

- Hofman JM, Duncan JW, Athey S, Garip F, Griffiths TL, Kleinberg J, Margetts H et al. (2021) Integrating explanation and prediction in computational social science. *Nature* 595:181–188. <https://doi.org/10.1038/s41586-021-03659-0>
- Irwin A (2018). No PhDs needed: how citizen science is transforming research. *Nature* 62(7726):480-483 <https://doi.org/10.1038/d41586-018-07106-5>
- Jouhki J, Lauk E, Penttinen M, Sormanen N, Uskali T (2016) Facebook's emotional contagion experiment as a challenge to research ethics. *Media Commun* 4(4A):75–85. <https://doi.org/10.17645/mac.v4i4.579>
- Kemmis S (2014) Critical theory and participatory action research. In: *The SAGE Handbook of Action Research*, 121–38. SAGE Publications Ltd. <https://doi.org/10.4135/9781848607934.n14>
- Keuschnigg M, Lovsjö N, Hedström P. (2017) Analytical sociology and computational social science. *J Computat Soc Sci* 1:3–14. <https://doi.org/10.1007/s42001-017-0006-5>
- King AC, Winter SJ, Chrisinger BW, Hua J, AW Banchoff AW. (2019) Maximizing the promise of citizen science to advance health and prevent disease. *Prev Med* 119:44-47. <https://doi.org/10.1016/j.ypmed.2018.12.016>
- Kythreotis AP, Mantyka-Pringle C, Mercer TG, Whitmarsh LE, A Corner A, Paavola J, Chambers C, Miller BA, Castree N (2019) CitizenSocial science for more integrative and effective climate action: a science-policy perspective. *Front Environ Sci* 7:10. <https://doi.org/10.3389/fenvs.2019.00010>
- Land-Zandstra A, Agnello G, Gültekin YS (2021) Participants in Citizen Science. In: *The science of citizen science*. Springer. pp. 243–259
- Larroya F, Díaz O, Segarra O, Simón PC, Ferré S, Moro E, Perelló J (2023) Home-to-school pedestrian mobility gps data from a citizen science experiment in the Barcelona area. *arXiv:2302.07585v1* <https://doi.org/10.48550/arxiv.2302.07585>
- Latour B (2004) Which protocol for the new collective experiments. In: *Experimental cultures*. Kadmos Verlag. pp. 17-36
- Lazer D, Pentland A, Adamic L, Aral S, Barabási AL, Brewer D, N Christakis N et al. (2009) Social science: computational social science. *Science* 323(5915):721-723. <https://doi.org/10.1126/science.1167742>
- Liamputtong P (2007) *Researching the vulnerable: a guide to sensitive research methods*. SAGE Publications Ltd
- Mason W, Suri S (2012) Conducting behavioral research on Amazon's mechanical turk. *Behav Res Method* 44(1):1–23. <https://doi.org/10.3758/s13428-011-0124-6>
- Miller JM, RA Tewksbury RA (2001) *Extreme methods: innovative approaches to social science research*. Allyn & Bacon. 273p
- Nind M (2014) *What is inclusive research?* London: Bloomsbury Academic
- Nowotny H (2003) Democratising expertise and socially robust knowledge. *Sci Public Policy* 30(3):151–156. <https://doi.org/10.3152/147154303781780461>
- Nyamathi A (1998) Vulnerable populations: a continuing nursing focus. *Nurs Res.* 47(2):65-66 <https://doi.org/10.1097/00006199-199803000-00001>
- Olteanu A, Castillo C, Diaz F, Kıcıman E (2019) Social data: biases, methodological pitfalls, and ethical boundaries. *Front Big Data* 2:13. <https://doi.org/10.3389/fdata.2019.00013>
- OpenSystems (2018) Games for mental health video. Vimeo. 2018. <https://vimeo.com/258601719>
- Osborne M (2004) *An introduction to game theory*. vol. 3. New York: Oxford Univ. Press.
- Perelló J, Cigarini A, Vicens J, Bonhoure I, Rojas-Rueda D, Nieuwenhuijsen MJ, Cirach M, Daher C, Targa J, Ripoll A (2021) Large-scale citizen science provides high-resolution nitrogen dioxide values and health impact while enhancing community knowledge and collective action. *Sci Total Environ* 789:147750. <https://doi.org/10.1016/j.scitotenv.2021.147750>

- Poncela-Casasnovas J, Gutiérrez-Roig M, Gracia-Lázaro C, Vicens J, Gómez-Gardeñes J, Perelló J, Moreno Y, Duch J, Sánchez A (2016) Humans display a reduced set of consistent behavioral phenotypes in dyadic games. *Sci Adv* 2(8):e1600451. <https://doi.org/10.1126/sciadv.1600451>
- Pulcu E, Thomas EJ, Trotter PD, McFarquhar M, Juhasz G, Sahakian BJ, Deakin JFW, Anderson IM, Zahn R, Elliott R (2015) Social-economical decision making in current and remitted major depression. *Psychol Med* 45(6):1301-13. <https://doi.org/10.1017/S0033291714002414>
- Pykett J, Chrisinger B, Kyriakou K, Osborne T, Resch B, Stathi A, Toth E, Whittaker AC (2020) Developing a citizen social science approach to understand urban stress and promote wellbeing in urban communities. *Palgrave Commun* 6(1):1–11. <https://doi.org/10.1057/s41599-020-0460-1>
- Rowbotham S, McKinnon M, Leach J, Lamberts R, P Hawe P (2019) Does citizen science have the capacity to transform population healthscience? *Crit Public Health* 29(1):118-128.
- Rowell LL, Shosh JM, Bruce CD, Riel MM (2016) *The Palgrave International Handbook of Action Research*. Palgrave Macmillan New York
- Sagarra O, Gutiérrez-Roig M, Bonhoure I, Perelló J (2016) Citizen science practices for computational social science research: the conceptualization of pop-up experiments. *Front Phys* 3:93. <https://doi.org/10.3389/fphy.2015.00093>
- Salganik MJ (2017) *Bit by bit: social research in the digital age*. Princeton University Press
- Scheller D, Thomas S, Arnold A, Wissenbach KR, Hervé T, Nkoudou M, Cigarini A et al. (2020) CoActD2.1: Report on State of the Art of Citizen Social Science. Zenodo. <https://doi.org/10.5281/ZENODO.6075670>
- Senabre E, Ferran-Ferrer N, Perelló J (2018) Participatory design of citizen science experiments. *Comunicar* 26(54):29–38. <https://doi.org/10.3916/C54-2018-03>
- Senabre Hidalgo E, Perelló J, Becker F, Bonhoure I, Legris M, Anna Cigarini A (2021). Participation and co-creation in citizen science. In: *The science of citizen science*. Springer International Publishing. pp. 199–218
- Shapiro, Danielle N, Chandler J, Mueller PA (2013) Using mechanical turk to study clinical populations. *Clin Psychol Sci* 1(2):213–220. <https://doi.org/10.1177/2167702612469015>
- Smith E, Bélisle-Pipon J-C, Resnik D (2019) Patients as research partners; how to value their perceptions, contribution and labor? *Citiz Scie: Theor Pract* 4(1):15. <https://doi.org/10.5334/cstp.184>
- Sparrow B (2018) The importance of contextual relevance. *Nat Hum Behav* 2(9):607–607. <https://doi.org/10.1038/s41562-018-0411-7>
- Surbey MK (2011) Adaptive significance of low levels of self-deception and cooperation in depression. *Evol Human Behav* 32(1):29–40. <https://doi.org/10.1016/j.evolhumbehav.2010.08.009>
- Tauginienė L, Butkevičienė E, Vohland K, Heinisch B, Daskolia M, Suškevičs M, Portela M, Balázs B, Prüse B (2020) Citizen science in the social sciences and humanities: the power of interdisciplinarity. *Palgrave Commun* 6(1):1–11. <https://doi.org/10.1057/s41599-020-0471-y>
- The powers and perils of using digital data to understand human behaviour. (2021) *Nature* 595:149-150 <https://doi.org/10.1038/d41586-021-01736-y>
- Thomas S, Scheller D, Schröder S (2021) Co-creation in citizen social science: the research forum as a methodological foundation for communication and participation. *Humanit Soc Sci Commun* 8(1):1–11. <https://doi.org/10.1057/s41599-021-00902-x>
- Thornicroft G, Deb T, Henderson C (2016) Community mental health care worldwide: current status and further developments. *World Psychiatry* 15(3):276–286. <https://doi.org/10.1002/wps.20349>

- UN CPRD (2010) Convention on the Rights of Persons with Disabilities—Articles | United Nations Enable. <https://www.un.org/development/desa/disabilities/convention-on-the-rights-of-persons-with-disabilities/convention-on-the-rights-of-persons-with-disabilities-2.html>
- Vicens J, Bueno-Guerra N, Gutiérrez-Roig M, Gracia-Lázaro C, Gómez-Gardeñes J, Perelló J, Sánchez A, Moreno Y, Duch J (2018) Resource heterogeneity leads to unjust effort distribution in climate change mitigation. *PLoS ONE* 13(10):e0204369. <https://doi.org/10.1371/journal.pone.0204369>
- Vicens J, Duch J, Perelló J (2018) Citizen social lab: a digital platform for human behavior experimentation within a citizen science framework. *PLoS ONE* 13(12):e0207219. <https://doi.org/10.1371/journal.pone.0207219>
- Vohland K, Land-Zandstra A, Ceccaroni L, Lemmens R, Perelló J, Ponti M, Samson R, Wagenknecht K et al. (2021) Editorial: The science of citizen science evolves. In: *The science of citizen science*. Springer International Publishing. pp. 1–12
- Vohland K et al. (eds.) (2021) *The science of citizen science*. Springer International Publishing. <https://doi.org/10.1007/978-3-030-58278-4>
- Wang Y, Yang L-Q, Li S, Zhou Y (2015) Game theory paradigm: a new tool for investigating social dysfunction in major depressive disorders. *Front Psychiatry* 6. <https://doi.org/10.3389/fpsy.2015.00128>
- WHO (2003) Organization of services for mental health. mental health policy and service guidance package. World Health Organization.
- WHO (2022) World mental health report. World Health Organization. pp. 1–260
- Wiggins A, Wilbanks J (2019) The rise of citizen science in health and biomedical research. *Am J Bioethics* 19(8):3–14. <https://doi.org/10.1080/15265161.2019.1619859>
- Zhang HJ, Sun D, Lee TMC (2012) Impaired social decision making in patients with major depressive disorder. *Brain Behav* 2(4):415–423. <https://doi.org/10.1002/brb3.62>

## Data Availability Statement

No data sharing issues apply to this research as no datasets were generated or analysed during the current study.

## Acknowledgements

We thank the community of people with a mental health condition, caregivers and families working within the Federació de Salut Mental Catalunya (Catalonia Mental Health Federation) for the enthusiasm and for their invaluable help in the design and realization of the experiments. We are also especially thankful to F. Español for contributing during the first steps in the experimental design, to M. Poll for always giving us the institutional support from inside the Federation, to both E. Ferrer and F. Muñoz for building the bridge between us and the mental health ecosystem and to X. Trabado for encouraging us to run this research. This work was partially supported by Federació de Salut Mental Catalunya; by the former Ministerio de Ciencia, Innovación y Universidades (Spain), Agencia Estatal de Investigación (AEI), Agencia Estatal de Investigación (AEI) and Fondo Europeo de Desarrollo Regional (FEDER) through grants FIS2016-78904-C3-2-P and PID2019-106811GB-C33 (AEI/10.13039/501100011033); by Generalitat de Catalunya (Spain), Agència de Gestió d'Ajuts Universitaris i de Recerca (AGAUR), Grants no. 2017 SGR 1064 and 2021 SGR 00856;

and by the European Union's Horizon 2020 research and innovation programme (CoAct, under grant agreement no. 873048).

## **Competing Interests**

The authors declare no competing interests.

## **Ethical approval**

The authors declare that "Games for Mental Health" protocol was approved by the Ethics Committee of Universitat de Barcelona (Institutional Review Board IRB00003099). The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

## **Informed Consent**

Informed consent was obtained from all games' participants before starting the experiment. The participants also all agreed to transfer their image rights during the experiment to the Universitat de Barcelona.

## **Contribution of authors**

I.B. and J.P. conceptualised the study; I.B., A.C., J.V., and J.P. carried out the experiment, J.V. prepared the software for the final experimental setup reported; B.M. added to the paper the community mental health care perspective; I.B. and J.P wrote the original draft; and all authors critically discussed the results, revised the paper and have read and approved the final manuscript.