C·Act

Co-designing Citizen Social Science for Collective Action

#3.2

Digital and non-digital tools for conducting research

● ● ● ●

Date – 31 August 2021

Dissemination level - Public

Responsible Partner - UB

Author(s) - Franziska Peter, Isabelle Bonhoure, Josep Perelló.

Reviewers – Anna Cigarini

Document History

Version	Date	Contributor	Comments
1.0	25/07/2021	Franziska Peter, Isabelle Bonhoure, Josep Perelló.	First draft
2.0	27/07/2021	Anna Cigarini	Review
3.0	31/08/2021	Franziska Peter, Isabelle Bonhoure, Josep Perelló.	Final draft

Table of Contents

List of Figures

List of Tables

List of Abbreviations

CoRe Co-Researcher

CSO Civil society organisation

CSS Citizen Social Science

EC European Commission

FOSS Free and Open Source Software

FSMC Federació Salut Mental Catalunya

IC Informed Consent

KC Knowledge Coalition

lrtb from left to right, from top to bottom

R&I Action Research and Innovation Action

UB Universitat de Barcelona

WHO World Health Organisation

1. Executive Summary

The CoAct (Co-designing Citizen Social Science for Collective Action) project proposes to face social global issues by placing citizens in a vulnerable situation at the centre of the research. This approach represents a new understanding of Citizen Social Science (CSS), as participatory research co-designed with citizen groups sharing a social concern.

One of the social issues targeted is Mental Health Care (R&I Action #1, WP3) and specifically mental health social support networks. Social support networks refer to people's social environment, which is generated informally, not professionally. In this frame, the R&I Action #1 has been co-designed with Co-Researchers (CoRes) which are persons with self-experience in mental health and relatives, acting as experts in the field. They participate to all steps of the research, together with the promotors of the research: Universitat de Barcelona-UB and Federació Salut Mental Catalunya-FSMC.

This Deliverable D3.2: "Digital and non-digital tools for conducting research" describes and reflects on two tools that are cornerstones of the research co-design in this context:

1) **The Research Diary.** This hardcover publication, that was tailormade for R&I Action #1, was ideated to guide the CoRes during the process of microstories co-creation. It has been proved to serve as a useful bridge between the online co-creation sessions, done in pandemic times and the CoRes' offline individual work on writing down microstories related to their personal experiences.

2) **The Chatbot.** This Telegram-based chatbot is the first example, to our knowledge, of a chatbot used by a citizen science project. Its contents are fully provided by the CoRes and the promotors of the research. The chatbot consists of a package of python3 code and include several blocks of contents.

The Research Diary is openly accessible via Zenodo[1] and the Chatbot code is an Open Source code on Github[2], in order to improve their accessibility and potential re-use.

---

[1] https://doi.org/10.5281/zenodo.5342488
[2] https://github.com/Chaotique/CoActuem_per_la_Salut_Mental_Chatbot

2. Introduction

2.1 What is CoAct?

CoAct (Co-designing Citizen Social Science for Collective Action) is proposing a new understanding of Citizen Social Science, as a participatory research co-designed and directly driven by citizens and citizen groups sharing a social concern (See Figure 1). CoAct proposes to face four "wicked" social global issues by engaging citizens in a vulnerable situation. The joint effort will result in the implementation of new or improved science-related policies and in the advancement of the CSS approach with regards to its applicability in concrete fields or research.

Figure 1: Citizen Social Science in Action, with citizen groups, a specific concern, and with the support of the Knowledge Coalition.

In all CoAct R&I Actions (Mental Health Care, Youth Employment and Environmental Justice), citizens in a vulnerable situation are placed at the centre of the research and their role and dedication conceptually recognize them as Co-Researchers (CoRes). In parallel, the Knowledge Coalition is a network of stakeholders who are informed about the R&I Actions' goals, and plays an active role, either participating in or co-designing different actions, to harness CoRes' efforts and implement policies and measures based on scientific evidence.

2.2 R&I Action #1 research scope

R&I Action #1 focuses on Mental Health Care and social support networks. Social support networks refer to people's social environment, which is generated informally, not professionally. All individuals need an emotional environment that provides them with love, accompaniment, and support for their well-being, especially in difficult times. Families are particularly standing out, understanding that the family concept includes those people with whom close and continuous affective bonds are shared. In the case of people with mental health problems, having a social and affective environment is a key element for the recovery process. Giving support is also complex and generates specific needs in care and self-care. These issues need to be addressed in a way that benefit the accompanied person and do not cause discomfort in the accompanying person. Additionally, social support networks need to have continuity in time to be effective.

Research on social support networks in mental health is important because people with self-experience in mental health and their families claim the importance and effectiveness of social support networks as facilitators of the processes of recovery and the improvement of the quality of life. People's social support in case of emotional suffering is a determinant element for evolution and recovery (Knapp et al., 2007; Pernice-Duca, 2010; Cocke, 2015). Positive family environment is identified as a key protective factor against the risk of exclusion and homelessness (Mental Health Europe, 2008). Studies show that people living with mental illness who are provided with well-planned, comprehensive support in the community have a better quality of life, develop an improved level of functioning and social contact, and have fewer relapses (Merton & Bateman, 2007). Federació Salut Mental Catalunya and Activament Catalunya Associació reports (FSMC & Activament Catalunya Associació, 2017) showed that people with self-experience point to social support networks (family and friends) as key elements for recovery, well-being, and crisis management. However, scientific research on family and other social support networks' role in recovery model is still scarce.

Our research focuses thus on social support networks considering people with an experience in mental health as experts in the field in this matter. The research outcomes should be scientifically valuable but also should contribute to empower the mental health community. In line with these concepts, the R&I Action #1 was renamed "**CoActuem per la Salut Mental**"

8

(**CoAct for Mental Health**) to facilitate the local communication and engagement actions. This R&I Action builds on previous UB experience regarding research co-design (Senabre et al., 2018; Cigarini et al., 2021) and on the previous common work of UB and FSMC addressing community mental health care (Cigarini et al., 2018). It also nurtures from UB's background regarding collective experiments and digital platforms (Sagarra et al., 2016; Vicens et al., 2018).

2.3 R&I Action #1 participants
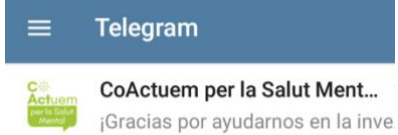
The R&I Action #1 is involving two different groups as **users of the digital and non-digital tools for conducting research:**

Co-Researchers (CoRes) includes persons with self-experience in mental health and relatives, acting as experts in the field. They have co-designed, together with OS and FSMC researchers, a collective research tool in the form of a **Telegram chatbot.** The collective digital conversation content, namely microstories, are built through co-creation mechanisms that allow to reach consensus and agreement among participants while including different perspectives and viewpoints. The contents have been co-created using a **Research Diary**, that was physically delivered at their homes. During the last phase of the project, they will analyse and interpret the results gathered with the **Telegram chatbot**.

Citizen Scientists are the participants to the Collective Digital Conversation (**Telegram chatbot**). This conversation is a safe space for collective and anonymised conversation established through mobiles of all registered participants interested in improving mental health social networks. Safety is defined by the fact that participants anonymity is maintained, as well as their privacy as the individual positions are not exposed in front of any other participant. The participants receive microstories written by the CoRes. All micro stories are planned to be posed to self-express the participants own perspectives based on their own experiences. The goal is to collectively generate new interconnected and multi-layered data able to embrace the complexity and the diversity of the mental health social support networks. The results then will be transformed into evidence-based actions.

2.4 R&I Action #1 digital and non-digital tools

As explained before, **one digital (Telegram chatbot)** and **one non-digital (Research Diary)** tools have been used to co-create and conduct research. Table 1 summarizes their features.

Tool name	Research Diary	Telegram Chatbot
Description	Pdf and hardcover book	Open chatbot operating in Telegram
Authors of the contents	UB and FSMC teams	CoRes (microstories) UB (general contents)
Characteristics	Hardcover publication with 62 printed pages	Public Python3 code, 222 CoRe experiences, 92 accompanying illustrations
Appearance		
Purpose of the tool	Provide to the CoRes a physical tool offering them guidance on how to write microstories related to their experience in mental health social support networks.	Engage citizen scientists in collective research to collect diverse information on mental health social support networks.
Users of the tools	CoRes	Citizen scientists
License	Creative Commons Attribution 4.0 International	GNU General Public License v. 3

Digital repository	Openly Accessible in Zenodo[3]	Open Source Code accessible on Github[4]

Table 1: Comparative features of the Research Diary and the Telegram Chatbot.

---

[3] https://doi.org/10.5281/zenodo.5342488
[4] https://github.com/Chaotique/CoActuem_per_la_Salut_Mental_Chatbot

3. Research Diary

3.1 Context

As described before, the Research Diary was used as a physical support by the CoRes for the co-creation of microstories dealing with mental health social support networks.

In October 2020, after an Open Call extensively disseminated (see video in Vimeo: https://vimeo.com/472726240), two CoAct for Mental Health presentation sessions for potential CoRes were organized. The participants were introduced with the idea of co-designing a chatbot with the aim of measuring social support networks in mental health. They were invited to write personal stories about their lived experiences of social support, accompanied by a professional writer and a professional graphic artist that illustrated some of the stories.

The co-design sessions began in M12 (December 2020) with the persons that confirmed their participation as CoRe. As said before, CoRes are persons with self-experience in mental health and relatives, acting as experts in the field. Overall, a total of 32 CoRes participated in the sessions: 22 individuals with an experience of mental health, 8 relatives of individuals with an experience of mental health, and 2 CoRes who are both individuals with an experience of mental health and relatives of individuals with an experience of mental health.

Four working groups were created based on the CoRes' lived experience of mental health. Each group met 4 times, online, for a total of 16 workshops (1:30 hour duration each). All group sessions were facilitated by a single facilitator. Additionally, in all group sessions at least one member of FSMC and one member of UB were present and two external collaborators joined the team: a professional graphic artist that illustrated most of the micro stories and a professional writer that guided the CoRes through their personal creative process.

The co-creation sessions were initially ideated having in mind the adaptation of the agile-based citizen science toolkit of a former SwafS project (StemForYouth[5]). This toolkit was though exclusively elaborated for face-to-face sessions. Given the pandemics situation, UB thus decided to adapt this methodology and to elaborate a different toolkit. This has taken finally the form of a Research Diary combining both detailed information about the project and practical to-be-filled cards (see Figure 3). The Research Diary was meant to be used as supporting physical material after, during and between the online sessions. In this way, it has encouraged and guide the CoRes' offline work thus allowing to keep a more continuous relationship with the project. The Research Diary was printed and sent by post to the CoRes and they received a digital copy by email.

3.2 Tool description

The Research Diary design was done by a specialized company (design professionals), with the aim of maximizing its attractiveness and usability. A hardcopy publication was printed out and a pdf also made available to the CoRes. The contents were written by UB and revised by FSMC.

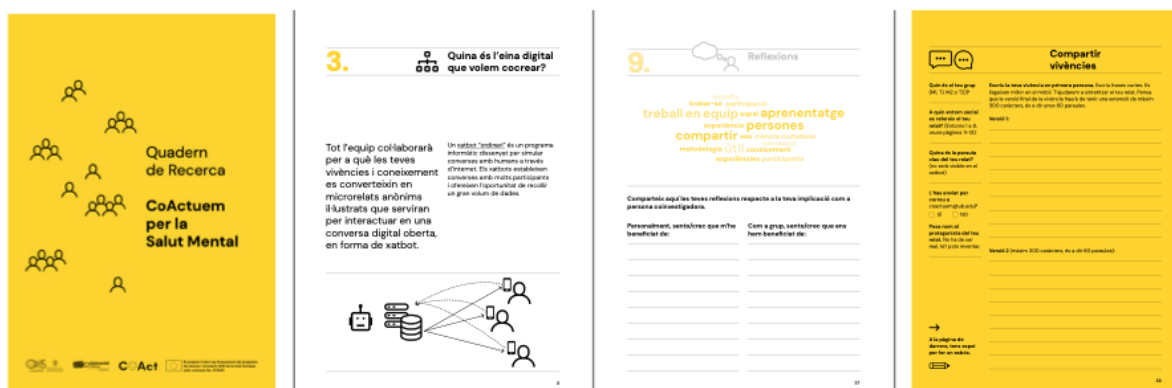Some examples of contents are shown in Figure 2.

Figure 2: Example of Research Diary content (Quadern de Recerca).

---

[5] StemForYouth Citizen Science material: https://olcms.stem4youth.pl/discipline/citizen-science

The process of writing microstories is not a straightforward task, especially when these stories deal with mental health issues. For this reason, a special care was devoted to the contents preparation to potentiate the use of the Research Diary.

While preparing the contents, the following main principles were followed:

- **Closeness and appropriation**. A warm and personalized style was used. The Research diary starts with the sentence: "This diary wants to accompany you as a Co-Researcher in the citizen science research CoAct for Mental Health." The diary offers to the CoRes many options of personalization and includes notes taking features. The objective was that the CoRes appropriated themselves the research diary and considered it as a close tool.

- **Clarity of the contents.** The Research Diary was ideated as a standalone and accessible document. For this reason, all aspects of the project are carefully explained, taking special care of not using any difficult scientific wording that could prevent its accessibility. Plain language guidelines were followed.

- **Clarity of the terms of the collaboration.** For the research team (UB and FSMC) it was of crucial importance to clearly define what the CoRes will have to do, when they will have to do it and in which terns, including how their personal data will be handled. For this reason, the Research Diary included a Timeline, a description of the tasks to be performed and reproduced the Informed Consent that the CoRes had already firmed.

- **Usability.** As the main goal was to produce a practical and easy-to-use tool, the participant's perspective was carefully considered for all sections. In particular, the forms concerning the microstories writing were especially examined and "real" examples given in all cases.

- **Work recognition and traceability.** The Research Diary includes contents that were collaboratively elaborated with the CoRes during former steps such as key elements of social support networks and the description of associated environments. While ensuring the traceability of the process, the inclusion of these elements also implies the recognition of the central role of the CoRes and of the work already done.

These principles resulted in the Research Diary structure described in Table 2.

Name of the Section	Shortlisted contents
1. What is CoAct for Mental Health?	- Main goal of the project - Time frame and funding
2. What do we want to investigate?	- Mental health social support networks description - Key elements of support networks (work done previously with CoRes)
3. Which digital tool do we want to co-create?	- Rationale of the Chatbot - Main features of the Chatbot
4. What do we propose you?	- Description of the expected CoRes contribution - Timeline of the project
5. How will we do it?	- Co-creation rules and ethical values - Privacy and confidentiality
6. Social Environments	- Description of eight social environments related to support networks (Key elements of support networks (work done previously with CoRes)

7. Your microstories	- Micro stories framing
	- Explanation of the co-creation dynamics
	- Sharing experiences (format #1)
	    ○ Rationale and examples
	    ○ Empty templates
	- Finding solutions together (format #2)
	    ○ Rationale and examples
	    ○ Empty templates
	- Discover roles (format #3)
	    ○ Rationale and examples
	    ○ Empty templates

8. Resources and strategies	- Rationale, examples and templates
9. Reflections	- Rationale - Auto-evaluation templates
Annex: Informative Sheet	- Informed Consent

Table 2: Exhaustive description of the Research Diary contents.

The Research Diary is openly accessible in Zenodo (https://doi.org/10.5281/zenodo.5342488) and will be included in the CoAct Citizen Social Science Toolkit to increase its possible impact.

3.3 Feedback from users

This feedback was collected during the whole duration of the co-creation process through both online group discussions, and an evaluation assessment survey at the end of the process.

Co-Researchers

As main users of the material, the CoRes made the following observation:

- They highly valued the fact of receiving a physical artefact at home, especially as it coincided with one of the COVID waves in Catalonia. The diary was perceived as a way to connect to a tangible reality.
- They thanked the authors of the Diary for the high-quality contents of the publication and the amount of work associated.
- They valued the material as easy to use and they wrote the first drafts of their stories in it.
- They also valued the opportunity to represent visually their lived experiences.
- The publication was effectively accompanying them during all the process as we could observe that they were having the Diary closed by in nearly all sessions.

Overall, among the positive aspects of the co-design sessions, the CoRes made clear that the Research Diary proved to be a strong motivating factor for keeping engaged with the project. It was key to empowering them to share their unique views on both positive aspects of social support networks in mental health and the challenges encountered. The Diary allowed participants who were less vocal, who otherwise may not have been able to express their opinions, to fully participate. The Diary supported the CoRes in the drafting process and gave them the opportunity to record and illustrate their lived experience.

Facilitators of the sessions

The facilitators of the session (one entitled facilitators and representatives of UB and FSMC) observed that the Research Diary was a useful tool in order to vertebrate the co-creation sessions and to have a common reference.

Research Team

Although the writing of the Research Diary represented an extra amount of work that was not initially foreseen, the publication had also very positive effects. Appart from its practical purpose, it allowed the research team to agree on a common wording regarding the project, its goals and the purpose of the chatbot. This internal clarification was beneficial for the further steps of the R&I Action #1 and it allowed to precisely define some key aspects of the CoAct research cycle in the context of CSS. The production of the Research Dairy has been thus a good exercise, which allowed to clarify the vision of the research team and to find a way to plainly transmit it.

17

4. Chatbot

4.1 Context

As explained in Section 2, a Telegram Chatbot with the name "CoActuem per la Salut Mental" (in English "CoAct for Mental Health") has been co-designed. It facilitates the collection of answers from thousands of participants over a long period of time via the Telegram messaging application in private conversations with the chatbot.

A chatbot is an automated conversation generator that can be included in quite different digital environments, for instance for customer support on enterprise websites, for daily automated news via social media, or in the case of the "CoActuem per la Salut Mental" chatbot to moderate an automated conversation in a messaging application such as Telegram. For many purposes it might be helpful to create the answers to the customers or followers by making use of Natural Language Processing and Artificial Intelligence to simulate a real conversation. In CoAct for Mental Health, this effect is not wanted: the participants should be conscious of contributing to a scientific data collection by relating to microstories provided by the CoRes. Especially for the topic of mental health it is important that the chatbot does not fake to be a real conversation partner, or even a friend. Also, the chatbot was created to gather specific information tightly limited to the research question raised by CoRes. All contents sent from the "CoActuem per la Salut Mental" chatbot to the volunteering participants is written by humans (the CoRes and OS) as illustrated in Figure 3. The experimental setup tries to enable a comparable experience for all participants. In total, instead of using the artificial intelligence of a machine to simulate a conversation, the project wants to encourage and moderate collective intelligence of us humans to jointly explore and revolutionize mental health support networks.

To our best knowledge, "CoActuem per la Salut Mental" is the first co-created Citizen Science chatbot. Using a chatbot for participatory research has several outstanding benefits,

especially for Citizen *Social s*cience: The participants can answer the question when it is most convenient for them. As the Telegram application that hosts the chatbot can be installed on smartphones and desktops, the participants can answer in a private, safe surrounding. This way, the participants can take their time to answer, collectively nourishing a rich and well-thought dataset of answers. Furthermore, the chatbot will run on the course of a long time, more than a year. The chatbot is therefore also seen as a media to explore how to increase long-term engagement, which is generally challenging in Citizen Science projects.

During the design of the chatbot, special focus was put on the maximization of the privacy that participants and CoRes can be guaranteed, see Section 4.3.
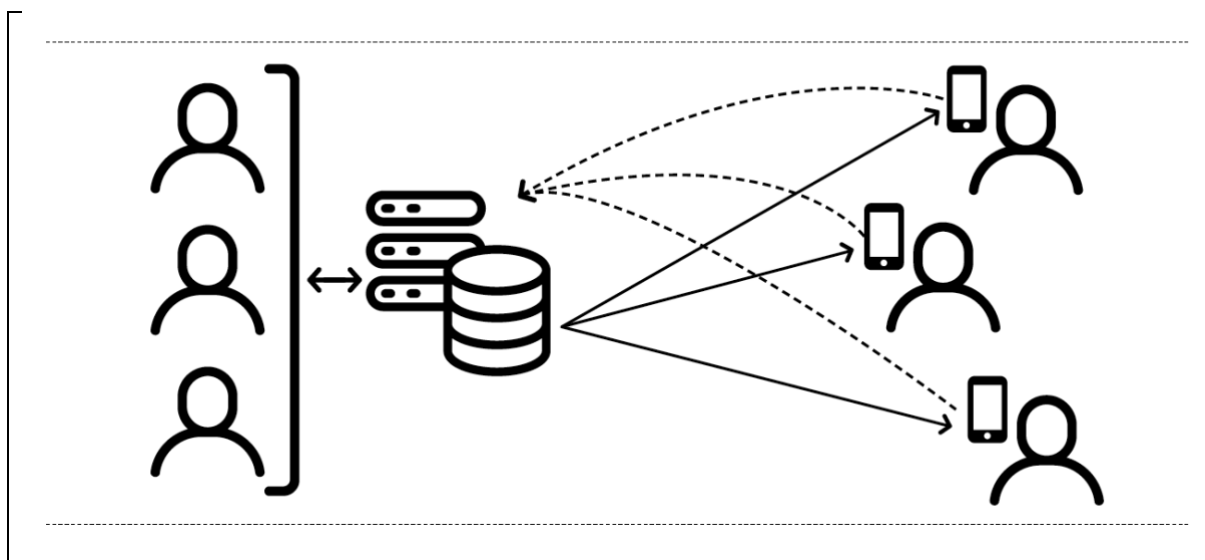
Figure 3: Human-written contents (left-side) sent from the "CoActuem per la Salut Mental" chatbot (centre) to the volunteering participants (right-side). Source: Research Diary.

The chatbot wants to measure structures and features of the mental health social support networks of the participants (in the code they are called "users" or "clients") of the chatbot. To this end, as described in section 2.3, the CoRe shared their experiences in form of microstories (in the code: "games"). The participants of the chatbot (Citizen Scientists, see section 2.3) are asked to relate to these stories, tell if they themselves or their surrounding have lived similar experiences or how they would act in the described situations. A private conversation with a chatbot ensures that participants can freely share their answers.

The chatbot was built with the experience from a former pilot project UrGENTestimar (UrGENTtolove, "gent" standing for people in Catalan). There, a chatbot was used to inform, invite, and prepare participants to join a presential experiment at a three-days fair, FiraTàrrega 2017, performed with a different application (Cigarini, A., Vicens, J. & Perelló, J., 2020).

The "CoActuem per la Salut Mental" chatbot makes a major leap from the pilot project:

- We expect to outnumber the participation in comparison to UrGENTestimar by a factor ten at least (in UrGENTestimar there where about 200 participants, in CoAct we aim for more than 1000 participants).

- The CoAct chatbot is prepared for a much longer duration (81 days vs. over a year). Also, the CoAct chatbot works mostly autonomous.

- The CoAct chatbot invested in languages: Additionally, to Catalan, Spanish, and English, all content of the chatbot is also available in German. Furthermore, the quality of the translations was improved by employing professional translators. In addition, special care was taken to use non-discriminatory gender-neutral language to avoid nurturing the social stigma of mental health and to address delicate issues such as suicide. The chatbot will be presented at international conferences and disseminated by EU and non-EU partners to diversify the sample represented in the dataset and to allow for a global analysis.

- The quality of the stories has improved in comparison to the rather simple dialogues in UrGENTestimar. This was achieved by investing more time and efforts into the both the writing and the editing process, including the expertise of a professional writer and of the FSMC. When performing data anlysis, we will also be able to use more sophisticate and more visual algorithms and techniques taken from Complex Systems Science and Computational Social Science.

- The participants' experience was improved by including illustrations, by emphasizing important keywords in bold or italic, and finally by making use of emoticons.

4.2 Co-Design Process

20

The co-design process of the Chatbot was divided in several phases and partially based on the use of the Research diary described in Section 3.

Phase 1: Co-creation of the Chatbot microstories

As described in Section 3.1, the CoRes participated to several co-creation sessions. Additionally, UB, FSMC, the professional writer and drawer and the session facilitator met in editorial board meetings, to discuss story by story in terms of linguistic correctness, clarity of expression, compatibility with technical requirements, and psychological dimension and context of the story, on the one hand to prepare the stories for the chatbot and on the other hand to improve the co-design process. If some modifications of the stories were proposed, the final versions of the stories were then validated by the CoRes via email.

Phase 2: Co-design of the Chatbot Features and Appearance

In M14 and M15, 2+4 online sessions of 90min each were dedicated to the co-design of the chatbot.

In the first 2 sessions, the current state of the chatbot was presented to the CoRes. As an introduction to the bot and as a preparatory exercise for later diffusion strategies, the questions "What is a chatbot? / What is the CoAct for Mental Health chatbot?" were discussed. In the second sessions, UB explained possible research questions (in preparation of T3.4) and shared preliminary results from a short internal micro-experiment with the chatbot, to give the CoRes a clearer picture of the type of data collected.

In the four following sessions, the CoRes were invited to criticize the visual representation of the chatbot, discuss its main functionalities as well as desirable features, and give feedback on formulations and design choices in the chatbot. To stimulate criticism, OS asked specifically for intuitiveness of the interaction, velocity of sending the messages, text clarity, and tone and content of messages. The CoRes could test the chatbot hands-on during the session and give their feedback either spontaneously in the video sessions or later via email.

At the same time, these sessions served as a first technical test with a larger number of participants.

During these 6 sessions, a detailed 7 pages/2600 words document of feedback from the CoRes was collected and implemented in the chatbot. The main changes that the CoRes recommended and their implementation in the bot are:

CoRes' recommendations	Implementation in the chatbot
Leave it to the participants to control the speed between messages, in total speed down between messages.	After at least every fourth message in each dialogue, there is a "Continue" button that invites participants to read the above message carefully, and that allows to advance when wanted.
Introduce emoticons, emphasize important word by setting them bold, more media in the welcome dialogue.	The recommendations were implemented. The welcome dialogue will be extended by an explanatory video that is now in production
Several specific improvements of formulations, especially putting much clearer certain information in the welcome dialogue and in the closing messages of the stories.	Implemented as proposed.
Delete co-answers in stories of type T (see Appendix A) that might feel as a judgement of the choice of the participant.	The co-answers were deleted from all stories of type T.

Table 3: Examples of changes to the chatbot design recommended by the CoRes and their implementation in the chatbot.

During the gradual launching of the bot that started with two inauguration sessions in M19, the CoRe are invited to give their feedback on the dynamics and functioning of the chatbot via email.

4.3 Tool description

The chatbot consists of a package of python3 code, publicly available under https://github.com/Chaotique/CoActuem_per_la_Salut_Mental_Chatbot. The code is connected to a Telegram API with name @CoActuem_bot. The code interacts with a mongoDB database that contains the stories on the one hand and the participants data (i.e., their answers to the chatbot and their hashed Telegram identifier, see below). From the participants point of view, the chatbot is a conversation partner within Telegram. It is made noticeably clear to the participants on various occasions that they do not interact with a human being but with a machine. For the participants, the chatbot looks the following way:

Figure 4: The text and logo that users see before starting a conversation with the bot, the bot description and logo, and the informed consent in PDF format, all available in four languages (lrtb).

The chatbot's management of which content it sends to whom does not rely on any Machine Learning or Artificial Intelligence methods (such as Natural Language Processing). To account for the delicacy of the topic of mental health, all contents were prepared before the start of the experiment. The contents are sent in form of short dialogues, about once a day.
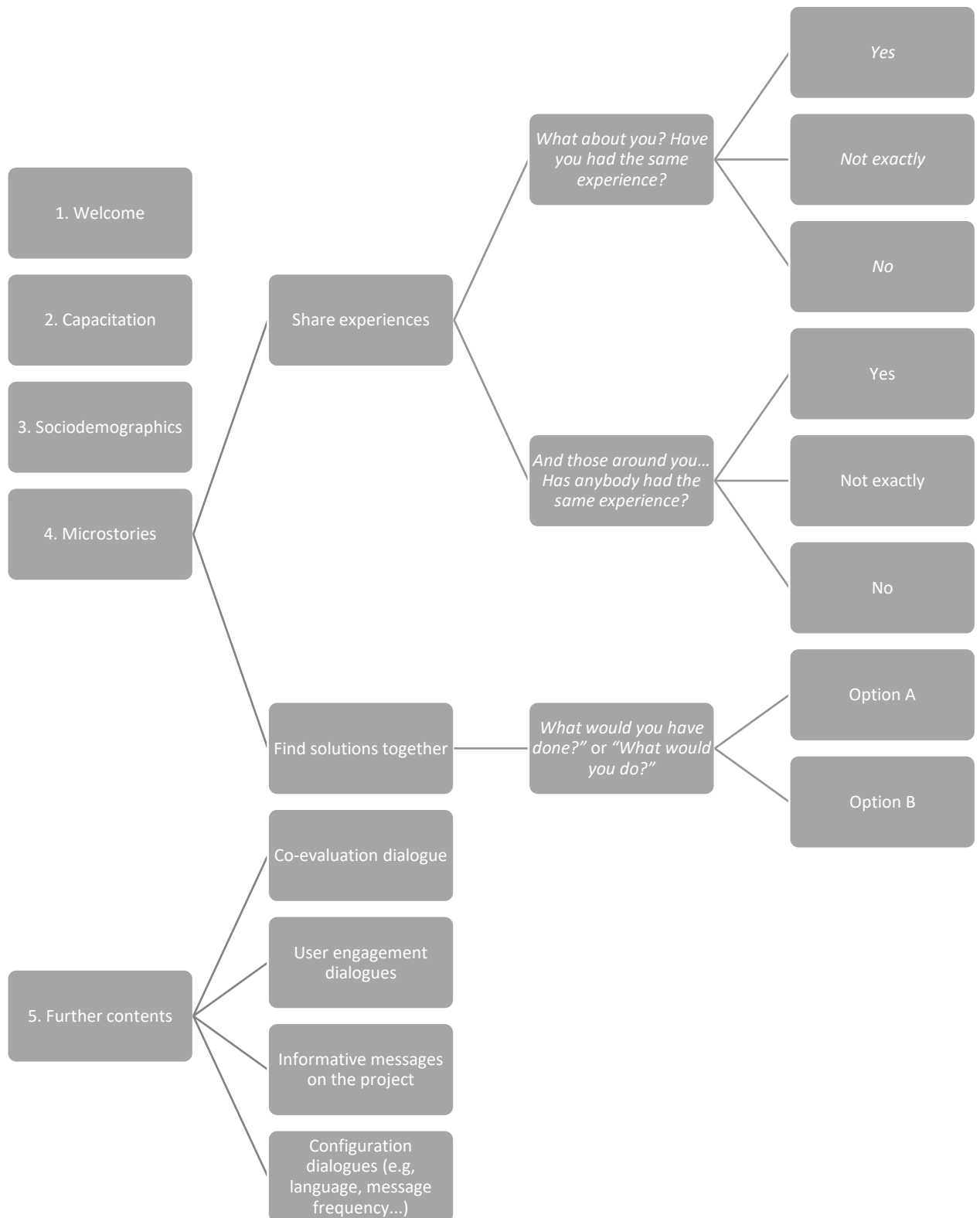
Figure 5: Sequence of content as it is sent to all participants: After a welcome-, capacitation, and sociodemographic dialogue, the participants obtain micro-stories in a fixed sequence,

alternated with information on the project, the experiment's progress and a co-evaluation dialogue.

Three introductory dialogues

The conversation between participant and chatbot is fixed for all participants, see Fig. 4. The conversation starts with a *welcome dialogue* that allows to choose one of four languages (Catalan, Spanish, English, German), explains purpose and context of the project, and asks the participants to give their informed consent to participate to the research.

The following dialogue is a *capacitation dialogue*, explaining with two examples, which type of interaction is asked from the participants.

The third interaction of participant and chatbot is the *sociodemographic survey* whose outcome will contrast the answers to the stories in the final data analysis. Participants are asked for their range of age and gender identity, country of residence and postal code. The second part of the survey asks for mental health problems of the participants and their surroundings, whether they act as informal caregivers, whether they are professionals related to mental health, or whether they participate(d) in an association in the field of mental health. Also, the degree of implication with the wellbeing of others or themselves is asked from the participants. Not any of the questions in the sociodemographic survey is obligatory - there is always a button *"I cannot/don't want to answer."*
These three introductory dialogues and one example of a story are stored alongside the code in the github repository as examples.

Microstories

The microstories form the heart of the chatbot. They consist of short narratives of up to 400 characters that describe a situation or circumstances that were experienced by the CoRes in the context of mental health social support networks. The co-design process described in Section 4.3 resulted in 222 stories of two distinct types, type C, *"Compartir vivències"* ("share experiences", 128 stories) and type T, *"Trobar solucions junts"* ("find solutions together", 94

26

stories). Type C contains two questions that accompany each story: *"What about you? Have you had the same experience?"* and *"And those around you… Has anybody had the same experience?"*, respectively. Both can be answered with either *"Yes"*, *"Not exactly"*, or *"No"*. Type T contains only one binary decision with questions *"What would you have done?"* or *"What would you do?"*. The authors were allowed to provide more than two possible answers for each story of type T. Depending on whether they gave two, three, or four options, the story resulted in one, three, or six dialogues with the different possible combinations. The structure of each type is extremely rigid, meaning that each story results in a fixed set of messages that form one dialogue. The rigid format enables a rigorous data analysis in T3.4 of WP3. Each dialogue is stored in one json file in the story database collection *gamesInfo*, see Appendix A.
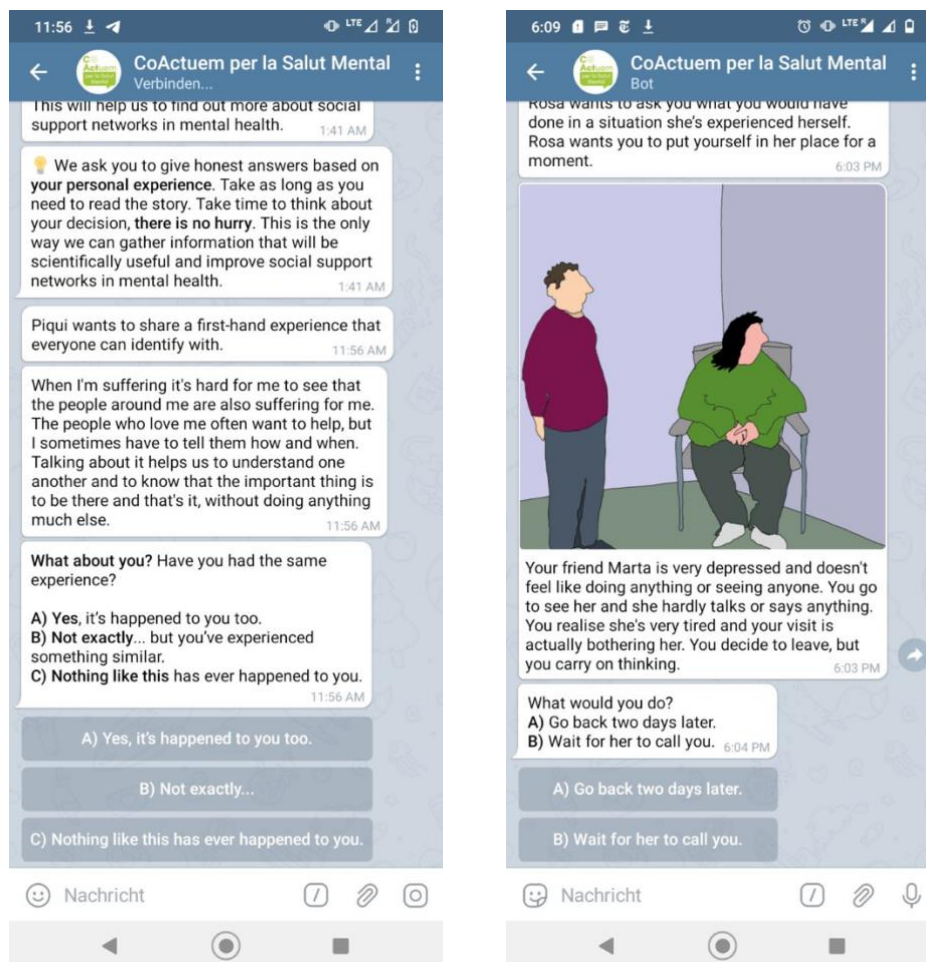

Figure 6: Examples of interactions with the chatbot during micro-stories C and T, respectively.

The 222 stories written by the CoRes are sent to all participants in the same fixed sequence. Former Citizen Science projects revealed a typical exponential decay of participation. We must expect that most participants will answer only few stories and few participants answer all stories, see Fig. 6. As we want to apply network theoretic methods on the gathered data, we need to ensure that a finite set of stories is answered by almost all participants (Newman, 2010).
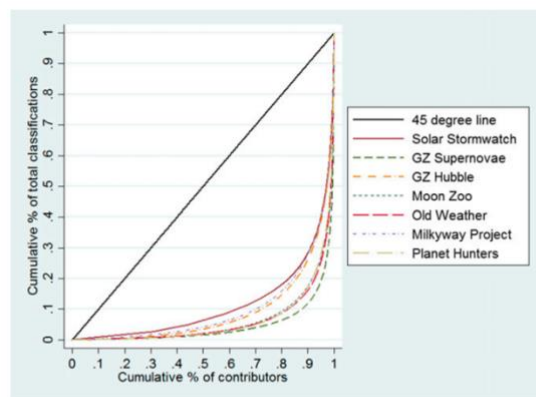

Fig. 3. Lorenz curves for the distribution of users' total classification counts in each project. The Lorenz curve indicates the cumulative share of classifications (y axis) made by a particular cumulative share of users (x axis). The stronger the curvature of the Lorenz curves, the stronger the inequality in contributions. For comparison, we also show the 45° line, which corresponds to total equality, i.e., all users contribute the same amount.

Figure 7: Few participants answer many questions while most participants answer only a few questions in digital citizen science projects (Source: Sauermann and Franzoni, 2015).

Further bot contents

Other than the microstories and the introductory dialogues, also dialogues on participants' engagement, informative messages on the project, and a co-evaluation dialogue that will be repeated several times during the year will be sent during the one-year experiment. Participants can also call configuration dialogues, to adapt the language or the story frequency.
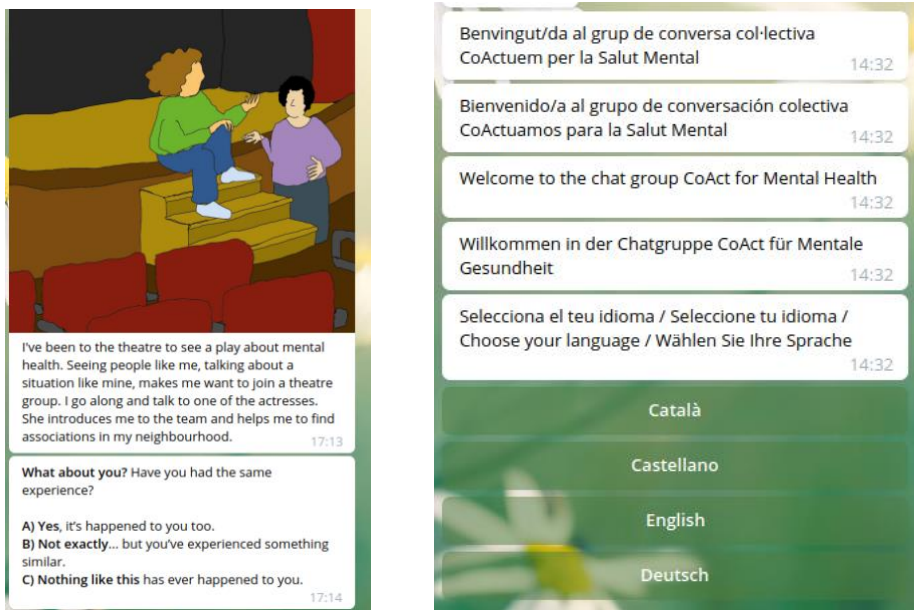
Figure 8: Example story and interaction via buttons to choose the language.

Digital tool uses

The tool can be used in two ways: The most direct form of usage is the participation in the experiment, i.e., by joining the "CoActuem per la Salut Mental" chatbot and by answering the stories. Beyond that, the openly available chatbot code can also be adapted to different contexts and be filled with different content for other participatory research projects.

4.4 Technical Setup of the Chatbot

The chatbot consists of an Open Source python3 code, written by OS, and a mongoDB database. The python3 code manages the conversations, interacting with the participants in Telegram and reading from/ storing on the database, see Fig. 8.

The program runs on a server of the Universitat de Barcelona inside the Catalan Universities Consortia cloud. The cloud-computing guarantees a high degree of cyber-security and is committed to the ethical standards of the Universitat de Barcelona. As result of a counselling interview with the Open Knowledge Foundation, the Telegram Identifier that the chatbot needs from the participants to be able to communicate with them, is stored apart of the research database and can be deleted with a single button after the end of the experiment.

The questions that we ask to the participants are limited to the very research purpose and the data protection matters have been advised and supervised by the Universitat de Barcelona Data Protection Office, while the project was approved by the Ethics Committee of the Universitat de Barcelona. For instance, we do not ask the exact age of the participants, but their age bracket. The scientific interest behind each question is explained to the participants, together with scientific references. The collected data does not allow us to identify the physical person that communicates with the chatbot.
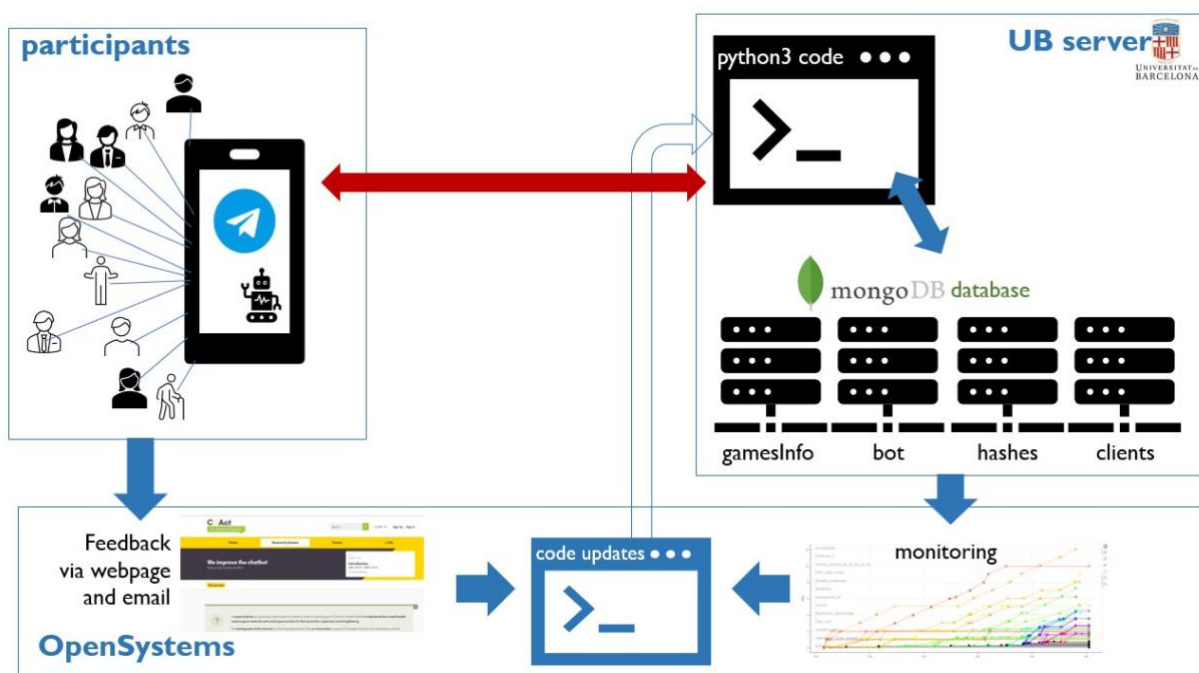
Figure 9: Schema of the interactions between python3 code running on the UB server and the participants, with monitoring and feedback loops by OS.

4.4.1 Data Base

The chatbot code interacts with a non-SQL database that works over json files, corresponding to python3 dictionaries, lists, and arrays.

The database on the one hand contains all information necessary for the functioning of the chatbot and other hand the experimental output, i.e., all answers given by the participants. The database consists of four major components (in mongoDB: collections):

- **gamesInfo**: Contains all 222 microstories, 17 informative texts, 12 user experience dialogues, 3 co-evaluation dialogues, welcome, capacitation, and sociodemografic dialogue, and the dialogues for chatbot configurations. Each dialogue is one item in the collection. Each dialogue has a name ("game ID") selected by the CoRe but not visible in the bot.

- **clients**: Each participant is represented by an item in this collection. Each item contains information on which stories the participant has already answered (so that no dialogue is sent twice), which answers the participant gave when (in all dialogues, including sociodemographic survey, all stories, all configuration dialogues a.s.f.), which story the participant is currently answering and which message he/she is currently at (to be able to send the following message). Further, there are 4 different status values 0, 1, 2, and 3 for "Informed Consent not yet given", "actively receiving content", "pausing", "permanently inactivated". The ending time of the last dialogue is stored to derive the resulting timing of the following dialogue. The ID of each participant is hashed, which allows to delete the personal data (the Telegram ID) with one click, while keeping all answers to the experiment.

- **hashes**: Under each hash, the according Telegram ID. This collection is only necessary during runtime of the bot and should be deleted after finishing the experiment to maximize the privacy of the chatbot.

- **bot**: Contains waiting and pending list with participant hashed ID, further the sequence of stories as they will be sent by the chatbot to all participants.

An instance of such database can be generated automatically with the python3 code given in manipulate_db/create_empty_db.py in the main folder of the github repository.

4.4.2 Code documentation and Open Source

The code of the chatbot is published under the GNU General Public License version 3 on https://github.com/Chaotique/CoActuem_per_la_Salut_Mental_Chatbot.

A README.md file and the requirements.txt file in the main folder give clear instructions on how to use the chatbot code as a toolkit. The python3 code is documented following the PEP 257 Docstring Conventions.

Telegram is a FOSS and anyone can use the application for free, write their own Telegram chatbot or use the code presented here without any financial effort.

4.4.3 Runtime, Monitoring, Backups, and Logging

Monitoring Bot Runtime

- The bot is run as a nohup job, with output stored in folder *log/*
- A cron job runs a script on the server every five minutes that checks whether the bot is running and stores this information in a log file. The same cronjob saves timestamp to the bot's error log, tries rerunning the bot and sends an alert mail, when it sees that the bot stopped.

Monitoring database current state

- A daily mail to the research team reports simple statistics like number of current participants and percentage of first persons in a short text plus table.
- A weekly mail plots the main temporal evolutions like how many female participants enter the bot, or how many of the male participants are caregivers.

Backups

Backups of the entire database are run once a week over ssh via mongodump.

The bot code and related files are regularly synchronized via git with the developer github repository.

5. Concluding remarks

The present deliverable describes, and analyses two complementary tools elaborated to co-design and conduct Citzen Social Science research.

The Research Diary, that can both be related to some other self-reporting tools in Natural Sciences (laboratory notebook) and in Social Sciences (field diary) proved to be an effective tool to motivate and engage the Co-Researchers. It also succeeded in transmitting a clear rationale for the R&I Action #1 and a clear protocol and guidelines for writing microstories.

The use of a tailor-made and tangible object for research co-creation, that was conducted exclusively through online sessions due to the pandemic, also evidenced that there are many ways to involve collectives potentially interested in taking an active role in a research. It also shows that mixing "pre-digital" tasks like hand-writing or drawing and the most innovative digital tasks like chatbot coding, can be enriching in all cases.

The successful use of the Research Diary thus clearly advocates for the inclusion of tailor made and creative tools in the research co-creation cycle, rather than one "fits for all" solution.

The Chatbot serves as experimental measuring device for the networks of social support in mental health. With help of the Research Diary, the chatbot has been filled with 222 microstories with the CoRes personal experiences in mental health. The CoRes were and are invited to co-design all components of the chatbot.

To our best knowledge, no chatbot has ever been co-created to perform a Citizen Science research. The Chatbot has been showing a strong potential to develop Citizen Social Science research and more particularly to innovate on how to run behavioural experiments that can be narrowed down to the concerns and research questions of the CoRes. Furthermore, an outstanding level of privacy can be ensured to both CoRes and participants.

The chatbot will run for one year starting mid-September 2021. A developing version already runs for final testing with the CoRes.

6. References

Cigarini, A., Bonhoure, I., Vicens, J., & Perelló, J. (2021). Public libraries embrace citizen science: strengths and challenges. Library & Information Science Research, 43(2).

https://doi.org/10.1016/j.lisr.2021.101090

Cigarini, A., Vicens, J. & Perelló, J. (2020). Gender-based pairings influence cooperative expectations and behaviours. Sci Rep 10, 1041.

https://doi.org/10.1038/s41598-020-57749-6

Cigarini, A., Vicens, J., Duch, J., Sánchez, A., & Perelló, J. (2018). Quantitative account of social interactions in a mental health care ecosystem: cooperation, trust and collective action. Scientific reports, 8(1), 1-9.

https://doi.org/10.1038/s41598-018-21900-1

Cigarini, A., Vicens, J., Duch, J., Sánchez, A., & Perelló, J. (2018b, February 28). Jocs x la Salut Mental: Resultats de la recerca amb Salut Mental Catalunya. Scientific reports. Zenodo. http://doi.org/10.5281/zenodo.1186978

Cocke, A. (2015). Comprender la Psicosis y la Esquizofrenia. British Clinical Society.

European Commission (2016). European Framework for Action on Mental Health and Wellbeing. EU Joint action on mental health and wellbeing. Final Conference - Brussels, 21 - 22 January 2016.

h2020-SC1-BHC-22-2019-framework-for-action_en.pdf (europa.eu)

Federació Salut Mental Catalunya i Activament Catalunya Associació (2017) Ús i priorització d'eines i recursos per a la recuperació i autogestió del benestar des de la 1a persona.

http://activatperlasalutmental.org/wp-content/uploads/2018/10/4.-Informe-de-lan%C3%A0lisi-quantitatiu_%C3%BAs-i-prioritzaci%C3%B3-deines.pdf

Federació Salut Mental Catalunya i Activament Catalunya Associació (2017). Conceptes i eines per a la recuperació i el benestar: significats i estratègies de les persones amb experiència de trastorn mental".

http://activatperlasalutmental.org/wp-content/uploads/2018/10/2.-Estudi-qualitatiu.-Conceptes-i-eines-per-la-recuperacio-i-benestar.pdf

Federació Salut Mental Catalunya i SPORA Consultoria Social (2017). Taules de Salut Mental. Indicadors de seguiment i avaluació

http://www.salutmental.org/wp-content/uploads/2017/10/indicadors-taules2017-web.pdf

Knapp M., McDaid D., Mossialos E. and Thornicroft G. (2007). Mental Healt Policy and Practice across Europe. The future direction of mental health care.

https://www.euro.who.int/__data/assets/pdf_file/0019/240346/E89814_overview.pdf

Mental Health Europe (2008). From exclusion to inclusion – The way forward to promoting social inclusion of people with mental health problems. Brief report translated by Merton, R. and Bateman, J. Social inclusion, its importance to mental health (2007). Mental Health Coordinating Council

https://www.mhcc.org.au/wp-content/uploads/2018/05/mhcc-social-inclusion.pdf

Newman, M., Networks: An Introduction, Oxford University Press Inc., New York (2010).

Pernice-Duca, F. (2010). Family Network suport and Mental Health Recovery. Journal of Marital and Family Therapy.

10.1111/j.1752-0606.2009.00182.x

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

Senabre, E., Ferran-Ferrer, N., & Perelló, J. (2018). Participatory design of citizen science experiments. *Comunicar. Media Education Research Journal*, *26*(1).

https://doi.org/10.3916/C54-2018-03

Vicens, J., Perelló, J. & Duch, J. (2018). Citizen Social Lab: A digital platform for human behavior experimentation within a citizen science framework. Plos One. 13, e0207219.

https://doi.org/10.1371/journal.pone.0207219

7. Appendix

Structure of the story json files

To give a clearer impression on the nature of the interaction dialogues, we now explain their structure in detail.

The json files of a story dialogue contain in the outermost object:

- ["_id"] unique ID for each story, not visible in the bot
- ["initial_messages"] the message ID of the message to start with (here "1")
- ["points"], gamification element, currently not in use in the bot
- ["title"] the dialogue type (here "compartir_vivencias" or "encontrar_soluciones_juntos")
- ["messages"] a json object with all the messages.

The json object behind key "messages" has message IDs as keys, and a message object with the following entries as values:

- ["type"] either NA, SA, WA, or CA standing for no answer, select answer, wait for answer (of another participant, currently not in use) and compare answer (with answer of another participant), respectively
- ["text"] either an object with languages ("ca" Catalan, "es" Spanish, "en" English, "de" German) as keys and message text in html format as values; or simply a string - in this case the chatbot defaults to Catalan
- ["vars"] is a list with only one entry for historical reasons. It needs to be present in messages of type SA, WA, and CA and can be present in NA. The entry itself is an object with the following entries:
- ["name"] ID under which possible answer is stored
- ["type"] "button"
- ["texts"] list of objects with button texts in 4 languages (or list of strings, then defaults to Catalan), each list entry fills one button

- ["values"] list of same length and order as "texts": short ID for each answer, as will be stored by the chatbot stored together with "name" in the *clients* database collection
- ["wait"] either null or integer of seconds the chatbot shall wait before sending the next message
- ["next"] either string (then gives message ID of message to be sent), or object that allows to send different next messages depending on the answers of the participant in the current or former messages.

The structure is the following, for story types C and T:

message ID/ answer ID	Type C	Type T
"1"	Greeting	Greeting
"recurso"	Links and Contacts of Support	Links and Contacts of Support
"1b"	Announcement Type C	Announcement Type T
"2"	Explanation Type C ◉	Explanation Type T ◉
"3"	Introduction to author (pseudonym) type C ◉	Introduction to author (pseudonym) type T ◉
"4"	Story + Illustration ◉	Story + Illustration ◉
"5_yo" - "13_yo" / "yo_1", "yo_2", "yo_3"	"What about you? Have you had the same experience?" + validation loop	-
"5_otro" - "13_otro"/ "otro_1", "otro_2", "otro_3"	"And those around you… Has anybody had the same experience?" + validation loop	-

"5" - "13"/ "x_1", "x_2", "x_2"	-	"What would you have done"/ "What would you do" + validation loop
"14_A", "14_B"	-	Answer from author to participant if answer was A/B, respectively
"14" (C) / "15" (T)	closing acknowledgements	closing acknowledgements

The message "recurso" appears in 33 stories of either type C or T, for stories that have been categorized by the FSMC as probably impacting on the participants of the bot. The recurso (= resource) message provides links and contacts of help resources in different countries.

The blue button ◉ means that there appears a button "Continue" below the message that allows the user to control the speed of receiving messages.

92 stories come with a .jpg with an illustration, created by Pau Badia. The files need to be stored in the correct relative path from the pipeline in order to appear in the json. Later they need to be stored in a folder accessible to the bot that sends these stories.

After testing messages of type "14_A" and "14_B" in the bot together with the CoRe, CoRe, OS, and FSMC agreed that such type of answer might feel as a judgement of the choice of the participant. The json file therefore contains the order to skip these messages by directing from the former messages 13_A/13_B directly to the closing message. This way, the feature can easily be reactivated for other purposes.

The three blocks ("5_yo" - "13_yo", "5_otro" - "13_otro", and "5" - "13") all have the same structure. We show below for "5_yo" - "13_yo". The message block has the function of asking a central question and validating the participants choice.

message ID	Function message

/ answer ID		
"5_yo"/ "yo_1"		Question ("What about you? Have you had the same experience?") + 3 options ("Yes", "Not exactly", or "No") called A, B, and C
If A	"6A_yo"	You chose A.
If B	"6B_yo"	You chose B.
If C	"6C_yo"	You chose C.
"7_yo"/ "v_yo_1"		Is this what you wanted to choose? + options Yes/No
If Yes	"13_yo_1"	Your answer has been saved.
If No	"8_yo"/ "yo_2"	What do you want to choose? + 3 options ("Yes", "Not exactly", or "No") = A, B, and C
If A	"9A_yo"	You chose A.
If B	"9B_yo"	You chose B.
If C	"9C_yo"	You chose C.
"10_yo"/ "v_yo_2"		Is this what you wanted to choose? + options Yes/No
If Yes	"13_yo_2"	Your answer has been saved.
If No	"11_yo"/ "yo_3"	What do you want to choose? + 3 options ("Yes", "Not exactly", or "No") = A, B, and C

If A	"12A_yo"	You chose A.
If B	"12B_yo"	You chose B.
If C	"12C_yo"	You chose C.
"13_yo_3"		Your answer has been saved.