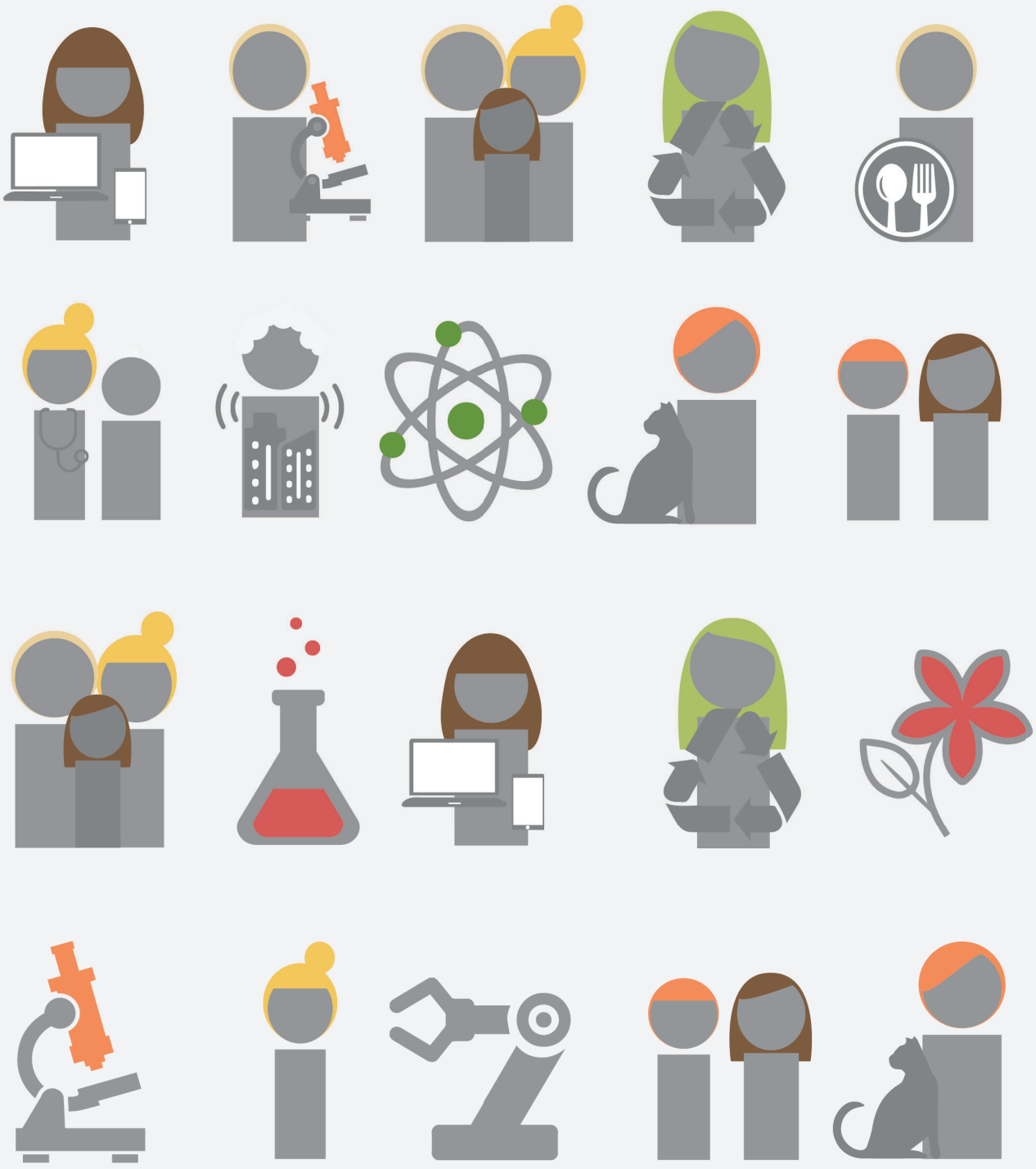
CITIZEN SCIENCE TALENT PROGRAMME 2022



SDU

SDU CITIZEN SCIENCE TALENT PROGRAMME 2022

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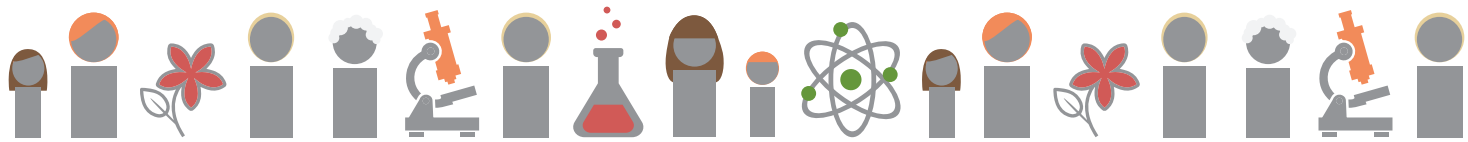

The 2022 Talent Programme on Citizen Science

The papers in this publication are the results of the second talent programme on citizen science at the University of Southern Denmark. In 2022, 25 graduate students completed the 20-ECTS programme in the Spring semester, and 7 completed the 10-ECTS follow-up with individual research.

The 25 students are selected for the programme based on their scientific proficiency, urge to experiment, drive to take initiative, communicative skill, and social engagement. The students work in small teams of three to develop citizen science pilot projects for research challenges proposed by proactive science advisors across all faculties (natural sciences, engineering, health sciences, social sciences, and humanities). The teams are cross-disciplinary, typically with one member representing the scientific discipline, and the other two from complimenting fields, like design and communication. While some, but not all, of the science advisors have prior experience with engaging citizens in research, it becomes the part of the challenge for the students to argue to their advisors how citizen science is beneficial to the scientific endeavour, much like they will need to do in their future career.

The programme is based on experiential learning in live citizen science projects, which the students establish from the ground up through the semester-long programme. We organise master classes, workshops, a summer school, and individual coaching sessions, but most of the learning happens in the teamwork of designing and organizing citizen science activities. The students need to recruit citizens interested in their project, to engage them with methods of gathering and analysing data, and to write up results in scientific writing. The booklet includes all 8 team papers.

In the 10-ECTS follow-up programme, students are free to choose their own research path. Some continue their first project, some pilot a new research idea, some investigate methods issues within citizen science. The booklet includes an example of each of these approaches.

We are indebted to the international experts, professors, and science advisors, who helped make the talent programme a success:

Professor Muki Haklay, University College London	Extreme Citizen Science
CEO Thomas Landrain, Just One Giant Lab	Citizen Science Platforms
Director of research Bastian Greshake Tzovaras, Open Humans	Citizen Science Platforms
Associate professor Kristian Hvidtfelt Nielsen, Aarhus University	The Science of Citizen Science
City archivist Lene Wul, Kolding Municipality	Engaging Citizens in Data Analysis

Citizen Science Center Zürich:

Managing director Rosy Mondardini	CS and the Sustainable Development Goals
Community manager Ursina Roffler	Community Management
Developer Andres Felipe Dorado Dorado	Citizen Science Tools

Citizen Cyberlab in Geneva:

Professor Francois Grey	SGD Solution Space
Senior lecturer Jose Luis Fernandez-Marquez	Citizen Science GEAR Methodology
PhD candidate Amudha Ravi Shankar	Open Data

University of Southern Denmark:

Head of office, Anne Kathrine Overgaard, Health Sciences	The Citizen Science Knowledge Centre
Research librarian Lotte Thing Rasmussen, University Library	CS Communication & Social Media
Souschef Thomas Kaarsted University Library	Stakeholder Mapping and Cases of Citizen Science
Associate professor Lars Breum Christiansen, Sports Science	Community Development
Associate professor Henry Larsen & SDU Theatre Lab	Complex Responsive Processes of Relating
Lecturer Ralf Andersson, Journalism	Media and Society
Lab director Flemming Thøisen & Marcus Ronalds, SDU MakerLab	Do-It-Yourself instruments
Associate professor Sara Egemose, Biology	Analysing Hard Data
Associate professor Leena Eklund Karlsson, Public Health	Analysing Soft Data
Associate professor Yingkui Yang, Environmental Economics	Scientific Writing Traditions
Professor Kerstin Fischer, Human-Robot Interaction	Scientific Writing Traditions
Professor Jacob Buur, Participatory Design	Ethnographic Studies & CoDesign

As part of the programme, we organised a study trip to the Citizen Science Center Zürich and the Citizen Cyberlab in Geneva, and we joined the European Citizen Science Association Conference 2022 in Berlin to further get a feel for the Citizen Science practices in various science traditions.

We hope you will enjoy reading the papers as much as we enjoyed developing the talent programme with the participants!

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DOES AI DREAM OF TRUSTWORTHY SCHEDULES?

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ABSTRACT

The process of creating schedules or timetables is often complicated and time consuming. This is for example the case of large institutions, e.g. universities, schools, or hospitals, where schedulers deal with large quantities of data, or with fast-paced environments, e.g. the service and hospitality industry, that necessitate speed and flexibility. This paper seeks to investigate the possibility of artificial intelligence (AI) as a tool to help schedulers in their duty. The study was carried out through a combination of Citizen Science, Value Sensitive Design (VSD) using interviews, a workshop, and a survey to investigate which values an AI-based scheduling aid should embody for it to be trusted, chosen, and useful to the people that interact with it.
It is concluded that scheduling is a social activity highly dependent on the context of the work environment. As such, the design of any AI-based scheduling aid should be mindful of both the human component and the context of use.

KEYWORDS:

Citizen Science.
AI; VSD; Socio technical Studies;
Timetabling;
Scheduling

INTRODUCTION

This project deals with the use of Artificial Intelligence (AI) in the context of creating timetables and schedules. The creation of schedules and timetables is a very common occurrence in many work environments and often constitutes one of the sources of revenue of the people in charge of it. Introducing a technology such as AI in these environments has the potential of affecting both the people making the schedule and those receiving it, as they are both bound to interact with it at some point in the schedule or timetable creation process. Understanding the possible intricacies resulting from this interaction is thus vital for this project. Human–Computer Interaction is a wide- and far-reaching field which investigates the questions of how to integrate technology into everyday life. Central concerns of the field are ethics, knowledge, and values. There is a thin line that separates useful and harmful technologies. Technological innovations can make the workers' life easy, but at the same time, if not well thought out, they may result in loss of job positions and general hardship for workers who are rendered obsolete by it, as well as misunderstanding and delays (see Cawthorne & Devos, 2020). As such, the purpose of this paper is to provide the foundational blocks for future studies that will involve citizens, in particular direct stakeholders such as schedulers and schedulees (a term we coined indicating those who receive the schedules) in the co-creation and testing of possible AI-based scheduling aids.
This paper is a pilot study, and therefore it is only concerned with identifying which values, characteristics and features are most important for both schedulers and schedulees, and not with the actual co-creation. Our starting assumption is that a profitable working relationship between both schedulers and schedulees is based on mutual trust on each other's intentions and work-ethics. Consequently, our aim is to understand which characteristics an AI-based aid should embody for it to be trusted by, chosen by, and useful to those who interact with it. Therefore, we seek to answer the following research questions:

- Which values, characteristics, and features make a good scheduler, according to the direct stakeholders?
- And which, if any, can be implemented in an AI-based helper to make it trustful, useful, and valuable?

THEORY

Citizen Science

Citizen Science is a discipline based on the involvement of citizens into the formulation, investigation, and resolution of scientific problems (Hecker, et al., 2018). Despite its extended use in various fields, however, there is no concise way to define what Citizen Science is (Riesch, 2015). As such, for the purpose of this project, we intend Citizen Science as a way for citizens and researchers to collectively (re)develop research questions and hypotheses and collect data. Within Citizen Science, there are many conventions used to indicate the level of participation, the type of interaction between citizens and researchers, and the type of project one is presenting. In our case, we have used the Golumbric scale on the building blocks of Citizen Science (Golumbric et al., 2017), the Bonney scale on project description (Bonney et al., 2009a), and the Haklay scale on citizen involvement (Haklay, 2013).

According to Golumbric, there are three fundamental aspects of Citizen Science: *Inclusion, Contribution,* and *Reciprocality*. *Inclusion* deals with the activities built for public participation by the researchers. *Contribution* is twofold and looks at how the project contributes to science, and at the same time how it impacts the public. Lastly, *Reciprocality* looks at what the citizens and the researchers can do for each other in the context of knowledge elicitation and dissemination (Golumbric et al., 2017).
The next scale, instead, looks at the different types of projects that exist in the context of Citizen Science. According to Bonney, Citizen Science projects can be of various natures: Some are *contributory*, where both the research question and the protocols are established by the researchers with little to no input by the citizens. Some are *collaborative* and presuppose a larger involvement of the citizens in the creation of the project and its protocols. Lastly, some are *co-created*, meaning that the project is created via collaboration of the citizens and scientists (Bonney et al., 2009a).
Finally, according to Haklay, the level of involvement of the citizens in this discipline can be varied and is often measured upon a four-level scale. All levels imply voluntary participation, beginning from level one (Crowdsourcing) where the citizens act as sensors, moving up to level two (Distributed Intelligence) where citizens act as basic interpreters, level three (Participatory Science) where citizens participate in the problem definition and the data collection process, and the fourth level (Extreme) where the citizens partake in collaborative science (that is all the tasks from previous levels) (Haklay, 2013).

Citizen Communities

As the body of data to gather and analyse in Citizen Science projects is often substantial, and studies are carried out over large periods of time, it is very common to witness the creation of citizens communities. These communities are therefore created and maintained in time to allow for a space in which likeminded citizens who feel a greater inclination to participate, can discuss, interact among themselves and with the researchers, and learn more about the topic (Land-Zandstra, Agnello & Gültekin, 2021). The participants thereby gain the opportunity to acquire expertise on the field and disseminate their newly acquired knowledge enriching the scientific literacy of the community (Land-Zandstra, Agnello & Gültekin, 2021).

Artificial Intelligence (AI)

This project revolves heavily around AI, it is therefore now necessary to introduce what AI is. According to the European Commission's Communication on AI, the following definition applies: "Artificial intelligence (AI) refers to systems that display intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve specific goals." (European Commission, 2019). In the context of this project, we define AI as algorithms using the *machine reasoning approach* (European Commission, 2019) to produce a reasonable schedule by attempting to minimise potential scheduling conflicts, usage of bad timeslots, and other factors while at the same time storing large quantities of data. Specifically, we will be looking into trustworthy AI, that is defined by the European Commission as based upon seven fundamental principles: (1) Human Agency and Oversight, (2) Technical Robustness and Safety, (2) Privacy and Data Governance, (4) Transparency, (5) Diversity, Non-Discrimination, and Fairness, (6) Societal and Environmental Eell-Eeing, and (7) Accountability (European Commission, 2019).

Value Sensitive Design

As the purpose of this paper was to gain insights on which values, characteristics, and features should be imbued in an AI-based scheduling helper, the project group decided to combine Citizen Science with Value Sensitive Design (VSD), to get to the bottom of the question.
VSD is a tripartite iterative methodology aimed at taking into consideration values and ethical questions that must inform the design of technologies (see Friedman et al., 2013, and Umbrello & van de Poel, 2021). The three iterative phases, *conceptual*, *empirical,* and *technological* are usually described as follows. The *conceptual investigation phase* deals with the investigation of the direct stakeholders, the context of use, and the theoretical investigation of the values. The *empirical investigation phase* uses quantitative and qualitative methods to investigate the values expressed by the direct stakeholders in the context of use, and more in general the human context in which the technology is (or will be) situated. Lastly, the *technical investigation phase* looks into the technologies themselves and in designing them in accordance with the values individuated in the *conceptual and empirical investigations* (see Friedman et al., 2013).
Due to the theoretical nature of our research, we have chosen to focus on the conceptual-empirical investigations. Herein the citizens were called upon to help the researchers individuate values and features that should be incorporated in the design of the tool.
A question that is of particular importance when dealing with VSD is 'whose values'. Indeed, there is much debate revolving around whose values are being imbued in the design of a technology, those of the designers, of all the stakeholders, or only the direct stakeholders (See Flanagan et. al., 2005). Similarly, another debated issue is the question of the non-universal, contextual nature of values. For example, an article by Alsheik regarding long distance dating in Arabic countries, raised the issue of the concept of privacy being intended differently in the Arabic context than in the western one (Alsheik et al., 2011). As such, for this paper, we will be looking at values expressed by the direct stakeholders (schedulers and schedulees) working in Europe at the time of the project.
Other approaches, such as User-centred design especially in the form of participatory design (see Spinuzzi, 2005;

Buur J. & Binder T., 2006), should be taken into consideration as frameworks for further iterations of the project, aimed at involving the citizens in the design of the tool.

METHODS

Interviews

The interviews were planned as relatively unstructured interviews (here onwards called semi-structured), that is a type of interview where a guiding set of questions is asked without any particular script or timeframe (Martin & Hanington, 2012). We chose semi-structured interviews over structured ones to allow for a more natural flow and flexible detours, as opposed to the more rigid framework typical of structured interviews. We agreed that following the natural flow of the conversation, while still asking the intended questions, would yield more authentic and well-thought-out replies. Through this process we focused on asking a number of questions dealing mainly with the preferred scheduling tool, scheduling preferences and techniques, attitudes towards technology in the context of scheduling, and finally issues and pain points of this task. The interviews were held in places of choice of the interviewees to allow for a more relaxed and enjoyable experience. The aim of these interviews was to understand the direct stakeholders and the context of scheduling.

Workshop

The workshop was planned using the role-playing technique which consists of presenting the participants with a role to take over in a realistic scenario (Martin & Hanington, 2012). We used the data gathered from the interviews to inform the structure of the workshop, and our approach. For example, after learning that most of the interviewees understood scheduling as a logic game, equating it to games such as puzzles, Sudoku, and Tetris, we structured the exercises of the workshop as "scheduling puzzles", partly inspired by the idea of those games and the board game Monopoly. We asked the participants to imagine that they were managers in a company and that they were in charge of scheduling for a fictitious (but realistic) group of people working in a call centre. Each worker had to have a certain number of shifts, all shifts from Monday to Friday had to be covered, and all the requests from the participants had to be respected as much as possible. We further created descriptive profiles for said fictitious employees, using stock pictures and inventing realistic information about their personal life, hobbies, and constraints. This was done to attempt to make the scheduling work less impersonal, and because we theorized that some of the personal elements from the profiles might become deciding factors during the conflict solving portion of the exercise.
At each level, the schedulers had to deal with more complicated scenarios, including unforeseen circumstances inspired by the chance cards from Monopoly. The last exercise was created to allow for at least one or two overlaps between the workers requests to gather insights about how schedulers prioritise requests (i.e., who or what takes precedence and why?). The participants were asked to explain their thought process to the researchers and the rest of the group, with the intention of sparking useful discussion about different techniques.

Survey

Once interviews and workshops helped the project group find a clearer direction for the project, it was time to collect data specific to the research questions we set out to answer.
This part was specifically hard, as we needed to contact a large number of interviewees belonging to a specific group of citizens (schedulers and schedulees) living in Denmark, preferably between the cities of Aarhus, Odense, and Kolding, and interested in contributing to our project. We initially toyed with the idea of a workshop, but soon realised that the constraints, especially in the summer months, made it impossible to find a sufficient number of citizens willing to join us, despite tailored calls to action. We then decided to remove the location constraints and chose to appeal to existing international communities that worked with scheduling and had an interest in Citizen Science. As such, we turned to Reddit, and cross posted a discussion topic in subreddits inhabited by citizen scientists and schedulers. However, due to us never having posted on the site before, our account was a complete outsider to the communities and thus had little opportunity to garner the interests of the redditors.
To solve the issue, the project group settled on creating a branched survey with a line of questions specific for schedulers, one for schedulees, and then a common set of questions (Martin & Hanington, 2012). The survey was structured as a series of closed questions, aimed at collecting quantitative data, and open-ended questions, aimed at discussing the previous replies, as well as topics such as values, characteristics, and potential features they might find desirable in an AI-based aid. While the survey did not allow for internal discussion, it was still able to reach a larger number of citizens mostly based in Europe and spark their interest in the project. An example of this were some aspiring citizen scientists contacting one project member to ask for more information about whether the tool will be prototyped and whether citizens will be involved in that process.

DATA

This section analyses the data collected during the project, beginning with the preliminary data provided by interviews and the workshop, and moving onto the more substantial data provided by the survey.

Citizens Profiles

By the time of the survey, the project had already gone through several reworkings. Thus, we deem it necessary to take a moment to discuss who the citizens were that

volunteered their time for our project, and what changed in each phase.
At the beginning of our project, we initially aimed to look only at university and school staff that dealt with timetabling. This soon revealed itself to be a complicated project, firstly due to the smaller pool of citizens that lessened our chances to find willing volunteers, and secondly because of our general lack of contacts and networks in these fields. Following these considerations, we then chose to expand our pool of candidates to schedulers in general. As such, the interviews and initial workshop involved a wide array of people coming from different fields. The results of these interactions, however, revealed that the opinions of the schedulees were also necessary for our research, as they are the ones appointing the trust. Therefore, the data collected in the survey include opinions from schedulers and schedulees. The responses from the groups were kept separated and then compared with each other to find a common ground. This common ground was particularly important in providing insights about which characteristics should be included in the tool as a baseline and which should be specific for interfaces made for schedulers/schedulees.

Preliminary Data

Through the use of semi-structured interviews, we were able to collect qualitative data regarding especially scheduling program choices, attitudes to technology, and scheduling issues.
Out of six interviewed, two people were working for larger organisations (university, hospital) which mandated the scheduling programme used. Three were working for smaller organisations (e-commerce, service) and had freedom of choice over which programme to use. One stated that their scheduling was done manually, without the use of any program.
In terms of attitude towards technology, five out of six interviewees stated their mistrust towards AI as a potential scheduling aid. The reasons listed were different in nature: one of the citizens stated that the exercise of scheduling was an excellent training exercise for logic in their field. Two more stated that scheduling was a substantial part of their hourly income, and they feared that a machine would take that away. One argued that they feared integrating complex technology would put further stress in their already stressful career, and another argued for the superiority of human instincts and common sense when dealing with social situations such as scheduling. All five of them, however, admitted to general ignorance towards what AI is, and were basing their replies on assumptions. In general, they equated all AI's with their previous exposure to AI. Some envisioned it as being like a chatbot on a website, others as analytics algorithms seen on social media.
Out of the interviewees, all of those who made schedules for themselves and their colleagues reported a higher level of stress and anxiety connected to the task, especially mentioning self-doubt and fear of being partial to colleagues they like better. This was a non-issue for those scheduling for external workers.
A common mention was the reference to scheduling as a logic puzzle or a logic exercise. Mentions were made of puzzle, Tetris, and Sudoku (Cf. Workshop).
Following the interviews, we set up a workshop partly influenced by the data collected from the previous interaction, e.g., scheduling as a logic game. Out of the original six participants, only two gave their availability, while a third participant was recruited externally.
From the workshop we were able to collect the following qualitative data:
Out of all participants, the two who were used to scheduling for their colleagues and themselves approached the task with a similar logic, placing the need of maintaining a positive work environment over efficiency. The one scheduling for external people, however, seemed to think less of the workers as individuals, not having to interact with them, but more like pieces of a puzzle to solve.
There was a consensus that the main objective was the overall satisfaction of the workers, as they are the ones for whom the schedule is made for. Furthermore, and most importantly, their trust of the decisions made by the schedulers was seen as the key for maintaining a healthy and harmonious work environment.
All three participants, furthermore, seemed to mostly approach the scheduling process through five similar tasks: (1) collection of availabilities / preference collection (e.g., vacations, special circumstances); (2) drafting of the schedule; (3) renegotiation of the schedule and problem-solving activities (contingent to the presence of overlaps or issues); (4) re-drafting of the schedule (contingent to the presence of overlaps or issues); (5) schedule execution.
Finally, there was no consensus over ways to rank preferences, leading the researchers to think that there is not a one-size-fits-all solution that can be used to solve such a complicated issue, and the question of preference ranking, and elicitation is highly dependent on context.

Survey Data

A total of 28 citizens replied to our survey, of which 10 were schedulers and 18 were schedulees.
Regarding the quantitative data, the responses to the questions indicated a more positive attitude towards AI than previously expected stressing, however, that that trust was only dependent on having some degree of control over the AI's decisions. For example, almost half of our respondents in both categories stated that they would not feel comfortable either handing out or following a schedule made exclusively by AI. However, if the schedule was made by an AI and checked by a human hand, or vice versa, they would feel comfortable with it.

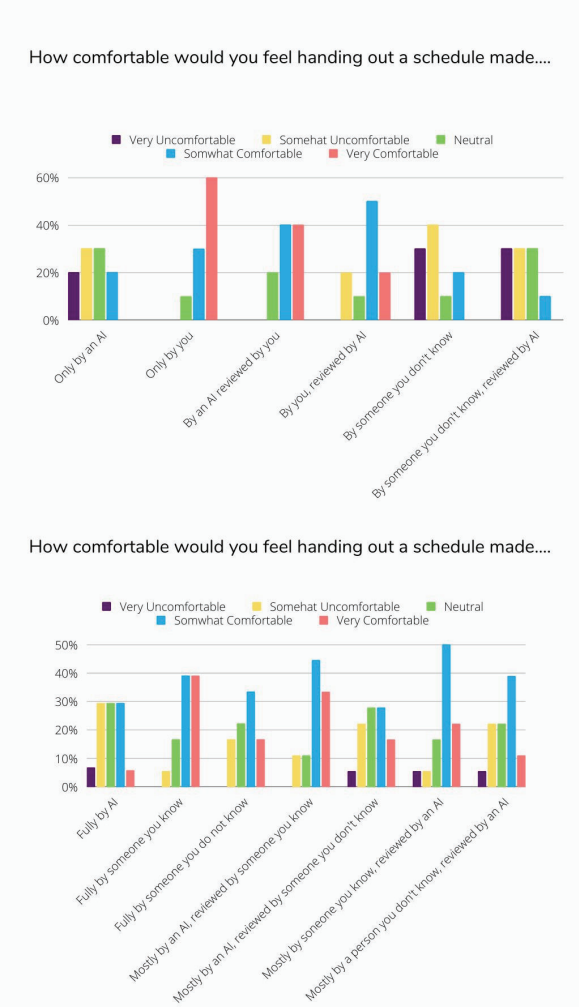

Figure 1: Illustrating data regarding the level of comfort with handing out or receiving schedules made without, partially with, or fully with AI according to the schedulers (top) and schedulees (bottom).

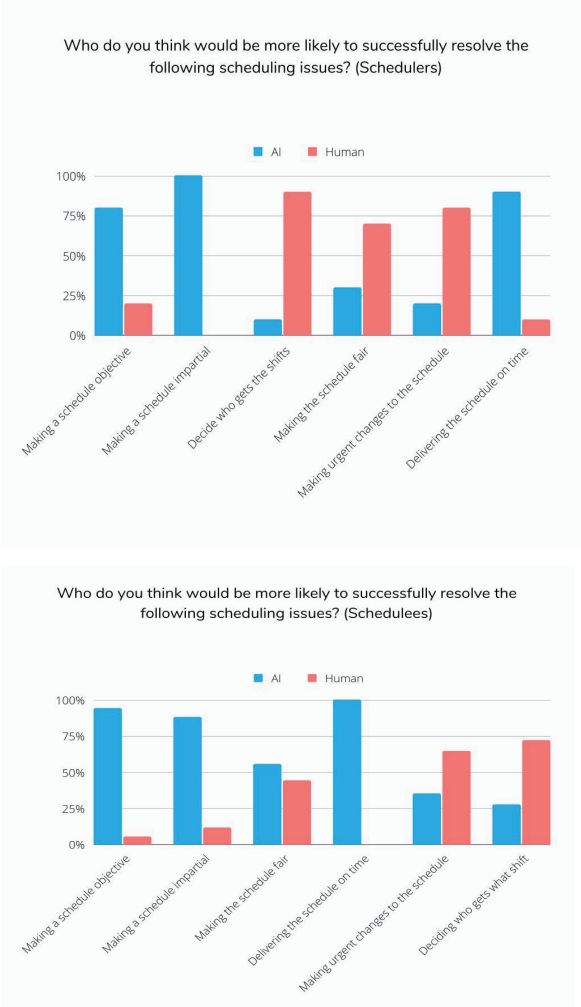

Figure 2: Illustrating which tasks are more compatible with Artificial or Human Intelligence according to schedulers (top) and schedulees (bottom)

Furthermore, there is a stark contrast between which actions the users thought AI could perform better than a human and which the human could perform better than AI. According to both groups, aspects such as timelines of the schedule, impartiality, and objectivity were overwhelmingly in favour of AI. Whereas aspects such as negotiation with the schedulees, fairness, and ability to make urgent changes were in favour of the humans, see figure 2. While impartiality refers to not being biased, fairness represents being just or playing according to the rulebook. Moreover, it has been observed that some respondents interpreted "fairness" as a more human characteristic in comparison to "impartiality".

In the questions made exclusively for the schedulers, we asked in which area of scheduling they would feel comfortable with the involvement of AI. Despite what we initially gathered from comments in the interviews and workshop, only 4 out of 10 people would feel comfortable using AI to check for mistakes. On the other hand, 8 out of 10 of our respondents would feel comfortable using an AI-based scheduling helper to aid in the storing of the preferences and to supply them with suggestions on how to optimise the schedule. Furthermore, 4 out of 10 responded that they would be interested in using the tool to help them rank the preferences, see figure 3.

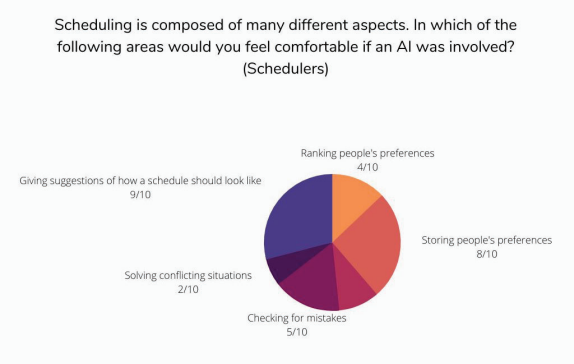

Figure 3: Illustrating in which tasks the schedulers would feel comfortable with the involvement of AI.

The open-ended questions comprised the majority of our qualitative data in both dedicated survey branches. The schedulers were asked to discuss questions such as values, features, and characteristics of an AI-based scheduling aid, while the schedulees were asked to give their opinion on subjects such as trust and how comfortable they would feel having an AI make decisions about them. Both groups were then asked to express their opinion on what spoke for and against the involvement of AI in the context of scheduling.

To analyse the replies and gather the data, each question was broken down and each remark of the respondents was written on a post-it and placed on a whiteboard dedicated to either schedulers or schedulees. We put emphasis on keeping the remarks untouched at this time. Once the post-its were placed on the whiteboards, the replies were analysed again. To not misinterpret any reply, the replies of the individual participants on the other questions were taken into consideration when doing the analysis. This time we created thematic clusters of answers using the individual post-its created earlier. Once the clusters were finished, we then created descriptive labels representative of their content. This allowed clear patterns to emerge from the answers. The bigger the clusters, the more relevant the category became.

Figure 4: Illustrating clustering during the qualitative data analysis.

From the analysed data it emerged that for both groups, values such as human agency, technical robustness and safety, transparency, societal and environmental well-being, and accountability are seen as pivotal to scheduling. Aspects such as a good work environment trump efficiency. Values such as Privacy and Data Security, and Diversity and Non-Discrimination were not mentioned with regard to AI. However, the question of fairness was prominently discussed by the participants with many responses questioning the definition of fairness. For example, one of our respondents wondered "what is even fair?". In terms of the features a good AI aid should embody, again, the robustness of the program, i.e. the program being well coded, possibility of human agency, i.e. overriding the program, transparency in the decision-making process, and customizability were the most mentioned factors. Factors such bias avoidance, and low possibility of errors were also deemed important. One reply raised the question of sorting out liability issues. Some replies also seemed to call for features aimed at work-life balance (such as features to show the amount of work done by an employee, vacation distribution, time off, etc.). These findings can be seen in table 1.

Table 1: The values, features, and characteristics an AI tool should embody according to the direct stakeholders

Values/Features/Characteristics	Mentions out of 28
Speed	12
Transparency	7
Streamlining the workload (Efficiency)	5
Technical robustness	5
Human agency - overriding features -	4
Features dealing with work-life balance	4
Customisability	2
Bias avoidance	2
Low possibility of errors	1
Ease of use	1
Accountability	1

To the question of what would make a good scheduler according to the schedulers, the following characteristics were the most frequently mentioned: flexibility and common sense/lateral thinking. The full list of characterstics can be seen in Table 2.

Table 2: Characteristics that define a good scheduler according to schedulers

Characteristics	Mentions out of 10
Flexibility	4
Common sense / Lateral thinking	4
Knowing the context	3
Sympathetic/Empathetic	3
Organised	2

Good memory	1
Multitasking	1
Decisive	1
Problem-solving	1
Solution-oriented	1
Efficient	1
Willingness to learn	1

FINDINGS

By analysing both the preliminary and final data, the following insights have been gathered:

5 out of 7 EU guidelines on trustworthy AI are desired: In general, all participants have agreed with the guidelines presented by the European Commission on what makes an AI trustworthy. The only exceptions have been the principles of Privacy and Data Governance and Diversity, Non-Discrimination, and Fairness. We hypothesise that these concerns are highly contextual and therefore not going to be a priority at all workplaces. In certain use-cases, e.g., at hospitals that deal with sensitive, personal information, they might be of very high priority while being less important elsewhere.

Different workplaces entail different constraints: Certain workplaces schedule a tight-knit group of people on short timeframes, e.g., the weekly shifts used by restaurants. Other places make timetables for a vast number of people, e.g. the course planning at universities. The differences between workplaces thereby results in different challenges of scheduling. Thus, the AI must be designed with the particulars of a workplace's scheduling requirements in mind. Furthermore, not all organizations allow the schedulers the freedom to choose their scheduling tools. Therefore, it would be worthwhile engaging representatives from such organizations to satisfy both the employers and employees.

Scheduling is a social activity: A considerable number of respondents have stressed the importance that emotions and an emotional connection between workers and schedulers play in this task. Human factors, such as lateral thinking, adaptability to circumstances, but also ability to bond with others, read between the lines, and understanding of thoughts and circumstances are also thought to be pivotal to build trust between schedulers and schedules. While many criteria of a good scheduler can be taken over by a machine, the humanness of the act is undeniable.

People are comfortable cooperating with a hybrid solution: People have been comfortable with the idea of letting humans work together with an AI-based scheduling aid. Generally, the respondents have ranked the strengths of humans and AI's differently. E.g., humans are at good at empathising, while AI's are good at error correction. Consequently, it can be seen that many of the strengths of humans and AI's are complementary. The combination of these different strengths leads to a more holistic solution.

Humans and machines make the optimal solution: When asked to describe the ideal scheduler, a number of characteristics were described. Some of these are inherently human, e.g., flexibility, context awareness, common sense, empathy, and willingness to learn. It is difficult to see how these can be implemented in an AI. Other characteristics, however, are more straightforward. Abilities like multitasking, good memory, logical thinking, and problem-solving can be more easily implemented. As such, it appears best to incorporate both humans and AI's in the solution to leverage the strengths of each.

People are confused by the term 'AI': A considerable number of respondents have been confused about what 'AI' is. Certain individuals equate AI with Machine Learning. Others have not appreciated the limitations of AI and have simply stated if the AI is programmed well, then of course it can do well.

DISCUSSION

On the Method

The project has used the methods of Citizen Science and VSD to integrate the direct stakeholders in the research process to elucidate the central values of the scheduling activity and how AI may be used in this activity. We have used interviews, workshops, and a survey to engage the stakeholders in the research.

The project has chiefly been a crowdsourcing project. We have engaged citizens to provide us with data on the values important to scheduling. The success of a crowdsourcing project depends on its scope in terms of data quantity and time span. We now address how this project hits both marks.

Regarding data quantity, crowdsourcing is most useful when there is much data to be collected. This is because it makes the most sense to engage a large number of citizens when there is much data to be collected. Given that the present study has undertaken a conceptual-empirical investigation, there has been no prototype for the participants to interact with. Thus, the only data each participant has been able to provide is their opinions and reflections on their work. As such, the quantity of data has not been immense.

Regarding time span, great lengths of time are useful for fostering a community around a project. This is useful because some participants feel a greater inclination to participate and learn (Land-Zandstra, Agnello & Gültekin, 2021). With a community the participants gain the opportunity acquire expertise on the field and disseminate their newly acquired knowledge enriching the scientific literacy of the participants (Land-Zandstra, Agnello & Gültekin, 2021). Given that our project is a pilot study, time has been limited. The creation of a community has therefore been outside the scope of our project.

Summarising, the present study has not been able to hit all the hallmarks of a crowdsourcing project. However, the project has not been merely a crowdsourcing project. We used interviews and workshops to engage citizens to frame the research questions. Thus, citizens were involved in the

initial phases of the project to frame the questions. Yet, the questions were not proposed by the citizens. Additionally, the citizens were not involved in designing the data collection. Thus, using the scale proposed by Haklay (2013), the initial phase of the project engaged citizens at the third level, while the rest of the project has been at the first level. Using the classification of (Bonney et. al., 2009a), the project is a contributory project.

A contributory project requires contributions by participants. We encountered issues with recruiting and engaging citizens to partake in the project. As summarised by (Land-Zandstra, Agnello & Gültekin, 2021), citizens are often motivated to participate when they have a pre-existing interest in the topic. From our preliminary investigations done to hone our research questions, we encountered a tendency for people to see the complexities of scheduling as a non-issue not requiring technological intervention. Namely, most interviewees viewed scheduling as just another part of their job which they would need to attend to. If this view is widespread, arousing the interest to explore the possibilities of automation proves difficult. We cannot state how prevalent this view is, but we have experienced difficulties recruiting, nonetheless.

This might not be the only source of difficulty in the recruitment of participants. As stated in (Bonney et. al., 2009b), complicated projects tend to attract few participants, so project designers must be careful not to make a project too difficult to engage in. In our case, we have used interviews, workshops, and surveys to engage participants in reflecting on their work and how an AI might affect this. This is much less straightforward than getting participants to label data points as is done in many Citizen Science projects (see the projects surveyed by Franzen et. al., 2021). Additionally, some of our participants have expressed interest in interacting with a prototype. This evidences that people prefer to interact with concrete technology rather than discussing its capabilities in the abstract. As an example, there are a plethora of projects that involve citizens in the creation of ML algorithms (Lotfian et. al., 2021; Franzen et. al., 2021).

As such, we conclude that Citizen Science is suited to the prototyping of an algorithm. When developing the assumptions underlying an algorithm, and how the algorithm will enter a sociotechnical context, Co-Design may be more appropriate.

On the Results

The results concern how the direct stakeholders perceive the suitability of AI as a scheduling aid. The findings therefore tell two stories. Firstly, they tell how comfortable each citizen group is with interacting with AI—since if AI were wholly inadequate, the citizens would be less comfortable cooperating with it. Secondly, they tell what each citizen group desires the AI to do to ensure comfortable cooperation.

We first discuss the schedulers. In general, the schedulers expressed they would be comfortable sharing responsibility with an AI. On the other hand, a majority of schedulers expressed discomfort letting the AI take charge of making the schedule. Interestingly, the reported discomfort on letting an unknown person do the scheduling was even greater than the discomfort felt towards the AI. This may at first seem surprising until the role of transparency is considered. Many respondents have brought up the necessity of the AI being able to explain its reasoning. It must be clear why the AI creates the schedule in a certain way. If this is not clear, the AI is deemed untrustworthy. An unknown person presents the same difficulty. Their line of reasoning is not known and thus more difficult to trust. This points to the fact that the difficulties in acceptance of AI lies not in problems concerning the technology itself, but rather in the difficulties of understanding the decisions made by the AI.

The schedulers also highlight other concerns that relate to trust. Many of the schedulers feel that understanding the work environment is vital to ensure the long-term workability of the schedules. The schedulers have highlighted that understanding the schedulees' circumstances is necessary to schedule them appropriately. Respondent 4 wrote extensively about how it is important to consider that different people are comfortable with different workloads and assignments. A functioning schedule needs to account for these variables. Furthermore, Respondent 27 even mentioned that a potential feature of an AI-based scheduling aid should be work-life analytics to ensure that a good environment is kept. Thus, a chief concern of scheduling is to ensure a healthy work environment. Building this understanding of the environment requires clear communication between the schedulers and schedulees. This is related to the transparency of decision-making.

Next, the schedulees. The schedulees report comparable levels of comfort with all imaginable scenarios be it receiving schedules made by an AI, a known person, an unknown person, an AI supervised by a known person, etc. However, they, like the schedulers highlight certain human qualities as essential to scheduling. They have especially discussed that the schedulers need to be able to take personal details into account, e.g. family situation, stress, etc. They deem such details as being important to consider in making a fair schedule. They have also mentioned the importance of being embedded in the social context of the work environment. They describe that when the scheduler is a colleague, the scheduler has a better chance at understanding the workloads involved and the preferences of the schedulees. The embodiment of the scheduler in the social context allows for successful cooperation between the scheduler and the schedulees. Based on these responses, together with the responses by the schedulers concerning the healthy work environment, we conclude that scheduling is chiefly a social activity in the work environment.

Acknowledging that scheduling is a social activity, questions of contextuality burst forth. A few of the characteristics described by the respondents as desirable are

straightforward to understand and thus implement. E.g., transparency and flexibility are two examples. The AI should under any circumstance be able to explain its reasoning. This ensures trustworthiness of the AI. The AI should also be flexible. It should be able to accommodate a variety of different scenarios and resolve the possible conflicts without trouble. This ensures the usefulness of the AI. But human qualities like empathy and contextual awareness are much more difficult to design without recourse to the context. Many schedulers have remarked the importance of understanding the schedulees to ensure optimal assignment of tasks. Which skills and personality traits figure into these considerations depend on the line of work. Additionally, different organizations have different work cultures and thus different perceptions of how time should be spent, how breaks are to be taken, etc. Thereby, the personal qualities that need to be considered depends on the context in which the AI must be integrated. How this can be done cannot be judged on the basis of the present pilot study. Rather, thorough technical investigations and prototyping is required involving the stakeholders of a certain workplace or in a certain line of work.

Despite the valuable information we have gathered from the responses, they are not without faults. The questionnaire has been carried out in English, yet most of the respondents have not been native speakers. Thus, a language barrier has been present. Disregarding language, there are also biases in the responses themselves. Firstly, since we have not collected any demographic data, it is impossible to cross-check the responses with the background of the respondents. This presents several difficulties. Schedulees may have very different opinions on AI, work-life balance, etc. depending on their background. Similarly, what constitutes good scheduling will be dependent on the line of work. A person scheduling nurses will likely have different priorities than a person dealing with factory workers. Furthermore, since the schedulers are anonymous, we cannot say whether the schedulers are perceived as competent or incompetent at their workplace. This means it is impossible to say whether the qualities they describe are desirable and ensure functioning schedules. Regarding competency of the schedulers, we have noticed that many of the qualities described by the schedulees as desirable in an AI-powered tool could be just as reasonably applied to human schedulers. This presents the worry that the respondents have not given the limitations and opportunities of AI any noteworthy consideration—rather, they might just have reflected on quality scheduling. This diminishes the usefulness of the description given by the schedulees.

Future Work

Our project concerns the values people desire in an AI-powered scheduling aid to cooperate with it successfully. The framework of VSD thus proves useful since it attempts to integrate value investigations into the design of technology. A central tenet of VSD is the tripartite methodology consisting of conceptual, empirical, and technical investigations (Batya & Friedman, 2019). In the present study, we have only undertaken conceptual and empirical investigations. A conceptual investigation addresses questions of who the stakeholders are, what conceptual framework best serves the project, and how the success of the project is to be best evaluated (Batya & Friedman, 2019). An empirical investigation addresses questions regarding what values stakeholders appreciate in their sociotechnical context, how are certain activities practised and conceived, and how are value tensions resolved by the stakeholders (Batya & Friedman, 2019). As such, we thought it paramount to begin with these investigations. Not only will the AI agent cooperate with, or outright replace, the schedulers, but all other workers in an organisation will also be affected by the decisions of the AI. However, we have so far only investigated what people want to see in a scheduling aid. Following the tripartite methodology, the next steps will be to investigate how people interact with an AI-based scheduling aid, and to prototype the algorithm to see what features are desired.

To study the interaction, we have planned a workshop based on the Wizard of Oz method (Martin & Hanington, 2012). The participants of the workshop will be both schedulers and schedulees. The schedulers and schedules will first discuss the perceptions of AI and scheduling in their own line of work. Afterwards, the schedulees will interact with the participating schedulers and actors playing the role of AI in a series of puzzles analogous to the ones used in the preliminary workshop (see the section on Method). The workshop will end with a discussion where the schedulees can talk about their experiences with the different schedulers, human, AI-based, and hybrid.

Regarding the technical investigations, we have made no plans. However, we can give suggestions on how to proceed. To carry out the technical investigations, a particular organization or line of work needs to be chosen. Once this has been done, further interviews and workshops can be conducted to ground the contextual values talked of earlier. When all values are understood, prototyping can begin.

The prototyping would have to take place over a long period of time. This is because technology disrupts the social context by having unintended consequences (Umbrello & van de Poel, 2021; Selbst et. al., 2019). As such, people will likely first oppose the prototypes outright, but after having become accustomed to them, they will have a more sober view on the prototypes. The citizens could then periodically report on their experiences with the prototypes and then discuss with each other what works and what does not. From these discussions, the citizens will be able to make suggestions on how to improve the prototypes. To us, this seems to be the optimal way of mitigating the unintended effects of technology.

FINAL REMARKS

This paper has dealt with an investigation of which values, features, and characteristics should an AI based scheduling tool embody, according to both schedulers and schedulees, for it to be trustful and helpful.
The project has used a combination of Citizen Science and VSD, together with methods such as interviews, workshops, and surveys. The project has concluded that scheduling is a social activity, and it is highly dependent on the context. Any AI-based scheduling aid that will be developed in the future should consider the importance of the human factor and of the context and should be mindful of the values, features, and characteristics important to the specific users.

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AI timetabling

FEELING THE CLIMATE CRISIS EXPLORING THE EMOTIONAL IMPACT OF CLIMATE FICTION

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ABSTRACT

The prominence of climate fiction, literary stories specifically addressing climate change, has increased rapidly in recent years. They are powerful and believed to have a positive impact on ecopolitics by allowing readers to envision possible climate futures and convincing them of the severity and urgency of climate change. The purpose of this pilot study is to investigate exactly that in twofold manner: first to investigate the topic of climate fiction, and the influence that they impose on emotions and feelings. And secondly, how can these emotions be used to predict a concrete action. This research aim is explored through a series *Citizen Science* models, that will support the quantitative and qualitative involvement of citizens, in order to understand the emotional impact of climate fiction.
The results of the analysis revealed that different forms of climate fiction interactions lead to different emotions.

KEYWORDS:

Climate Fiction; Emotions; Citizen Science

INTRODUCTION

Scientists emphasize the urgency of the climate crisis. Yet, it seems like an event happening at a far distance. Climate fiction offers a window in the future and the reader can explore how emotions can be useful towards tackling climate change.

As Schneider-Mayerson (2018) states, emotions and feelings play a prominent part in most reading experiences. Climate fiction stories are highly influential, which in particular can be seen in how they affect the readers' emotions. They are powerful in a sense, that they can "(...) *lead to a wider and deeper climate consciousness and thereby contribute to more progressive environmental policies and politics*" (Schneider-Mayerson, 2018). The study found that readers expressed negative emotions such as anger after reading, which could encourage them to take action. Readers also experienced guilt and shame, which would have a considerably less positive impact towards environmental efforts. Nevertheless, the study emphasizes the overwhelming majority of feelings that are undeniably linked to affective responses, whether active or passive.

Narrative medicine has shown that reading medical fiction has a great impact on doctors' empathy level. Doctors can develop narrative skills of recognizing, absorbing, interpreting and being moved by the stories of the illness through fiction. Practicing medicine with narrative skills supports doctors to better understand patients (Charon, 2006). We are inspired by narrative medicine and curious if climate fiction could potentially play an important role in helping to prepare for, cope with and devise solutions for the climate crisis.

Research Question

The motivation behind this research paper is thus to explore the nexus between climate fiction and its correlation to the emotional status of citizens, by using different approaches from the citizen science field. To help guide the research and ensure aim is being kept, the following questions have been proposed:

RQ1: *To what degree do Climate Fiction stories have an influence on emotions?*

RQ2: *In what way can Citizen Science methods contribute in potentially changing the behavior of citizens?*

FRAMING THE FIELD

Citizen Science

Sociologist Irwin initially coined the term *Citizen Science* in 1995, describing it as "*a science which assists the needs and concerns of citizens (…) a form of science developed and enacted by citizens themselves*" (Schneider-Mayerson, 2018). Whereas, more recently it has been defined as a practice through which the researcher engages the citizens through participation, collaboration and co-creation in order to increase scientific knowledge, according to Hecker (2018).
It is thus a method commonly used for data gathering and it is centered around generating interaction and dialogue between citizens and researchers, thereby bridging the gap in order to encourage a discussion based on knowledge and facts. General citizen science projects address a wide variety of topics across numerous fields, including biology, art, history, climate, nature, social science, literature and space.

Hodgkinson claims that citizen science can be advantageous in the pursuit for novel approaches and solutions to crucial wicked problems, one of which is the climate crisis, which is still a problem that has to be tackled (Schneider-Mayerson, LitHub, 2021).

Climate Fiction

A relatively recent subgenre of science fiction called *Climate Fiction*, draws on the knowledge of biologists and ecologists to envision a future world that is scientifically plausible. In its essence, climate fiction, also abbreviated cli-fi, is literature that addresses the world's most pressing issue - climate change (Schneider-Mayerson M., 2018).

Climate fiction can play a pivotal role in uncovering and exploring the severity of the climate crisis. This serves to both remind and encourage readers to consider its potential repercussions, while simultaneously alerting them of the consequences of passivity. This may also contribute to a shift in perception, attitudes, and beliefs, as well as the adoption of beneficial actions and behavior. However, it stands to reason that if literature is capable of all these things, then it can also have a negative influence on readers (Schneider-Mayerson & Matthew, 2021).

Measuring Emotions

The *Mood Meter* is a tool developed by the Yale Center for Emotional Intelligence (Figure 1). Its purpose is to help people identify and gain a better understanding of their emotions. The tool is primarily used within the field of education, to support the development of emotional intelligence among students and improve the learning environment.

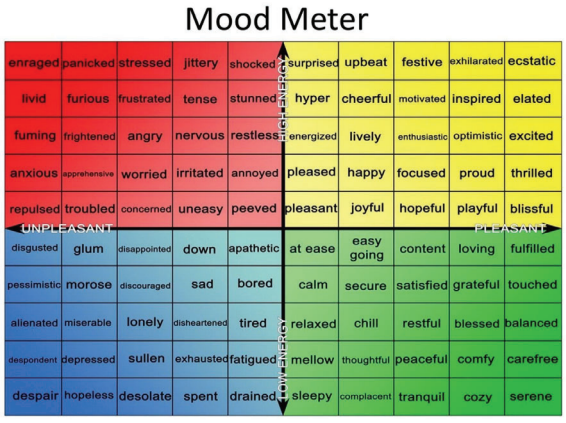

Figure 1 - Mood Meter

Two axes divide the Mood Meter into four quadrants — red, blue, green, and yellow — each representing 25 emotions. The x-axis states how pleasant an emotion is and the y-axis states the energy level of an emotion.
The red quadrant contains emotions that are unpleasant and high in energy, for example fear and anger. These emotions usually make people hyper alert and hyper focused. The blue quadrant contains emotions that are unpleasant and low in energy, which are often related to sadness and depression and usually lead to narrowly focused and pessimistic thinking. The yellow quadrant contains emotions that are pleasant and high in energy. These emotions usually make people happy and joyful. The green quadrant contains emotions that are pleasant and low in energy, which are emotions that usually lead to a calm and content state in which the need to solve problems or fix things is at a minimum (Brackett et al., 2006).

METHODS

This paragraph aims to highlight two main methods used in our research which combines both a physical approach, through physical activities, and a digital one, through the creation of a Facebook group as a platform for discussion and inclusivity.

The methodological approach that we have given to the project was driven by the Golumbic model, which incorporates three fundamental elements of citizen science: inclusion, contribution and reciprocality (Golumbic, 2015, 1-56).
In the use of these methods, we have worked with one specific element, the one of reciprocality. In reciprocality, both us researchers and citizens work together towards a common goal, there is an ongoing communication, the data and findings are open to the public.
It is especially in three activities that it is possible to detect this: “The Emotion Journey”, “The Climate Fiction Gallery” activities and “The Power of Climate Fiction” Facebook group.

In both quantitative and qualitative approaches, participants have contributed to the project by helping to answer the research questions and dig deeper into the climate fiction world and its relation to emotions.
By creating a public installation at the Sustainability House, we have created a space where any participant can interact with each other’s data and the material we presented, as it will be further explained.
Based on these affirmations and by taking into consideration the “Crowdsourcing Geographic Knowledge” designed by Haklay (Haklay, 2013), the participation level that was worked with is at level two - “Distributed Intelligence” - in which citizens/participants were the interpreters and volunteers for the project by actively being involved in the process of gathering data.
Below, it follows the journey that has brought to a better understanding of the topic chronologically.

Physical Installation

For our installation at the Sustainability House, we have designed three different interactive activities, in which participants engaged with climate fiction in the form of consuming (“The Emotion Journey”), acting upon the data (“The Climate Fiction Gallery”) and creating data (“How Does it End?”). (Figure 2).

The Emotion Journey

The path of the installation starts with the activity called “The Emotion Journey”. In this part of the installment, participants are asked to track their emotions while reading the chosen climate fiction story called “Climate Migrants”, by Shanna Yetman (Yetman & Comstock, 2021). This story was solemnly chosen based on its length, for a fast read that could give a hint to participants on what climate fiction is.

Figure 2 - Installation overview

Tracking the emotions was possible through threads on a mood board that was divided into high and low energy and pleasant and unpleasant, based on the Mood Meter previously explained (Figure 3)(Figure 1).

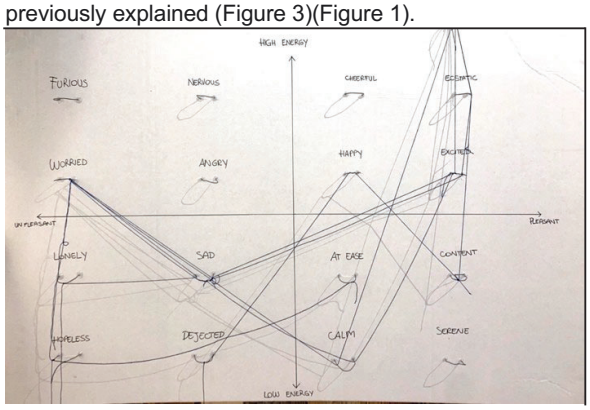

Figure 3 – The Mood Meter of The Emotional Journey

The tool was adapted to the activity, by reducing the 100 emotions explained above to the following sixteen:

- **Furious**
- **Nervous**
- **Worried**
- **Angry**
- **Lovely**
- **Sad**
- **Hopeless**
- **Dejected**
- **Careful**
- **Ecstatic**
- **Happy**
- **Excited**
- **At ease**
- **Content**
- **Calm**
- **Serene**

By limiting the Mood Meter to sixteen emotions, a simplistic version of the mood meter was created, which made it easier for the participants to skim through.
The selection of these sixteen emotions was based on the general belief that these words are easily known and understandable by citizens, as well as being properly translatable into Danish for a higher level of inclusion.

The Climate Fiction Gallery

For the second activity, "The Climate Fiction Gallery" was created, by using images designed by Barrau (Khan, 2022) (Figure 3).

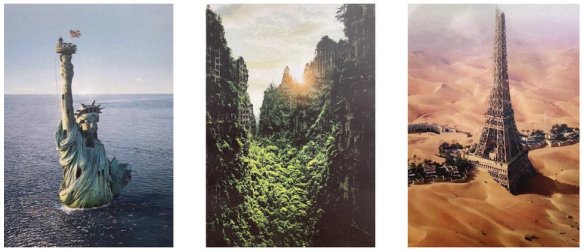

Figure 3 – Climate Fiction images by Barrau

In the activity description, participants were asked to share their thoughts and feelings related to the images through the post-its provided. The aim was for people to openly see others' thoughts and give the opportunity to comment/add-on to others opinions.

How Does it End?

The final activity was "How Does it End?", in which the participants were asked to explore their thoughts about the future by continuing a climate fiction story. The chosen story was "Myth of Rain", by Seanan McGuire, which narrates how Julie, a young woman with a passion for owls is trying to rescue the forest fauna before the world they live in is torn down. While the rich people move away to escape the burning California, Julie and her friends realize they are running out of time. The fire is bursting in the forest and Julie and her friends start to prepare for their mission to rescue the owl they saw the day before. At this point, it was decided to give freedom to the participants to continue and end the story in order to investigate whether their ending would be positive or negative. The participants had the option of doing so by writing on a provided piece of paper that would then have to be put in a box (Figure 4).

The choice of the story was based on the fact that the context of this one is relatable to any reader.

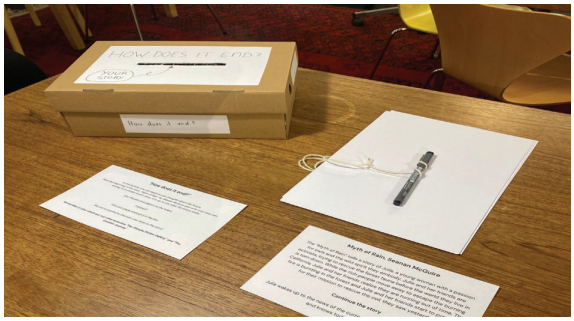

Figure 4 – Outlook of the third activity

Facebook Group

During the visit of the Citizen Science Center in Switzerland in May 2022, a lot of knowledge was gained on the use of online platforms as a good citizen science tool. Additionally, a few papers have described how creating a Facebook group for a specific topic is a good way to engage citizens and let them discuss freely in an open space.
Specifically, the paper "Facebook groups as citizen science tools for plant species monitoring" concludes that:

"Social networks can provide a valuable complement to the data collected by scientists for research purposes." (Marcenò, 2021)

Based on the information above, the Facebook group "The Power of Climate Fiction" was created. The group

was intended for climate change and fiction stories enthusiasts, where they were encouraged to have a wide-ranging dialogue and interesting discussions among them on the influence of climate fiction and related material.

RESULTS

As previously stated, the data gathering took the form of an installation consisting of three distinctive activities, each with their own level of citizen participation and intervention. In this paragraph, the results and findings of our research will be showcased.

The Emotion Journey

For this initial activity, the majority of the six received respondents initiated their emotional journey on the right hand side of the Mood Meter, indicating a degree of pleasantness (Figure 3). Simultaneously, they all ended in the left hand side, reporting unpleasant emotions and a lower degree of energy. Below in Table 1, the exact emotional journey is presented in chronological order.

Respondent #	Emotional Journey
1	calm → worried → sad → lonely
2	excited → calm → sad
3	excited → sad → worried
4	excited → sad → worried → hopeless
5	content → happy → dejected
6	at ease →hopeless

Table 1 – Individual respondents on Emotional Journey

The Climate Fiction Gallery

In “The Climate Fiction Gallery”, twelve post-its were gathered, describing feelings and thoughts related to the images by Barrau.

Specifically, the first picture under Figure 3 of the Statue of Liberty in New York nearly submerging under water gathered five responses that contained *fear*, *anxiety* and *concern* as the emotions described. In Particular, three responses stood out as they posed a question. One of them was wondering how to prevent this future disastrous scenario, with the continuing war in our present world. Another wondering how much land will actually be left in the remaining earth, if this was to actually occur. The third respondent worried why more is not being done to genuinely stop climate change.

For the second image of the growing forest under Figure 3, a total of four responses were gathered, with each response reflecting the respondent's immediate thoughts, feelings, and perceptions. They all embraced the characteristic of having a positive outlook on the image, as they described an immediate sense of nature's empowerment as a result of reclaiming what was once theirs. Words such as *beautiful*, *interesting*, and *ambivalent* stood out.

The last image depicting the Eiffel Tower in Paris covered by sand under Figure 3, received a total of three responses, all with the common denominator of describing this fictional scenario as *surreal* and *crazy*. The picture provoked *wonder* and *curiosity* about how the world, and particularly Europe, would be and feel if they each had their own desert.

How Does it End?

Two responses were received for the "How Does it End?" activity. The first story talked about how collaborating with the rich, the protagonist could have saved the owl and more animals in the forest. Therefore the recurring theme that stood out was how collaboration and unity among diverse groups of people could be effective. Unfortunately, it was not possible to foresee how the story would have ended, due to the participant having to leave, but the topic and remarks did set a positive scene of *hope*.

In the second ending, *hope* and *optimism* were topics that emerged from reading the story. The participant, in fact, wrote that the protagonist of the story managed to save the owl, however, by leaving the other animals behind.
If emphasis was put on the owl, it can be concluded that the story had a *happy* ending. However, if the bigger picture was to be considered, it becomes clear that not all the animals could be saved, which may be *discouraging* and cause *fear*. Moreover, there was a substantial disparity between the wealthy and the rest of society, which, among other things, can engender *rage* and *unrest*.

The Power of Climate Fiction Facebook Group

The Facebook group created gathered eight members. The content of the group was mainly divided into asking questions, sharing images and videos to encourage reactions and activity among the members. Some participants have been actively commenting on the posts created, have created posts on their own, have asked questions within the group and have reacted to other’s posts. The group was decided to be open, therefore, accessible to any citizen who would find the topic interesting. However, specific people (researchers, writers, cli-fi enthusiasts) were invited into the group to start a discussion and to test whether this platform could be potentially used as a citizen science one.

DISCUSSION

The focus of the research revolved around investigating the emotional impact that climate fiction could potentially have on citizens. In the implementation of the three designed citizen science activities, each had its own level of citizen involvement, however, all had the purpose of achieving a collection of emotions, which would ultimately contribute to the already existing knowledge available.

A limitation of the design of the activities was the number of citizens participating. This may be due to several things, one being a language barrier, as the majority of the activities, including the selected climate fiction stories to be read, were in English. This could have been prevented if a selection of climate fiction stories had

been translated into Danish, enabling participation by all citizen groups.

We identified clear differences in the emotional responses between the different activities. While the "How does it end?" activity generated the most *optimistic* responses, the "Emotion Journey" and "The Climate Fiction Gallery" provided more *fearful* and *hopeless* responses. This finding highlights the importance to consider in which way citizens engage with climate fiction. We can distinguish between consumption of climate fiction, acting upon information and creating climate fiction.

The optimistic emotional responses in regards to creating climate fiction, raises the question if this type of activity is empowering citizens the most. The optimistic and hopeful endings the citizens wrote for the climate fiction story, is in contrast to the climate fiction that is being published. In fact, a lot of published climate fiction leads people into negative emotional responses, as explained in the introduction of the paper.

This raises the question on whether writing climate fiction is just a creative outlet for participants to express their desired outcome for the future or if the writing experience empowers them to adopt a more sustainable lifestyle and devise solutions for the climate crisis.

The consumption of climate fiction, through reading a story, showed to be counterproductive. In the research, citizens reported a *sad* and *depressed* emotional state after reading.

An emotional state that is related to pessimistic thinking, does not empower citizens to take action towards climate change. However in our research citizens only read one climate fiction story and the emotional response might be different if the citizens read a different story. Future research could use the emotional journey to track the emotional response to several different climate fiction stories. This would give insights on whether reading climate fiction is counterproductive or if this is only true for certain stories.

Similar to narrative medicine, climate fiction can potentially become an educational tool. In contrast to narrative medicine, which is targeted towards doctors, climate fiction as a tool can be used in different fields and contextes.

Since this research indicates that the way participants interact with climate fiction has an impact on how they feel, considering the choice of activity is not only important when using climate fiction as a tool, but also holds potential to various outcomes.

When it comes to "The Power of Climate Fiction" Facebook group, the power of creating a community, a platform of communication is a great way to connect citizens with researchers and science. As previously explained, online platforms can and do have the potential to spread awareness on citizen science, therefore, by combining a digital tool together with the physicality of our activities, the aim was to gather a large amount of data and increase the level of involvement that could lead the project towards the highest degree of participation defined by Haklay (Level 4 - "Extreme") (Haklay, 2013). However, compared to the installation, the level of engagement in the Facebook group has been lower, perhaps due to the low advertisement done around the group. This can raise a discussion on how, within a citizen science project, defying the level of participation can be complex if within a project, multiple methods are applied.

CONCLUSIONS

This research aimed to (1) identify to what degree climate fiction stories have an influence on emotions and (2) determine in what way citizen science methods can contribute to potentially changing citizens' behavior.
Based on the climate fiction installation created, it is possible to conclude that different forms of interaction lead to different emotions. Our findings support empowerment through interacting with climate fiction in different ways, rather than only consuming it.

The initial finding of our pilot study demonstrates that it is possible to involve citizens in the collection and interpretation of climate fiction based on their emotions. This holds the potential to also involve citizens to gain a greater understanding on how the emotions triggered by climate fiction can potentially change citizen's behavior.
While citizen science methods hold the potential to interact with climate fictions in different ways, the Facebook group showed the challenges of building a community.

The findings of this pilot study can be the foundation of a large-scale Citizen Science research on the emotional impact of climate fiction. We suggest that future research investigates how the emotions provoked by climate fiction can contribute to the development of solutions for the climate crisis or motivate citizens to change their behavior in favor of sustainability.

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Feeling the Climate Crisis

HOW TO USE SCOUTING SKILL DEVELOPMENT TO BUILD SELF-EFFICACY ON DIGITAL MEDIA

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ABSTRACT

Background: The mental health among young adults between the age of 16-24 is decreasing due to the use of digital media. This is not the case among scouts, who show e.g. better digital leadership skills, higher self-efficacy and better mental health than the general population.
Aim of the study: Our aim of this study is to see whether it is possible to develop a tool that transfers the scouting skill development strategies in a way that can benefit young adults in general.
Methods: Using Citizen Science-approaches, we involved citizens in both problem definition, data analysis and tool development, by facilitating participatory and collaborative workshops and data collection.
Results: Our data showed that young adults today are especially annoyed and angry by commercials and comment sections when using digital media. We developed a tool that addresses these negative emotions, and through scouting skill development strategies allows them to work with these emotions under guidance and while reflecting with their peers.
Conclusion: While we found it possible to develop a tool based on Citizen Science-methods, we need to test and adjust the tool before potentially implementing it in e.g. high schools and vocational schools, with the goal of improving mental health in young adults.

KEYWORDS:

Scouts, Mental Health, Digital Media

INTRODUCTION

The Danish National Health Profile 2021 has recently been published, and in this, it is shown how the mental health of young adults is decreasing rapidly, especially among young adults between the age of 16-24. This is partly due to stress, anxiety, depression, and low self-esteem (Sundhedsstyrelsen 2022, Vidensråd for Forebyggelse 2020).

Studies show that these symptoms in young adults are precipitated or increased by their use of digital and social media (Hoge et al. 2017, Ivie et al. 2020). Though some studies do suggest that the use of digital and social media has the potential to empower and develop leadership skills in young adults (Perez-Fuentes et al. 2019, Middaugh et al. 2017), other studies also show that especially unstructured use of social media and low self-efficacy are risk factors in experiencing severe negative impact on mental health related to the use of digital media (Van Den Eijnden et al. 2018, Perez-Fuentes 2019). Several studies therefore suggest the need for a greater focus on empowerment, increasing self-efficacy and the development of competencies as a solution (Hoge et al. 2017, Ivie et al. 2020, Perez-Fuentes et al. 2019, Van den Eijnden et al. 2018, Turner et al. 2017, Middaugh et al. 2017).

In reaction to this, we are investigating the possibility of developing a tool for increasing self-efficacy, developing competencies, and empowering young adults on digital and social media. Here we have found inspiration in the scouting community's skill development strategies.

A well-known theory by Albert Bandura (1986), describes how self-efficacy is increased through four steps: mastery experiences (small wins and the continuing of completing small tasks), vicarious experiences (positive examples, guides and role models), social persuasion (ongoing feedback) and current emotional state (a positive emotional state increases self-efficacy). These steps to increasing self-efficacy are very similar to the scouting skill development strategies. The scouting community and their hands-on experiences with skill development go back to 1907 (World Organization of the Scout Movement 2022). The scouts learn to complete a series of tasks in order to receive badges, symbolizing the achievement of a specific skill. The scouting community has traditionally been known for their very specific hands-on survival skills, but they also teach skills with a broader focus, providing badges within communication, teamwork etc. (Mærkelex 2021). Through creative problem solving, the scouts complete a series of small tasks within an area, while simultaneously receiving feedback and guidance from their scout leaders. By doing this, they are following Banduras (1986) previously described steps to increasing self-efficacy.

What adds to our curiosity on the scouting community's hands-on approach to skill development, is that studies

show that scouts generally have better mental health throughout life (Dibben et al. 2017, Royse 1998), show greater digital leadership skills (Girl Scout Research Institute 2019) and have higher self-esteem (Dibben et al. 2017, Royse 1998). A study shows that young adults taking digital leadership have higher confidence in their own knowledge, supportive guidance from adults, experience with trial-and-error learning and creative problem solving and high self-efficacy, and that this is more often seen in scouts than in other young adults (Girl Scout Research Institute 2019). This makes us curious as to whether the hands-on skill development strategies of the scouting community are a particularly effective way to develop self-efficacy and thus better digital leadership skills and better mental health in young adults.

Therefore our aim of this study is to investigate, through a citizen science approach, how these skill development strategies of scouting can be used in the development of a tool for young adults suffering from symptoms like stress, anxiety, depression and low self-esteem, due to their use of digital media. The purpose is to improve self-efficacy in young adults and thus hopefully as a long term goal, their mental health, as they continue to live in an increasingly digitized world.

METHODS

In developing the tool, we have included two different groups of citizens; young adults between the age of 16-24 and experienced scout leaders. The purpose being to develop the tool based on the needs of young adults today as well as based on the skill development strategies of scouting.

As we want to use the skill development strategies and experiences of scout leaders to build self-efficacy, we included the scout leaders in both the initial problem definition phase and in the tool development phase. We managed to get in contact with a total of seven experienced scout leaders from established scouting troops in Denmark. Based on the studies we had read about the benefits of scouting, we wanted to get more insights and perspectives from actual scout leaders in real life, in order to get a sense of what they were able to teach us and what type of data we might need, both from the scout leaders and from young adults. This before moving on and specifying the purpose and aim of the tool. We held a participatory workshop with the aim of gaining the scout leaders' perspectives on training young scouts, as well as their scouting practices and strategies. To get the scout leaders engaged and elaborating on these topics, we used tools such as figurines of scouts of different age groups and had the scout leaders categorize different types of skills on post-its (Brandt, Binder & Sanders 2013).

In order to define the problems as experienced by young adults, we reached out through social media and to "stress workshops" for young adults in Odense municipality. Here we recruited 10 young adults who were suffering from symptoms like stress and anxiety, due to their digital media use. We asked them to upload screenshots of situations they had seen on digital media that had triggered these negative emotions. To facilitate this, we used the "Citizen Science Logger", where citizens can upload pictures directly from their smartphones to an applet, along with any notes they might have (CS Center Zürich 2022). We chose this tool to simplify and ease the work of contributing data for the participants, as young adults are using their smartphones for the majority of their digital and social media use (Danmarks Statistik 2021). We let the data they provided define what young adults found to be most challenging and triggering when using social media, and thus what we wanted our tool to address.

After gathering data from the young adults, we returned to the experienced scout leaders and shared with them both our scientific knowledge of how scouting and skill development contributes to self-efficacy on digital media and better mental health, and also challenges expressed by the young adults. The aim was to learn from the scout leaders' hands-on knowledge on skill development in young adults, in a co-analytic process. We did this in a participatory and collaborative workshop, in which we developed the concept and purpose of the tool. The overall process of developing the tool is based loosely on the "design thinking model" (Dam 2022). However, it is important to note that this project did not manage to arrive at the design testing. Instead, we used the citizen science-approach to (1) empathize with the problem of the young people through the data collection and through that (2) create the problem definition. Also the (3) ideation and (4) prototyping was done collaboratively, as described above. Using design thinking as an approach in the context of citizen science helps reach not only a higher level of citizen involvement, but also allows the highest involvement in the development process of the tool and challenges our assumptions as researchers.

The methods used are based on the citizen science-principles of reciprocality (Golumbic et al. 2017), where we achieve our scientific results through partnerships and collaboration with the citizens who will be affected by our research. Citizen involvement in science can be done on four different levels, according to Muki Hacklay (2011). Level one is by "crowdsourcing", level two is by "distributed intelligence", level three is in "participatory science" and level four is in "extreme science" (Hacklay 2011). We chose to include the young adults on level three; in "participatory science". We let them define which problems they needed our tool to address, by having them select the data we based the purpose of our tool on. We chose to include the experienced scout leaders on level 4; "extreme citizen science". We developed the tool in collaboration with the scout leaders by including them both initially in the problem definition phase as well as in the data collection and analysis. Here we let them choose

which skills were most relevant to include in the tool, in order to address the expressed needs of young adults.

In figure 1 we have illustrated the cycles in the iterative process of developing the tool.

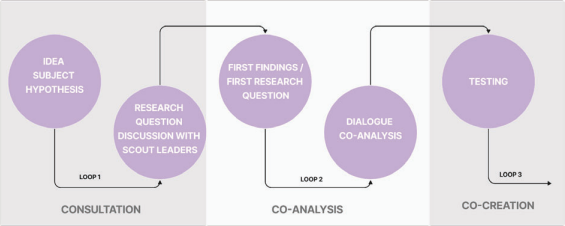

Figure 1: Iterative development process

RESULTS

Discovering the scout skill development mindset

Talking to the scout leaders provided valuable insights in the everyday practices of scouts and the unique mindset they apply when completing tasks. This mindset gives scouts a significant advantage compared to non-scouts (Girls Scouts Research Institute 2019, Dibben 2017) in developing necessary skills such as problem-solving. To achieve this mindset, an important framework the scout leaders kept emphasizing was teamwork and peer-learning. Scout leaders only guide scouts to a certain level. Instead, scouts learn from each other and guide themselves through difficult tasks. They are enabled to learn and explore together. Scouts are also encouraged to take responsibility for their actions. According to the scout leaders, scouts only achieve badges when they are willing and capable of completing specific tasks. Their success depends on their own actions and their ability to take responsibility. Another important ingredient is creativity. The scout leaders named several concrete examples of how to engage the scouts in learning activities by designing the activities that require creative solutions. For example, one task included identifying fruits that had been frozen within ice cubes. The scouts were allowed to make use of all their senses by looking at the cubes, tasting them or touching them, or any other method that would result in identification of the fruits.

The key topics that emerged during this initial discussion were: teamwork, peer-learning, responsibility, creativity and problem-solving.

Social media interactions and related emotions

In total, we collected 23 screenshots of social media situations that induced negative emotions in young people. The screenshots were taken on six different platforms with Instagram (11) and Facebook (6) being the most represented, followed by Twitter (3), WhatsApp (1), News Site (1) and Street Advertisement (1).

Figure 2 shows an overview of the expressed emotions. The emotion most stated was "annoyed" (13) and occurred mostly in combination with commercial posts (9). "Angry" was the second most mentioned emotion and occurred in combination with e.g., politics, homophobia and racism. "Anxious" (2), "Helpless" (1), "sad" (1), "worried" (1), "disgusted" (1) and "offended" (1) were other emotions expressed.
The types of posts were mainly "commercial" (10), followed by "comments" (3), "news article" (2), "suggested news article" (2), "image / meme" (1), "suggested post" (1), "retweet" (1), "post" (1) and "reactions" (1).

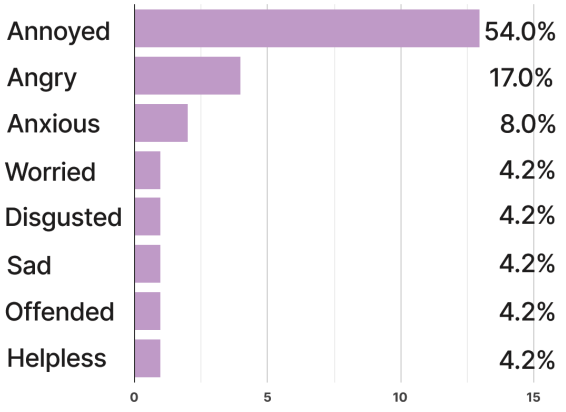

Figure 2: Emotions stated

Transforming the scouting mindset into a tool

In order to disseminate the relevant scouting skills, the scout leaders advised us to incorporate dilemma situations into our tool. Those situations would encourage young adults to find solutions on their own or together with peers. Self-efficacy in the solution finding process is of high importance and should be a focus for us, according to the scout leaders. Scouts are given the tools to explore solutions, but usually they are encouraged to do so without the assistance of scout leaders. Nevertheless, the scouts have access to receive guidance from a scout leader. That is the reason why, according to the scout leaders, dilemmas are an effective way to adapt problem-solving methods.

One significant relevant skill is conveying empathy for others. The scout leader explained that being a good friend is prioritized in their everyday scout life. Through listening to their fellow scouts' opinions and through helping them in difficult situations e.g., homesickness, scouts are taught to not only care for themselves but also for others. Equally, they are encouraged to reach out to their peers when they are in need of help or feedback. Upholding and referring to a support network of friends, family, teachers and others is therefore suggested by the scout leader to be another key element to include into our

tool. The scout leaders also advised us to make use of appropriate, user-targeted language to facilitate communication with the target group and to ensure successful transmission of the information.

In conclusion of this workshop it can be said that the importance of peer-learning, creativity and problem solving were repeated by the scout leaders, but they also added new key topics such as: self-efficacy, empathy, supporting networks, feedback, structure and user-oriented communication.
Figure 3 shows a model of the scouting mindset and how it can be used to disseminate problem-solving skills and self-efficacy.

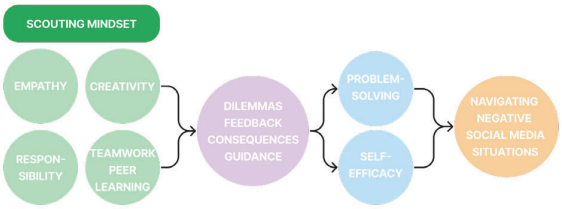

Figure 3: Updated Scouting mindset

How the Tool works

The tool consists of multiple different building blocks.

Persona: The participants do not play as themselves, but as a persona with random attributes. This helps not only for the participants to disconnect with the situation, but also emphasize with other people, and how they might perceive social media challenges.

Dilemma/Situation: The exemplary situations are based upon the data we collected from young adults and are presenting the frame of the tool. In the future these might as well be customisable.

Feeling: When confronted with the dilemma, the participants get to decipher what they/their personas are feeling, this initial feeling poses the problem framework.

Internal Reaction: When coping internally, the player gets to explore potential support systems to turn to, or what kind of coping mechanisms they might want to implore. When reacting internally, the player does not react on social media to the post.

External Reaction: When reacting externally, the participant decided to react on social media to the post. A potential question that is explored in this discussion could be how the participant would react.

Consequences: For this tool, there are prefabricated consequences that can be chosen by the facilitator/guide depending on relevancy for the situation. It could also be possible for the facilitator to come up for a whole unique consequence for each participant.

Scout to Tool Translation

As mentioned in the results, the key themes emerging throughout conversations were creative problem-solving, responsibility and teamwork / peer-learning. These were also highlighted during the co-creation phase of this project as the most relevant for coping with negative emotions.

The tool is set-up as an iterative guided process, divided into three stages, as it tries to imitate how scouts would work with any dilemma. As a platform, we derived at a physical board game, which can be found in appendix 1, Using the key findings from the co-creation workshop we derived at the stages of "Setting a framework", "Exploring possible reactions" and "Dealing with consequences", as this incorporates the way scouts build their relevant skills.

1. Setting up the framework

To allow for peer-learning and to teach the scouts about their own responsibility from a young age, the scout leaders provide only the framework of a task and only guide them as much as needed, rather than taking them through the entire process.

Similarly, the tool is designed in such a way that it does not give the participants a path to follow, but the building blocks let them build upon the problem presented to them. Therefore, instead of giving them predetermined answer options, a lot of the building blocks are left empty and for them to fill out.

2. Exploring the possible reactions

As the building blocks are left empty and for the participants to fill out, it allows for them to explore different options, also creatively and discuss them with the other participants. The tool is set-up as a multi-person experience, to further the peer-learning component of the scout skill development mindset and get feedback based on the actions taken. It also gives the space to solve the problem at hand with the help of others.

The peer-learning component also entails helping those that are struggling with a multitude of tasks and learning who can help with those tasks. Establishing this as a baseline allows one to reach out for help when struggling, giving scouts a sense of community and support system to fall back on when needed. While the tool does not create a support system in the same way, as this principle might suggest, it allows for reflection on the already existing support system a young person can reach out to when struggling.
By asking guided questions, the participants are invited to reflect upon their actions, considering the way they

communicate. This empowers the participants to take responsibility for their actions and reactions.

3. Reflecting on the consequences
An integral part of taking responsibility for one's actions and reactions is to accept the consequences of these. This also follows the hands-on learning attitude that can be seen in the scouting community where many skills are taught in said free framework, with the expectancy to not get it right the first time.

Crucial for this tool is giving space for reflection, as the goal is to cope with negative emotions. It is necessary for the participants to reflect on how their action to the problem made them feel, and compare it to how they felt before the interaction.
The goal is to provoke them to choose coping mechanisms and reactions that make them feel better after the interaction. Therefore, should a participant not feel better after the first iteration, it is easily possible to go into a second iteration.

Our suggestion on how to use the tool:
As discussed, the different building blocks of the tool are the basis for open discussion, but should still follow the intended flows, as described in the stages above. Figure 4, also gives a more detailed insight into how this is intended to work.

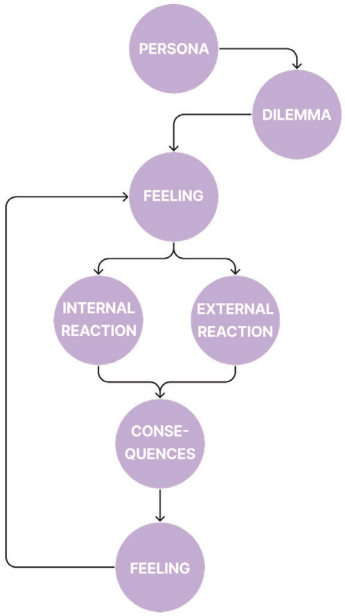

Figure 4: Overview over the building blocks

After creating their persona through a die roll, the dilemma is presented to the participants. From thereon, they get to use the different building blocks to (1) identify how the post makes them feel, (2) explore how they would react both internally and externally to the situation, (3) face the consequences of their reactions and (4) reflect on how this exchange/action made them feel.

The goal is to provoke the participants to choose coping mechanisms and reactions that make them feel better after the interaction. Should that not be the case, the steps 2 to 4 can be repeated as needed. Whenever that is achieved, the participants can move on to the next dilemma.

Figure 5 displays how the tool can look after the first iteration for one participant.

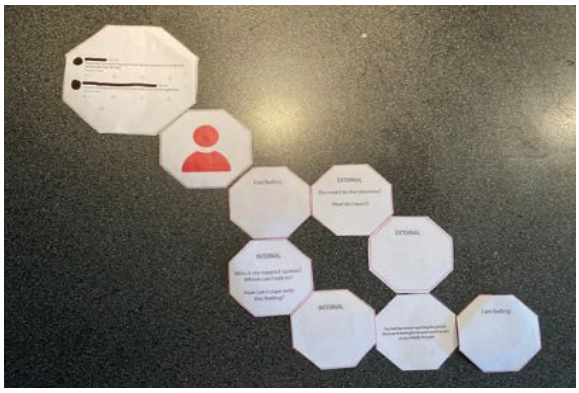

Figure 5: An example path of one iteration.

DISCUSSION

In recruiting the citizens, especially the young adults, we had some ethical concerns. We did not wish to expose the young adults suffering from e.g., stress and anxiety to unnecessary and additional triggers and negative emotions. That is why we did not ask them to intentionally seek out triggers, but simply asked them to screenshot triggers they stumbled upon during their regular use of digital media. Also, by reaching out broadly through social media, we made sure that no one felt pressured to participate and when reaching out to "stress groups" in the municipality, we let the stress counselors choose which young adults to approach. However, this of course poses the risk of selection bias (Szklo 2018). Our participants may not be representative of young adults suffering from poor mental health due to their use of digital media, and there is a possibility that this has skewed our results and decreased the effectiveness of the tool (Page 2016).

We argue that we have included the young adults in a "participatory science"-approach and the experienced scout leaders in "extreme citizen science", on a both participatory and collaborative level (Haklay 2011). However, this is done only in regards to the development of the tool, which the scope of this paper is limited to. Our motivation for these levels of citizen engagement in the development phase is to work with the stakeholders who are most engaged in and affected by the issues of decreased mental health among young adults, as well as in skill development in young adults. The shared goal of both groups of citizens involved in the project, as well as

our goal as researchers, is to help young adults to better mental health. The involvement of citizens in this goal has the benefit of making the final results more relevant and useful to the groups of citizens actually affected by it or to citizens who share our mission (Golumbic et al. 2017, Hecker et al. 2018). Though scout leaders are not the ones personally affected by the issue at hand, helping young adults build skills and self-efficacy is ingrained in the scouting community mindset (World Organization of the Scout Movement 2022), which is why we also found a great interest from the scout leaders to be a part of our project.

However, as this research paper only covers the development of the tool, and though we are planning to share our findings with the citizens who have contributed to our project, we acknowledge that further steps towards collaboration and citizen involvement are needed in the phases to come, in order for the entire process to be construed as "extreme citizen science". A way to continue this approach would be to reach out to the young adults who have contributed to our project, and have them test our tool, thus reciprocating directly with the hope of them building self-efficacy and thus better mental health.

Our next step from here would be to test and implement the tool. In doing this, we could draw on different disciplines. From a public health perspective, an effect evaluation would be the natural next step; testing whether our tool actually improves self-efficacy and whether this leads to better mental health in young adults. If the tool shows an effect on self-efficacy, we would move on to implementing the tool in a broader population. The target group being young adults between the age of 16-24, we would suggest implementing the tool in vocational schools and high schools in Denmark, using the teachers as guides/facilitators in using the tool. In these next phases, we would continue our "extreme citizen science"-approach and collaborate with both scout leaders, young adults and also the teachers in the continuous and iterative development and testing phase, as well as in the implementation phase.

An aspect of this tool was to investigate how relevant scouting skills can be mitigated into a tool that can help people from outside the scouting community. For this purpose we additionally suggest doing a design anthropological field study, as proposed by Kjaersgaard et al. (2021), as a next step. Hereby, we use the tool as a means to elicit further insights and this allows us to challenge central design assumptions. This is especially interesting, as this tool was developed by a group of citizens (the scout leaders) for another (young adults). A possible scenario for this could be letting scout leaders, who did not help design it, interact with the tool as if they were young adults. This would elicit assumptions of the scout leaders about non-scouts, how they behave and which skills they do and do not possess, bringing forward the gap between design assumptions and the actual experience. This gives an insight into how well the skills are translated into this tool. This approach is also in line with following the design thinking method, as the insights could potentially help reshape the problem definition and create an iterative process around the tool development.

Furthermore, testing the tool with social media intervention methods in mind could show whether the tool helps reduce negative noise on social media platforms, which in turn could help improve mental health conditions of young adults.

Counternarratives are alternative narratives that are used as countermeasures within social media intervention scenarios. As stated by Braddock & Morrison (2018), counternarratives on social media have the aim to create trust in a source and create distrust in extremist narratives. Kaufhold et al. (2018) expand that "Counter narratives are trying to disclose the illusion created by radical and extremist groups through a purposive and educational counter statement, and to initiate a rethinking in the affected individuals via thought-provoking impulses and advice." After using the tool, young adults may therefore be able to produce qualitative counternarratives but they may also produce less negative or extreme content that needs countering.

Another interesting, related discussion point could be whether, as a result of spreading the scouting mindset through our tool, dehumanization and prejudice (as described in Parker et al. 2020) on social media may be discovered and countered more effectively - maybe even reduced. Empathy, teamwork and respect for other opinions may help young adults with producing more mindful texts and finding the courage to disarm dehumanizing texts.

Finally, though this tool is developed for young adults between the age of 16-24, we see potential in upscaling and implementing the tool in settings with younger age groups as well. The scout leaders expressed difficulty with teaching these skills to older scouts who were not trained in this mindset in advance. This could also be the case for our target group. In order to upscale and use the tool in other and especially younger age groups, the tool would have to be adapted though. Especially, the persona options, the dilemma scenarios and the language on the board would have to be adjusted to fit a younger target group. Apart from this possibly increasing the effect of the tool, we would also argue that building self-efficacy in younger age groups could potentially have a preventive effect on mental health issues derived from the use of digital media.

CONCLUSION

In this paper, we identified creativity, responsibility, peer learning, and empathy as the main building blocks of scouting skill development. Furthermore, we demonstrated how Citizen Science-methods can be used in this instance to elicit insights and make them available

for another citizen group by transforming the skills into a tangible tool through co-creation. This tool manages to translate hands-on skills in such a way that they become accessible to acquire in a non-hands-on context. This opens up the possibility of using the skill development strategies of scouting as a way to increase self-efficacy in young adults in general, a group of citizens who would otherwise not benefit from these strategies. Further testing and implementation of the tool is necessary, but our hope and goal is that the tool can be a way to diminish some of the negative consequences of digital media use and improve mental health in young adults today.

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HOW TO COPE WITH SOCIAL MEDIA IN HIGH SCHOOL

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ABSTRACT

Background: Mental health is decreasing among young adults in Denmark and social media use plays a big role. There are no national guidelines or public health interventions targeted at the prevention of mental health challenges of young adults and previous minor interventions show no long-term effect. However, studies show that the scouting community experience less strain on their mental health and are better at navigating social media than their peers, due to a higher self-efficacy. In a previous study, we set out to develop a board game based on scouting skill development, aimed at young adults. This paper sets out to create a public health intervention integrating this board game.
Methods and data collection: Using Citizen Science-methods of co-creation and collaboration, citizen groups of high school student, school administration and scout leaders were included in interviews, workshops, design processes and data analysis to create a public health intervention meeting the needs of, as well as empowering, the stakeholders and considering barriers and facilitators in the implementation process.
Results: Through the collaborative process we found that main barriers for implementation were lack of time and resources and that an intervention targeted high school students should be implemented during the intro courses, when the students are allotted into their study programs. The intervention was developed to ease the implementation process and adjusted to meet the specific needs of the high school students and setting.
Conclusion: Citizen Science-methods showed a promising effect on empowering stakeholders and considering needs, barriers and facilitators in the intervention development phase and may help address the known challenges of implementing public health interventions. However, more work is needed before an intervention integrating the scouting skill development strategies is ready for pilot testing.

KEYWORDS:
Citizen Science, Mental Health, Public Health Intervention

INTRODUCTION

Mental health is decreasing rapidly among young adults between the ages 16-24 in Denmark, causing stress and anxiety as well as an increase in school dropouts, psychiatric admissions, and treatments. In the most serious cases, it can cause suicide, the number of which are also rising, especially among young women (Jeppesen et al. 2022, Katznelson, Görlich & Pless 2022, Sundhedsstyrelsen 2022, Berlingske 2022).

Though the reasons behind this development are complex and still in the early stages of research, several studies suggest that social media use plays a big role in these issues. Unstructured use of social media is proven to affect both sleep patterns and stress levels, cause anxiety and show to have a negative effect on quality of life in general in young adults especially, which is the age group shown to spend the most time on social media (Valkenburg, Meier & Beiens 2022, Shah et al. 2019).

Though the evidence is clear on the mental health challenges among young adults and evidence is building up around the negative consequences of social media (Valkenburg, Meier & Beiens 2022, Shah et al. 2019, Katznelson, Görlich & Pless 2022), any structured actions remain to be taken. There are no national public health interventions targeted at the prevention of mental health challenges of young adults. Families and communities are given no structured support or guidance. The psychiatric treatments and facilities lack the resources to act. Though the municipalities are responsible for the preventive health care in Denmark, the schools, which fall under the municipalities, and which remain to be the primary setting in the lives of young adults, are left to their own in developing strategies and policies for the mental health of their students. This results in unequal, fragmented or missing mental health care, which is often not evidence based (Jeppesen et al. 2022, Sundhedsstyrelsen 2022).

Though the mental health challenges of young adults are seen across gender and socioeconomic status (Katznelson, Görlich & Pless 2022), there is a small subgroup within the age group, which does not seem to be as affected by social media use and mental health challenges as their peers: young adults in the scouting community. Studies show that young adults who are part of the scouting community experience less strain on their mental health and are better at navigating social media than their peers, due to a higher self-efficacy built through scouting skill development strategies, gained through their scouting practice (Dibben, Playford & Mitchell 2016, Girl Scout Research Institute 2019).

Scouting is a private leisure activity in Denmark, and though scouting communities are currently experiencing an influx of members, it is still just a few percent of young adults who are participating in scouting communities and activities (Heckmann 2021). Scouting is often associated with a passion for nature and outdoor life. However, the scouting community is also built with a specific focus on empowerment, developing communication skills and independent problem solving; a focus that seems to benefit the young adults not only when building shelters, but also translates into navigating social media and coping with life as young adults in the digital age (Heckmann 2021, Girl Scout Research Institute 2019, World Organization of Scout Movement 2022). This could be due to the fact that scouting skill development is, knowingly or unknowingly, following on a well-known social cognitive theory by Albert Bandura (1986), that advocates building self-efficacy through four steps: **1.** *mastery experiences* (small wins and the continuing of completing small tasks), **2.** *vicarious experiences* (positive examples, guides and role models), **3.** *social persuasion* (ongoing feedback) and **4.** *current emotional state* (a positive emotional state increases self-efficacy). These steps to increasing self-efficacy are very similar to the scouting skill development strategies, in which the scouts learn to complete a series of tasks to receive badges, symbolizing the achievement of a specific skill (Mærkelex 2021). Through creative problem solving, the scouts complete a series of small tasks within an area, while simultaneously receiving feedback and guidance from their scout leaders. By doing this, they are following Bandura's (1986) steps to increasing self-efficacy; and thus, seem to become better at coping with today's challenges of navigating social media.

This translation and building of self-efficacy on social media through skill development in scouting, made us curious as to whether these hands-on scouting skill development strategies could be transferred to young adults in general, and to whether it is possible to let young adults who are not part of the scouting community gain some of the same benefits. With this goal, we set out to develop a game to build self-efficacy, based on the scouting skill development strategies and building self-efficacy, but targeted at young adults between the ages 16-24. Using Citizen Science-methods, we included both experienced scout leaders and young adults in a collaborative co-designing process of the game. We ended up designing a physical board game for young adults, based on some of the dilemmas young adults today face. The dilemmas are to be solved using scouting skill development strategies and peer collaboration, empathy training, creative thinking, and independent action, while receiving guidance and feedback; thus, building self-efficacy, which hopefully will transfer when logging on social media (Leonhardt, Fischer & Brüggemann 2022).

Having developed this board game, my next step was to plan and design a public health intervention, suitable for pilot testing, evaluation, and upscaling, integrating the board game as a part of young adult's digital training. As children and young adults spend most of their time in schools, school-based interventions have been widely acknowledged as the most obvious setting for public health interventions (Caldwell et al. 2019, King & Fazel 2019, Hugh et al. 2021, Van Loon et al. 2022, Gee et al. 2020). Several intervention research projects have been conducted, trying to find the most effective public health interventions for improving mental health, but the effects are limited, and they fail to be implemented long term (Schmidt, Werbrouck & Verhaeghe 2020, Caldwell, Davies & Hetrick 2019, King & Fazel 2019, Hugh et al. 2021, Van Loon et al. 2022, Gee et al. 2020).

However, a new approach to public health interventions is on the rise. Citizen Science-methods of collaboration and co-designing the interventions are shown to have a positive impact on the development and implementation processes in intervention research (Cedstrand et al. 2022., French et al. 2020, Lelie et al. 2022, Leask et al. 2019). Though the application of such research methods is still in its early stages and though the methods have not been used much in school-based interventions, there are a growing body of evidence supporting the effects on e.g. workplace interventions (Cedstrand et al. 2022, Ravalier et al. 2020, Lelie et al. 2022). Citizen Science-methods are thus beginning to gain acknowledgement for making citizens more empowered in interventions regarding their own health (Den Broder et al. 2018, Leask et al. 2019).

The purpose of this study was to plan a public health intervention, integrating the board game in a setting targeted at young adults, using a Citizen Science-approach of collaboration and co-designing. The aim was to prevent mental health challenges due to social media use within this group. The intervention would initially be targeted at high schools, as the high schools especially experience a lot of dropouts due to mental health challenges, and high school students are shown to have particular high levels of stress and anxiety due to social media use (Udesen et al. 2022, Bedre Psykiatri 2022, SDU 2022). However, the goal was also to create an intervention that has the potential of upscaling to other and broader target groups, securing equal mental health prevention for all young adults in Denmark. As most interventions fail due to the implementation process, the primary focus in the development process was using Citizen Science-methods to address and consider potential barriers and facilitators to a successful intervention as well as implementation.

Thus, my research questions were as follows:

Research Questions:

How can the board game be integrated in a public health intervention that both reflects and assists the needs of high school students in Denmark? Which setting and context are most suitable for implementing and integrating the game? How does the game need to be adjusted to the specified target group, context, and setting?

METHODS AND DATA

To ensure a structured approach to public health intervention development, the process of developing the intervention was framed by the 6SQuID model of "6 Steps to Intervention Development".

The SQUID-model goes through six steps: **1.** *Defining and understanding the problem and its causes.* **2.** *Identifying which causal or contextual factors are modifiable: which have the greatest scope for change and who would benefit most.* **3.** *Deciding on the mechanisms of change.* **4.** *Clarifying how these will be delivered.* **5.** *Testing and adapting the intervention* and **6.** *Collecting sufficient evidence of effectiveness to proceed to a rigorous evaluation* (Wight et al. 2016). The scope of this article will cover steps 1-4.

The model is based on best practices and the strength of existing frameworks, but has been updated to a more hands-on approach, and assumes a necessity of including a wide variety of actors and their needs and perspectives (Wight et al. 2016). This is an important reason for the choice to use this specific model, as multiple stakeholders are an essential part of this co-designing and collaborative project. Studies show that when developing and implementing complex public health interventions, a lot of barriers and facilitators can be identified and considered in the development phase, by including the relevant stakeholders who will either be affected by or participating in delivering the intervention (Cedstrand et al. 2022, French et al. 2020, Lelie et al. 2022, Den Broder et al. 2018).

I chose to make use of Citizen Science-methods throughout the entire development process. Citizen Science-methods in regards to public health, can be defined as "(...) *collaborative public health intervention development by academics working alongside other stakeholders*'' (Leask et al. 2019, p. 2) and the extent of the stakeholder engagement is on a continuum ranging from obtaining end-user feedback on a product designed by an expert designer, via co-creation approaches involving all actors on an equal contribution of knowledge throughout the development process, to meta-design which is initiated and controlled solely by end-users (Leask et al. 2019). In this project, I made use of Citizen Science co-creation approaches, collaborating with the stakeholders in an equal contribution of knowledge and decision-making through phases 1-4 of the development phase. The citizens included in the development process were the target group: high school students, as well as high school teachers, high school administration and the scout leaders who initially helped develop the board game, which were to be integrated in the intervention.

The co-designing workshops used in the abovementioned phases were structured around Spinuzzi's three stages in "Methodology of Participatory Design"; **1.** *Initial exploration of work*, **2.** *Discovery processes* and **3.** *Prototyping* (Spinuzzi 2005).

The choice of these models was based on "The Fundamental Elements of Citizen Science" by Golumbic et al. (2017), in which both inclusion, contribution and reciprocality is in focus. The SQUID-model presumes a high level of needs assessment and I have chosen to use an elaborate form of this, using co-design and collaboration. The phases 1-4 of the model, as this article covers, will first have elements of inclusion; activities the public can participate in. This through co-design workshops, fieldwork, and co-designing interviews throughout all four phases, as well as in the development phase of the game itself, which preceded this article (Leonhardt, Fischer & Brüggemann 2022). It also contains elements of contribution for both science and citizens, as we develop an intervention that aims to be a contribution to the mental health care and support for young adults and the adults in their primary settings. The citizens' contribution is not only to ensure a higher level of efficiency of the intervention, thus creating a more cost-effective intervention: the use of citizens and Citizen Science-methods will also be a contribution to the scientific knowledge base and can help other similar projects going forwards. Finally, the concept of reciprocality is essential to all the phases of collaborative development. We as scientists are not able to develop an effective intervention without including the citizens and their context, barriers and needs. The citizens in need of this intervention, the high school students, and teachers, will also benefit from the dissemination of the scientific basis behind the game and intervention, thus gaining a better understanding of tools for coping and navigating social media, but perhaps also gain a better understanding of why this challenge is proven so difficult to solve.

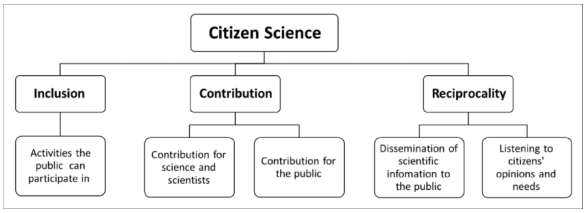

Figure 1: The Principles of Citizen Science. Golumbic 2017.

However, as the collaborative and co-designing process is fundamental for the development of the intervention, and as citizens without scientific training become co-researchers throughout the process, I have included Spinuzzi's (2005) structured approach to participatory design. This to ensure a high scientific level, despite the high level of citizen inclusion.

DATA COLLECTION

As the initial and exploratory step in the co-designing process, I contacted the high school administration of a high school in Denmark. The purpose of this was to get the principal's view on how the game suited the setting of a high school, if and how an intervention integrating this game could be best implemented and which adaptations were needed for a successful intervention. To get insights to this, I conducted a semi-structured interview with the principal of the highschool, followed by a process of letting her test the game in a setting of her own choice, including both high school teachers and 30 students in a high school class, thus obtaining and considering their feedback from interacting with the game in that context. The purpose of this was to gain insights to phase 1, 2 and 4 of the intervention development (Wight et al. 2016). As this project was a continuation of a previous development of the board game (Leonhardt, Fischer & Brüggemann 2022), in which we focused on phase 3; Deciding on the mechanisms of change, this interview also served as a dissemination of the scientific basis for the board game to the principal.

Following this, I moved on to a continuation of the exploration phase, as well as to the discovery phase and finally prototyping (Spinuzzi 2005). I conducted a participatory design workshop with four highschool students, in which they first got to interact with the game and make adjustments and additions to the initial prototype of the game, making it more relevant to them as a specific target group, as opposed to young adults in general. This was followed by a process in which I shared the feedback from the high school administration and teachers. The highschool students also came up with the solutions to the challenges experienced by the high school class, as well as an intervention design integrating the game, that took both their own as well as the other stakeholders' feedback into consideration.

Figure 2: Participatory workshop with high school students.

I presented the intervention design to the scout leader who helped develop the game, to make sure that the game and intervention draft still lined with the scouting skill development strategies, following the adaptations. Lastly, I disseminated the results of our process, the final intervention, to the participating citizens, both the principal, the high school students, and the scout leaders, asking for final comments and inputs.

RESULTS

1. Defining and understanding the problem and its causes

Through the semi-structured interview with the high school principal, I learned that the teachers are overburdened with the curriculum and do not have time to focus their efforts on preventing mental health challenges for their students during class. Also, the principal confirmed that they do not have any guidelines or expertise in how to prevent and deal with the challenges they experience and that it is solely up to her as principal to ensure that any efforts are taken, and this is voluntary.
Also, the principal felt that she was "*drowning in offers and solutions*", as the challenges of young adults are currently heavily covered by the media. Thus, she found it hard to navigate these offers and options and to decide which were to be most beneficial and suitable to implement.
The principal chose to test our board game in a high school class. Through this, she reported that several of the students felt a bit embarrassed and were easily distracted when discussing the dilemmas presented in the board game.

In the workshop with the students, we found that the high school students did not view social media as an isolated issue as the game was otherwise suggesting. The students expressed that the challenges of high school life are enhanced by social media, but not that social media was a

challenge on its own. Thus, the students adjusted the game to make it more about the social conflicts in highschool and how these were enhanced by social media, than about social media itself.
Furthermore, the students also found the game to be too personal, which led to a reintroduction of some elements of the board game in which the students were to play as a fictional persona, which were otherwise taken out to simplify the game. The students felt that these elements would help address the issues of embarrassment and distraction, by making it less personal and more of a general discussion of best courses of action to solve the dilemmas presented in the game.

This phase thus served as both an exploratory insight into the high school setting and context, and to specify and further develop the game, to make it more suitable to the needs of the specific target group, high school students. Here we found that the game, designed to and by young adults in general, could not be directly transferred to high school students, but needed adjustments to make it more interesting and appealing to the students.

2. Identifying which causal or contextual factors are modifiable

Through the interview with the principal, we agreed that the game was most likely not suited to be implemented in a curriculum within a specific topic, due to the lack of time and resources. The principal found that any activities involving the social culture and thriving in high school, was better implemented in the intro courses and activities, either in the beginning of the year or when the students were allotted into their respective study programs. The school has already budgeted time and resources for social initiatives and promotion of well-being during the months of intro courses and activities, and this is also when the students are new and social behavior and groups are established.

In her experience though, the students were usually preoccupied with just learning how to navigate being high school students in the beginning of the school year, so she suggested implementing the game later in the year, when the students were assigned the group of peers they were to follow throughout their time in high school. To test whether this assessment was true and whether the game was accepted and implemented by the teachers and students, the principal tried the game in this specific setting. Through this, we found that though the students were easily distracted and embarrassed, the students were generally positive and found the game to be potentially beneficial and spark interesting discussions. The teachers also found it to be a simple way to implement these social initiatives.

Implementing the game in the suggested setting, already prepared for, and assigned to promotion of well-being, opposed to just including it in the curriculum, would thus be a help and lessen the burden of the teachers having to come up with initiatives themselves, thus hopefully also lessen the resistance towards interventions.

In the workshop with the high school students, they also suggested implementing the game later in the year, when assigned to their study programs, as opposed to in the beginning of the year, as they would feel more comfortable playing the game when they were more experienced in high school life and the challenges this presented.

We discussed the possibility for an online component to the tool, and the high school students agreed that this would be an interesting addition. The principal was generally opposed to this. She found that they as teachers needed to be present as guides when having these discussions, and that the physical presence played a big role in establishing the social dynamics.

This phase thus served as a mapping of the context and setting best suitable for an intervention integrating the game, and to identify barriers and facilitators in the context of high school as an intervention setting.

3. Deciding on the mechanism of change

The mechanism of change was decided upon in developing the game with the scout leaders and young adults. The purpose of the board game is to build self-efficacy through scouting skill development strategies (Leonhardt, Fischer & Brüggemann 2022). Thus, when integrating these mechanisms of change in a holistic intervention, setting and context imposed the risk of deviating from the scouting skill development strategies planned by the scout leaders. Because of this, I chose to run the adaptations of the game by the scout leaders who initially helped develop the game.

They found that adding a layer of distance, by playing as another character, was an improvement and more in line with the scouting skill development strategies. They expressed that training empathy was an important element of the game, and that having the discussion among peers and trying to help and solve an issue for a fictional character, was similar to how scouts take responsibility for peers when solving problems in the scouting community.

The scouts also, like the principal, found the physical presence to be essential to building the skills, and impressed the importance of playing the game repeatedly as opposed to just once, as this continuous training and advancement is a big part of scouting skill development.

4. Clarifying how these will be delivered

Based on the workshops, interview, and ethnographic feedback, I drafted a program theory for the intervention, including the intervention components, mechanisms, expected outcomes and impacts, as well as the context the intervention would be implemented in. The mechanisms in the program theory continued to be based on the behavioral learning theory from Bandura (1986), which the game was based on, combined with the scouting experiences. The expected outcomes and impact were based on the evidence and literature supporting this theory (Leonhardt, Fischer & Brüggemann 2022).

However, the activities to achieve these outcomes and mechanisms, as well as the context and setting of the intervention, were designed with and by the stakeholders, high school students, teachers, administration, and scout leaders. This final intervention along with the program theory and the final adaptations of the game, were presented to the citizen groups of stakeholders, who all were given a chance to make final remarks, as well as ask questions.

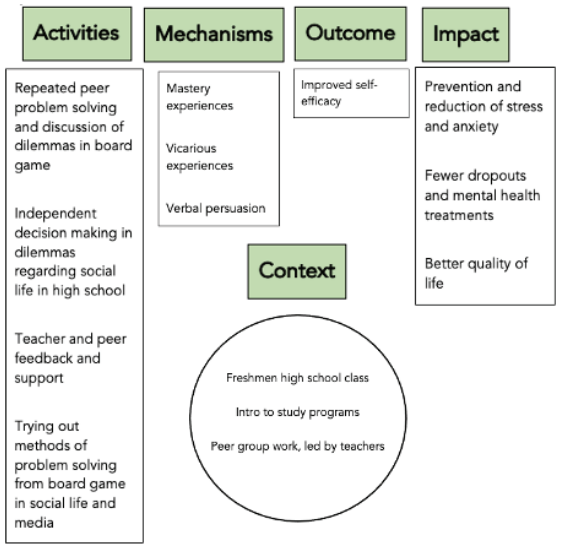

Figure 3: Program theory of the intervention

DISCUSSION

My study set out to do what I planned, as I developed a public health intervention, suitable for pilot testing, effect evaluation and upscaling, and which is co-created in collaboration with the relevant stakeholders. I managed to get groups of citizens who represented the stakeholders, and they were very engaged in the process and the outcome. This level of engagement and participation from the stakeholders in the development process should help ensure that the intervention actually meets the needs of the target group and stakeholders; high school students and high school teachers and administration. It should also give a higher sense of empowerment and ensure that potential barriers to the intervention and its implementation is considered and prevented from the start.

The use of the Citizen Science-methods was thus very suitable for designing this public health intervention, and I would argue that it is potentially an answer to the intervention tiredness and some of the barriers of implementation that is so often experienced in school based public health interventions as well as public health interventions in general (Leask 2019).
I would argue that the citizen involvement in the process is between a level three and four of the Citizen Science-levels (Hakley 2011), and the process to be considered ranging between "participatory science" and "extreme and collaborative science", in which citizens are included in both the problem definition, the data collection and to some extent in the analysis. In this project the citizens were co-designers in both the development of the board game, but also through all four phases of intervention development, also serving as co-scientists doing ethnographic fieldwork and co-analyzing results from workshops with the other citizen groups.

This extensive level of Citizen Science is however both time consuming and demanding work if we as researchers are to ensure scientific results while also facilitating and organizing this high level of collaboration. The success of collaboration in this project is thus possibly due to the small scale and simplicity of the intervention. As this intervention was a pilot project, a relatively small number of stakeholders have been included and were this project to be done on a larger scale, more interviews, more cycles of workshops and more ethnographic fieldwork would have to be done, making the co-designing process more extensive. Also, had the intervention itself been more complicated, had more levels, components or been cross-sectional, maintaining this level of citizen involvement would have been far more extensive and likely presented more challenges. A more complicated intervention would have required more stakeholder groups and a more iterative process of going back and forth in the co-designing process.

However, as complex issues require complex solutions, I would argue that this intervention could have benefitted from having more components and to be cross-sectional, including other stakeholder groups, such as health personnel, parents, the municipality etc. I would still argue that a collaborative approach would be suitable in a more complex public health intervention dealing with the mental health challenges of young adults, as issues and barriers to implementation of public health interventions only increase with complexity and layers, and as Citizen

Science-methods propose promising solutions to the challenges of intervention development and implementation (Leask 2019). However, a much wider timeframe and more resources would have to be allotted for this to be possible (Oliver, Kothari & Mays 2019).

I had some ethical concerns due to the subject of dealing with mental health in young adults. When dealing with public health interventions, there is always the risk of unintended consequences when interfering with established social systems (Bruhn 2001). However, the intervention is not an alternative to mental health treatment and is not targeted at people suffering from severe mental health issues, nor is it meant to treat mental illness. As the goal is only to build self-efficacy through problem solving and dialogue, and as we only confronted the high school students with dilemmas, they themselves have presented and already face daily, I expected that potential negative consequence was accounted for and prevented in the design. The choice of including the students in workshops, in a guided and safe environment, helped to consider potential issues early on as opposed to afterwards, resulting in adjustments of the game and empowerment of the students. Based on the principal's suggestions, I chose not to let the students try the game in the beginning of the school year, as we wanted to avoid feelings of unease and embarrassment. This was unfortunately not entirely avoided during the fieldwork, and more collaborative workshops before trying the game in the high school class would probably have prevented this.

I initially considered making the tool digital or adding digital components to the game or intervention. I found great inspiration in the CoAct for mental health project (University of Barcelona 2022), where they have the users interact with each other, supporting each other through relatable dilemmas similar to the ones presented by the high school students. The benefit of a digital version would be that young adults today could use the tool anonymously and throughout longer periods of time, thus potentially improving their self-efficacy further. This would address the primary concern of the scout leaders, in which they stressed the importance of playing the board game repeatedly, which might not prove possible in the chosen setting.

Digital health solutions for young adults are becoming increasingly popular, and new initiatives such as Mindhelper.dk, Cyberhus, Netstof.dk and gruppechat.dk are all Danish online initiatives, offering counseling to young adults experiencing mental health challenges (Mindhelper.dk 2022, Cyberhus 2022). Though these serve mostly as voluntary counseling and treatment of young adults already suffering from anxiety and stress, there is great potential in using digital solutions such as these in more preventive and targeted efforts as well. The digital solutions are well received by young adults and have potential for a greater reach than the physical solutions (Mejlholm et al. 2022).

However, in this project, the scout leaders found it difficult to maintain and approve of the scouting skill development strategies in a digital format, and the physical form of the tool was well suited for the setting we ended up choosing. The principal also specifically expressed a need for a physical product to implement in the high school setting. However, a digital variation or a digital component of the tool could potentially be explored and added to the intervention as well, though this would require resources beyond the scope of this project.

A suggestion presented from all the stakeholders was also the possibility of starting this digital training and building of self-efficacy in a younger age group. This makes sense from a perspective of prevention, as most habits are built in childhood, and as mental health challenges among young adults arise earlier and earlier (Whitebread & Bingham 2013, Katznelson, Görlich & Pless 2022).

Based on this project, I do believe that Citizen Science-methods propose a solution to some of the main challenges of public health interventions and the implementation of these. I also believe that scouting skill development strategies propose interesting solutions to some of the challenges young adults face today. However, I do not believe that the intervention in its current form would be sufficient to see an effect in a pilot study, as it remains to be too simple. More components to the interventions would have to be added if structural change is to be achieved and partnerships with some of the digital treatment and counseling solutions could be part of this.

However, were this to be done and were the intervention to show an effect in the evaluation, the next step would naturally be to first upscale the intervention to all high school students in Denmark, securing equal prevention of mental health challenges among young adults. From there, an adaptation of the intervention could be done to make the intervention fit a broader variety of target groups as well. In such an adaptation process, including the stakeholders in another collaborative process would be beneficial. It must be expected that different age groups of young adults live in different contexts and need the intervention in different settings, and thus that the intervention cannot be directly transferred to e.g., public schools without adaptations and more cycles of co-design.

It would also be beneficial to consider the language used in the game and intervention and target it the other age groups and perhaps socioeconomic groups, were the intervention to be implemented in e.g., vocational schools (Movsisyan et al. 2021). This would also be necessary if the upscaling were to continue with the principles of Citizen

Science, in which dissemination of scientific knowledge plays an important part. This dissemination must be expected to take different forms when upscaling and adapting the intervention to different age groups and across socioeconomic classes.

CONCLUSION

Citizen Science-methods are still relatively new, especially in public health, but the results are promising, as shown both in this project and in other similar projects. Benefits such as greater empowerment of the stakeholders and a more effective implementation process are an interesting contribution and solution to the known issues of implementing public health interventions. As public health aims to secure equal health, including mental health, for all citizens, taking steps to ensure that the citizens in questions are heard and that intervention to ensure these addresses and reflects the needs and issues of the citizens in question, seems a necessary and previously under-prioritized requirement.

Though this project is a pilot study, and more work would have to be done to ensure the effects of this intervention, the overall methods of collaboration in developing public health intervention should serve as an inspiration in the public health intervention research field, thus contributing to the solution to the known main challenges of the field, lack of effect and unsuccessful implementation processes. Citizen Science is thus a way to address these expected challenges early on and as a final note, I will agree with the statement that any public health interventions should be developed "(...) for the people, with the people or by the people'' (Den Broder et al. 2018, p. 506).

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YOUNG REFUGEES IN DENMARK - FACILITATORS AND BARRIERS TO INTEGRATION

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ABSTRACT

Immigration has for decades been a contentious and highly politicised issue in Denmark. Some refugees can establish themselves, thriving both socially and economically, however, this is far from the case for all. Through a multi-method Citizen Science approach and in collaboration with four refugees in Denmark, we aimed to co-create a pilot project to offer insight into the facilitating and hindering factors regarding Integration that exist in Danish society, and how these factors have consequences for refugees´ feelings of empowerment in the process of Integration. We found that a network is a facilitating factor, that integration Is a two-way-process and that visa restrictions can cause uncertainty and insecurity for refugees. While the co-creation of problem identification and development led to rich empirical data, the pilot project for citizen data collection did not generate new empirical material. We argue however, that this project contributes to the knowledge base on refugees living in Denmark and can help in the design of interventions to empower and facilitate the integration process. This project demonstrates that it is possible to co-create and design research within this target group, and in this field of research; and that there is potential for further development of the Raising Voices intervention.

KEYWORDS:

Citizen Science Approach, Empowerment , Social Capital, Refugees, Intervention, Denmark

INTRODUCTION

Migration and refugee policy is a complex, and often contentious issue (Dahl et al. (2020), p 216). Danish immigration and refugee policy has over the past two decades been a politically divisive issue and is generally framed in a negative light, having led to an increase in restrictions for migrants and refugees (Refugees, 2021, p. 1).Currently, there are 89.3 million people worldwide, who have been forcibly displaced by war, violence, or conflict, resulting in a violation of human rights (UNHCR, 2022), seeing an increase of international migrants by 60% since 1990 (Pyrhönen et al., 2017 i Dhal, 2021, p. 216). In 2015 at the height of the Syrian Civil War, Denmark received over 20,000 applications for asylum. More recently, the number of refugees applying for asylum in Denmark has fallen, with a mere 600 people being granted asylum in 2020 (Statista, 2022). This tendency indicates a decrease in applicants, and a tightening of restrictions, discouraging applications for asylum.

For the purposes of this study, and pertaining to the participants of our project, we will use the term refugee, which the United Nations (UN) defines as:
"owing to well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion, is outside the country of his nationality and is unable or, owing to such fear, is unwilling to avail himself of the protection of that country; or who, not having a nationality and being outside the country of his former habitual residence, is unable or, owing to such fear, is unwilling to return to it." (UNHCR, 2022). Despite many refugees, successfully integrating socially and economically, the UNHCR reports that there is a disproportionate overrepresentation of refugees who have not managed to integrate and face challenges such as unemployment, residential and social segregation, and barriers to citizenship (UNHCR, 2014).
This is also true of refugees living in Denmark today, and despite international pressure to improve conditions for refugees, Denmark has, according to the Migrant Integration Index (MIPEX) rescinded its commitment to integration. Moreover, in comparison to 2014 there has been an increase in visa insecurity, access to employment, family reunification and access to basic rights have been tightened. This restrictive Danish policy not only affects integration, but also influences how the Danish public view refugees and migrants (MIPEX, 2015) often leading to a harsh public discourse surrounding immigration and integration issues (Farkas, 2020, p. 3). A recent critical discourse analysis found that migrants are considered problems to be solved in Nordic countries; that they are limited in active and independent decision-making, and that there is a lack of focus on empowerment. This can result in detrimental health and well-being outcomes and

an impact on integration (Dhal, 2021, p. 216). Here we refer to Tengland´s definition of empowerment as:
"… an increase in the general ability to achieve intended quality of life goals, either through the removal of external (physical, social, political, economic) obstacles (increased freedom or opportunity), or through an increase in knowledge (consciousness raising, skills development, self-knowledge, etc), autonomy, self-confidence (and self-efficacy) or self-esteem" (Tengland, 2006, p. 197).

Given the unfavourable body of evidence surrounding this topic, and despite this negative depiction of both Danish policy and representation of refugees in Denmark, it is interesting to examine whether refugees can and do in fact feel empowered living in Denmark. Whether that is the ability to make qualified, independent decisions concerning one's own life, family, health, finances and education or having a feeling of self-worth and being able to contribute to society. As such, we engaged four refugees, with the aim of investigating what empowerment means to them, living in Denmark.

AIM

The aim of this project is to, through a Citizen Science (CS) Approach, investigate how young refugees experience life in Denmark, within a politically charged, and restrictive environment. This project will attempt to identify barriers, and facilitators to successful integration in Denmark and what elements contribute to refugees feeling empowered in this regard. In light of the recent war in Ukraine, we have chosen to focus on established refugees in Denmark with the hope of learning how they experience empowerment. This project may offer some insight into how to better facilitate integration for refugees in the future.

Research Question

What are the barriers and facilitators for successful integration, and what elements contribute to refugees feeling empowered in integration?

Figure 1: Participants of the Brio Train Workshop, discussing their path to Denmark.

MULTI-METHOD APPROACH AND DATA COLLECTION

In this paper, we address the approach of CS according to Muki Hakley´s definition, which will be described in this chapter, with a presentation of how we place this project according to Hackley's framework for participation in CS (Hakley, 2013, p. 105). Furthermore, we will describe the methods used for the preliminary groundwork leading to the co-creation of the design of the pilot study in citizen data collection.

Citizen Science Approach

Hakleys definition of CS is not a precise definition but is an attempt to clarify the core characteristics of the practice and is defined as: *"Scientific activities in which non-professional scientists voluntarily participate in data collection, analysis and dissemination of a scientific project (Hakley, 2013, p. 106)"*. In addition, he states that participants in science studies that are not active in the study, should not be included in the definition, and Hakley defines scientists as all active participants in a science project, although noting that CS can only exist within an academic framework and with the guidance of professional scientists (Hakley, 2013, p. 107).

As Hakley´s definition of CS involves some degree of active participation in science, Haklay offers a framework that classifies the level of participation and engagement for citizens. Although Haklay´s framework is similar to Arnstein's "Ladder of participation", he distinguishes himself from Arnstein by outlining a less rigid structure. Within the framework, Haklay allows various degrees of citizen participation but encourages that projects aim for the highest level of engagement and involvement that is suitable for the study (Hakley, 2013, pp. 115-116).

Participation and Engagement

This project was constructed in collaboration with four young refugees in Denmark. The aim was to engage the participants at level 3 "Participatory Science" according to Hakely´s framework on *Levels of Participation and engagement* in CS projects (see figure 2).

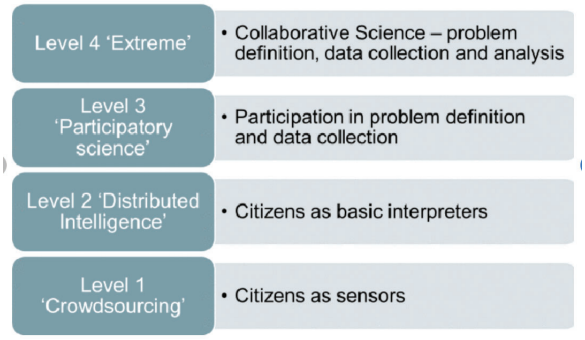

Figure 2: Hakley´s Model of Levels of Participation and Engagement in Citizen Science Projects (Hakley, 2013, p. 116)

The above figure presents Hackley's levels of participation and engagement of participants, in which this project aimed to engage the participants at level 3 'Participatory Science.' The participants were invited to a co-creation workshop, where they helped define the challenges that the pilot project should address. In addition, the participants were invited to participate in the pilot project of citizen data collection.

Inclusion, contribution, and reciprocity:

Though citizens play an active part in the scientific research process, it is fundamental in CS that the level of participation can vary and range from simple contributions of information to co-creation of projects that involve citizens in all stages of the research process (Golumbic, 2017, p. 2). We aimed to engage the participants at "Level 3, participatory science" including citizens in the problem definition of the project and addressing collaboration with the participants.
The following model (figure 3) demonstrates how we aimed for inclusion, contribution, and reciprocity according to the model of *"Three fundamental elements of citizen science"*.

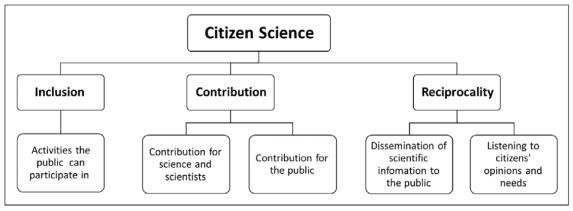

Figure 3: Three Fundamentals of Citizen Science, Columbic (2017)

Evidence indicates that collaboration between professional researchers and citizens can be beneficial to both science and society. While the main advantage for science is the contribution of new findings, the benefits for the public include a sense of achievement and individual contribution to science (Golumbic, 2017, p. 2).

The project was established with the aim of supporting participants in having an impact on society and a platform for raising awareness. The participants were informed about the value of their contribution to science and that they were co-creators of the pilot project (Golumbic, 2017, p. 3). To ensure reciprocity, we facilitated a co-creation workshop in which we asked the participants to identify and analyse challenges. Furthermore, we aimed to communicate the purpose of the project and their role in it, as well as including them in decision-making (Golumbic, 2017, p. 3).

Iterative Design Process

This project was built on an iterative design process, meaning that every point of data collection was thematically analysed and subsequently informed the next step. This process is depicted in Figure 4 below. Steps 1 and 2 illustrate the preliminary groundwork while step 3 illustrates the initiative to co-create on the project design leading to the pilot project in citizen data collection.

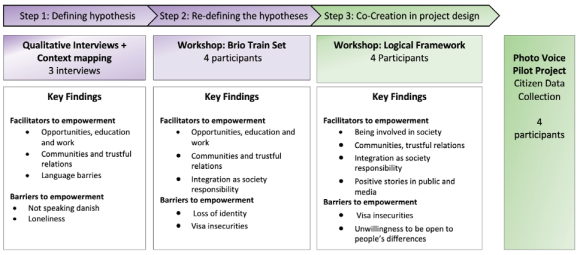

Figure 4: Iterative Design process of the pilot project

Figure 4 shows the iterative design process of the pilot project and builds on elements of Hackley´s (2013) participatory science model where we include citizens in the problem definition, and as basic interpreters of the project. Our model is also inspired by Golumbic et al. (2017) as we were able to encourage citizens to contribute to ideas and opinions on the forming of the project.

Before the participants were recruited for co-creation and citizen data collection, a preliminary groundwork of multi-method qualitative data was conducted, with the aim of investigating the relevance of establishing a CS study within the theme of the project.
The preliminary groundwork consisted of a broad literature review, three semi-structured interviews including context mapping, a workshop of four participants and subsequently the recruitment of participants for the co-creation for the design of the pilot project.

Literature

We conducted a preliminary review of current literature on the topic of empowerment and refugees in Denmark, utilising keywords in search engines, such as Google Scholar, and relevant electronic journal databases, combined with literature provided by the Citizen Science Team at SDU. Literature was compiled and organised in Endnote. This initial search contributed to a broad overview of the topic and guided further decision making in the project.

In the process of collecting empirical data, we informed participants of their rights, and stored the project's data on a secure database, ensuring protection of personal data.

Qualitative Semi-Structured Interview and Context Mapping

We developed a semi-structured interview guide and conducted three interviews with refugees living in Denmark. We combined this with a Context Mapping Approach to encourage conversation and description of experiences. The semi-structured interviews combined with the context mapping facilitated a dialogue about the experiences of the interviewees in fleeing from their home

country to Denmark. The context mapping enriched the conversation, bringing memories to the surface, and encouraged sharing of experiences.

Context Mapping

Sleeswijk Visser et al. (2005) describe context mapping a new, and upcoming field, that is still in a process of development. It involves various methods and techniques for mapping the context of people's interaction with products, giving researchers deeper insight into users' wishes, or in our case, citizens' stories. They state that context has many components other than setting, environment, time, and space and refers to
"… all factors that influence the experience of a product use".
There is also a focus on context being based on personal experiences and can facilitate a richer, more dependable view of a situation(FROUKJE SLEESWIJK VISSER, 2005, pp. 119-121). We used the context mapping to supplement the semi-structured interviews, facilitating story telling.

Train Set Method

The Train Set method is a productive and dynamic tool to facilitate conversation (Burr, 2020, p. 14). For this workshop we used a Brio Train set as a conversation starter and facilitated conversation concerning issues of migration in Denmark. By building a model railway and placing symbolic objects, citizens were asked to collaborate and build their journey starting from when they first arrived in Denmark and ending where they are now. The train set functioned as a tool to help us understand a refugee's journey, during and after arriving in Denmark.

Recruitment of participants

We participated in an event at Dansk Flygtningehjælp Ungdom (DFUNK) with the goal of establishing a connection with some potential citizens, informing of the project, and building trust. This enabled the recruitment of participants to the project.

Logical Framework and Co-creation Workshop

The co-creating of the design process of the pilot study, draws upon features of the Logical Framework approach (NORAD, 1999, pp. 2-3). Four young refugees were invited to participate in a co-creation workshop, where we acted as facilitators. Based on the preliminary groundwork, we laid out a hypothesis to open discussion amongst the participants. The discussion was aimed at identifying barriers and facilitators, or methods of empowerment, inspired by their experiences living in Denmark as refugees.

The first question of discussion was:
It is difficult for refugees to integrate into Danish society - why?
Participants responded by writing their thoughts and opinions on a post-It and presented their ideas for the group. Then the participants were asked to work together on clustering the post-its into themes.

Following this, we asked them to identify solutions to the barriers to integration with questions like:
How do we tackle these issues?
and What will the future look like if we don't do anything?
Again, we facilitated and organised the forum for participants to articulate and share their ideas on post-Its, cluster them and analyse common themes.

Photo Voice - a Pilot Intervention

Photo Voice is a photographic technique where we encouraged participants to take pictures of their daily lives that corresponded to a theme or question. Photo Voice as a method has three main goals: to enable reflections on strength and concerns, promote critical dialogue and discussion, and finally to reach policymakers (Wang, 1997, p. 369). In the final phase of our project, we established a Facebook group "Raising Voices," and invited the project's citizens to participate. The aim of this pilot study was to facilitate five days of data collection, building on our findings and providing a forum for the community. Once a day we posted a question encouraging participants to share pictures of objects, people or symbols that represented the theme of the question. The participants were then encouraged to interact with each other on the online platform and discuss the photos. We had hoped that combining the Photo Voice method and the social media tool, Facebook would facilitate an effective and accessible medium for promoting community and sharing of the good stories of integration (Liberatore, 2018, p. 1).

In the process of collecting empirical data, we informed participants of their rights, and stored the project's data on a secure database, ensuring protection of personal data.

Analysis

In the initial stages of the project, we examined current literature in the field of empowerment and integration of refugees in Denmark. This deductive approach played a key role in the design and analysis of the collected data, as we built on pre-existing research.

Semi Structured Interviews: All interviews were audio recorded and supplemented with field notes. We then identified recurring codes and analysed them into themes. These themes informed the planning and design of our subsequent data collections.

Workshop 1: The Brio Train Workshop was video, and audio recorded and supplemented with field notes and photographs. We found it important to video record the workshop to be able to later identify the use of the train

set. The data material was then coded and analysed into themes.

Workshop 2: Co-creation Workshop was audio recorded and supplemented with field notes. Significant quotes were identified and recorded. The participants were instrumental in identifying and analysing themes. These themes informed our key findings.

Reflexive Thematic Analysis

Reflexive thematic analysis (RTA) was applied as a method to analyse the overall data collection in the project. This approach allows a theoretically flexible interpretative approach, to identify patterns and themes in qualitative data. In the reflexive approach to thematic analysis, the researcher plays an active role in producing knowledge, meaning that codes and themes represent the researchers' interpretations of patterns in the data and allows the researchers to define themes and codes based on theoretical knowledge(Byrne, 2021, pp. 1-3). As the RTA approach allows for flexible interpretations, we identified and cross-examined recurring themes across the different data collections.

RESULTS

The following is an identification of significant findings and a discussion of how this impacts the ability of young refugees to feel empowered in the complex and limiting setting that is Denmark.

i. A network is a facilitator for empowerment and integration.

We found that the concept of a network or support was essential for young refugees' ability to integrate and feel empowered. The participants revealed that having a person, or group of people to guide and inform in a supporting way, increased a sense of empowerment for many of the young people we spoke with.

One participant explained that:

"Just like a child, you need to have safe relationships that help you, accept you and support you as you are. I was introduced to DFUNK and 'Fortællinger på Flugt (Stories of Persecution) by a woman who was a great support to me. She helped me understand many things about Denmark and Danish culture".

To examine the concept of network further, we have chosen to utilise the theory of Social Capital.

Bourdieu defines social capital as: 'The aggregate of the actual or potential resources which are linked to possession of a durable network of institutionalised relationships of mutual acquaintance or recognition' (Bourdieu, 1985, p. 248 i Andersen, 2011, p. 93). In identifying a network (social capital) as a facilitator, the participants in the project suggest that relationships with ethnic Danes is an essential and facilitating factor enabling the learning of the Danish language, introduction to Danish culture and institutions, and facilitating access to support groups education and employment opportunities. Indeed, social capital and empowerment concepts have been used as methods in promotion of participation among citizens (Andersen, 2011, p. 89) and can contribute to an improved integration process. This finding can inform a possible intervention for networking and integration among refugees and migrants.

ii. Integration is a two-way-process

Another significant finding of the project was that integration is a two-way-process. Participants suggested that both the host nation, and the refugee should be willing to work toward common goals and build trust through relationships. *"Integration is being able to collaborate. It should be a social responsibility to integrate, integration is good for everyone. Both parties must be able to cooperate and communicate. In order for me to be integrated in society, I must be able to understand and recognize the society I am part of. It goes both ways".*

Similarly, the UN Refugee Agency´s Discussion Paper on Integration of Refugees, stating that *integration of refugees is a dynamic and multifaceted two-way process which requires efforts by all parties concerned, including a preparedness on the part of refugees to adapt to the host society without having to forego their own cultural identity, and a corresponding readiness on the part of host communities and public institutions to welcome refugees and meet the needs of a diverse population (UNHCR, 2014, p. 1).* Given the harsh tone and restrictive environment surrounding integration in Denmark, it could be argued there is a need to intervene in this area, encouraging the host nation and refugee to meet on common ground. .

Figure 5: Logical Framework and Co-creation Workshop

iii. Visa insecurity is a barrier to empowerment and integration

The final important finding states that visa insecurity is a barrier to integration and has consequences for refugees´ empowerment. Visa insecurity was a dominant theme for some ofthe refugees.
One participant stated that:
"I can feel uncertain as to whether I will be allowed to stay in Denmark. You want to integrate, but you don't know if it's a waste of time. I have also felt afraid to spend money on something, because you would have to save up if you are now thrown out of the country".

The Danish approach to integration has been described as "Temporary Integration" where foreign citizens can benefit from access to basic rights and some targeted support for equal opportunities and yet are not able to access the long-term security of permanent residency (MIPEX, 2015). This temporary solution can have adverse effects on refugees' ability to make long-term plans, including planning for education and families and taking holidays and was a source of increased anxiety.

Photo Voice Pilot Intervention

While the participants played an important role in co-creating and defining the project, we found it difficult to maintain consistent contact with them. This resulted in withdrawal from participation and decision-making on the design of the pilot intervention. Due to limited resources, we had to make decisions without their input. Consequently, the Photo Voice pilot intervention did not contribute to any further data collection from the participants.
Moreover, given the difficulty maintaining engagement in the project could indicate that the participants did not find the pilot intervention and online community relevant. Another factor could be that the participants were recruited at DFUNK, which is already a source of strong community and therefore this project may have seemed redundant.

The method of citizen science has offered a valuable framework for investigating the issue of refugee empowerment in Denmark. Involving participants in the design of this project has been instrumental in informing our research and a method of empowerment, encouraging ownership and engagement in the project.

LIMITATIONS OF THE PROJECT

This project was co-created with a small sample size of citizens, consisting of only four young, talented refugees. These participants were all students, and as such were well-articulated. The participants are therefore not representative of all refugees.

Another limitation to the project is that one of the authors of this paper is herself an immigrant to Denmark, and through personal experiences may be biased.

CONCLUSION

Through a Citizen Science approach, we co-designed a project with four established refugees living in Denmark with the aim of answering the question: What are the barriers and facilitators for successful integration, and what elements contribute to refugees feeling empowered in integration? A multi-method CS Approach enabled data collection, which informed the subsequent step of the project. Participants identified the following factors that facilitate empowerment and hinder integration: Social capital in the form of a network is a facilitator for integration; integration is a two-way-process where responsibility rests on both the refugee and the host country and finally that visa insecurity is a barrier to integration. Furthermore, this project demonstrates that it is indeed possible to co-create and design research with this target group, and in this field; and that there is potential for further development of the Raising Voices intervention. The findings of this project contribute to the body of research on integration issues in Denmark and can guide the design of solutions for future interventions.

PROPOSAL FOR FUTURE INTERVENTIONS

The key findings of this project highlight aspects of integration, where focused interventions could potentially make a difference in the lives of refugees in Denmark. We see value in building on our findings, and expanding the project to more participants, and migrant groups.

The following are suggestions for how this project could be upscaled:

The Raising Voices pilot intervention has potential to be an effective platform for empowerment by sharing positive stories of integration in Denmark. This study could be extended to an international media platform such as JOGL, an online forum to build science communities.

Additionally, we would welcome collaboration with relevant NGOs, inviting them to a workshop in order to present the initial findings of our project, and apply for funding to cover activities, and to encourage active participation (incentive)…

In conclusion, reflection and lesson learning is essential in assessing what was effective and less effective in designing our CS project. Relevant adjustments could provide important insight into improving our project and the design of future interventions in integration.

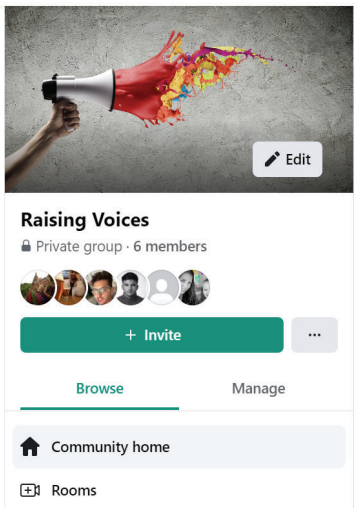

Figure 6: Photo Voice - Interactive Facebook Community, Raising Voices!

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COULD IMPROVING CITIZEN INVOLVEMENT HELP INCREASE LOCAL ACCEPTANCE OF WINDMILL PROJECTS?

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ABSTRACT

The objective of this paper is to investigate if improving citizen involvement can help increase local acceptance of windmill projects. To reach climate goals by 2050, Denmark is going to expand its wind power capacity by four fold as compared to the current level in the coming years. However, many citizens oppose the establishment of these facilities near their homes for a variety of reasons. This study hopes to identify the status of citizen involvement during windmill projects, and then to suggest future improvements. The research was carried out by conducting focus group interviews, surveys, and in-depth interviews with both citizens and municipalities. Results from our research show that the municipalities need to use more diverse approaches to involve citizens in the project at an early stage, including more communication, information, and collaboration. This is desired by citizens and suggests that it plays a key role in local acceptance and improves how citizens' concerns are addressed.

KEYWORDS:

NIMBY, Citizen involvement, Concerns, Windmill projects, Social acceptance, Denmark

INTRODUCTION

Expanding wind projects, especially on land, have been met with some opposition from residents in Denmark, which consequently has a negative effect on the Danish state's goal to become CO2 neutral in the near future. Protests have delayed or even ended wind projects across the country (Helms, 2019), (Brader, 2020). There are many factors contributing to the pushback, but improvement in terms of citizen involvement could play a key role in defusing future conflicts.

This phenomenon is known as "Not in My Backyard" (NIMBY). NIMBYism is characterized by citizens being opposed to various types of land development, such as, but not limited to, wind projects, in their local areas. They believe the development to be harmful or undesirable. Citizens will often oppose the development plans regardless of them having a positive or negative effect on the local community. However, the citizens would often support such developments if they were to be placed in other communities (CFI team, 2021).

The NIMBY effect may also be defined as social rejection of facilities, infrastructure, and services location, which are necessary for society, but have a negative connotation (E. Pol.et al., 2004). From previous research, three main reasons for this attitude are fairness, fear of risk, and distributive justice. Such classical social-psychological theories as the "social exchange theory" by Homans (1961) and "the equity theory" by Adams (1965) can be helpful to understand and manage the NIMBY effect. In addition, other authors' studies have found that financial compensation has an impact on people's acceptance or resistance attitudes (Freudenburg & Pastor, 1992).

The managerial aspect of the project implementation can also generate resistance. Khun and Ballard (1998) found that cases based on principles of decentralization of decision-making authority, and full meaningful public involvement, finished successfully without the NIMBY effect. Wolsink (1994) asserts that opposition is strongest in the planning phase and weaker before a local project is proposed. To explain this gap in attitude, Van (2015) found a possible explanation, which reflects variations in the level of local knowledge, exposure or access to information and experiential learning.

Danish research from 2020 came to a similar conclusion, through interviews with 73 Facebook groups (Haffmann, 2020). These groups were created by residents who were opposed to the construction of windmills. The two main conclusions drawn are: Danes have legitimate, concrete concerns about how the local wind project will affect the community, and they find the information given from

municipalities to be unclear and lacking. If the authorities were better at communicating and did so already while a project was being planned, more wind projects would go through with fewer conflicts (Borch et al., 2020) In response to the above findings, this study aims to identify the status of citizen involvement during windmills projects, and then to suggest future improvements.

METHODS

A combination of mixed research methods with both citizens and municipalities were used to investigate the problem and understand both sides of the issue. Different methods with citizens were used, including focus group interviews, a survey, and in-depth interviews. Likewise, different methods were used with municipalities, including a survey and an in-depth interview with an employer from Varde Municipality.

We conducted the focus group interviews with three citizens at the SDU Odense campus to gain an understanding of why they might be opposed to windmills being built near where they live. The citizens were asked to complete and discuss two tasks, in order to understand how comfortable they would be living close to a windmill, and the appropriate amount of compensation that could be expected when living near a windmill. Moreover, a survey was completed focussing on citizen involvement to help understand the citizens' emotions and attitudes. The questions were directed at understanding how they would feel if a windmill project was placed near where they lived, and how and why they would want to be involved in the windmill project. The survey was distributed online to different people and groups, including five Facebook groups focussing on windmills and climate change. To get a more in depth understanding of citizens' feelings and opinions regarding windmills and citizen involvement, we conducted eight in-depth interviews with different people in person or over e-mail. The interviews focused on understanding the same points as the survey, as mentioned above.

A survey was created for municipalities focussing on understanding how they had used citizen involvement in previous windmill projects. The survey was sent by e-mail to 19 municipalities. We also conducted an in-depth interview with an employee from Varde Municipality. The conversation focused on aspects of NIMBYism and how the process for windmill projects is handled in the municipality.

Aimed Collaboration

Our aim was to engage citizens and municipalities in conversations to discuss ideas and solutions for improved citizen involvement. This would be achieved by having approximately 2-4 citizens and 1-2 employers from a municipality to discuss focused questions. We hoped a dialogue between them would help build understanding between the different parties and help find solutions for improved citizen involvement.

RESULTS

Citizen Support

The citizens interviewed were between the ages of 32-77, lived in different areas of Denmark both in cities and in the countryside, and they all owned their own property. Four of the interviewees did not live near windmills, three of them did, and one owned their own windmill. The graph below shows how supportive the interviewees were of windmill projects in the local area.

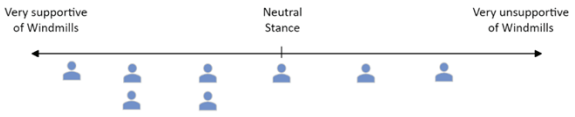

Figure 1: Level of support for windmills from interview results with citizens.

We received diverse results regarding the citizens´ opinions and concerns about windmill projects. One of the citizens from the interview shared that they were supportive of windmill projects, and even had their own Vestas-windmill in their backyard, which they have had since 1982. The citizen explained that they were two families living on a farm with very high energy consumption. Therefore, they have been extremely pleased with the wind energy, as they save money on the dishwasher, laundry, charging of electric cars, etc. On the other hand, one of the citizens explained that they were against windmills; "*They look like crap, they are noisy, and they kill birds. … To place them everywhere is crazy.*"

In addition, we received 64 completed replies from the citizen survey. The replies were varied which indicated the citizens' mixed opinions about all of the questions. However, the survey showed that 69% of the citizens were against a windmill project built in their local area, whereas only 19 % of citizens were not sure and 5% of citizens were not against them.

How would you feel if a windmill project was placed nearby where you live?	
Completely fine (contributes to the environment)	7
Okay	11
Not good	3
Very worried (noise, view, property value, health)	20
Against/complain	3
Do everything to stop it (protest)	4
Already live near one, is very bothered by it and it ruins the view	4
Already live near one, no problems with it	6
Put them out at sea	7

Okay, if they benefit financially	4

Table 1: Feelings towards windmill projects being built in local area from survey results with citizens. The results are categorised themes from quantitative data, and the most common results are shown in the table.

Citizen Concerns

Both the survey and interviews with citizens showed similar and recurring concerns about having windmills built in their local area. It was found that especially noise, health, views, and property value were the most common concerns for citizens. Other concerns are shown in figure 2 below. The figure also shows that there are more negative associations with windmill projects than there are positive. This could possibly be linked to–most information in the media, regarding windmill projects, being negative, and mainly about local resistance and failed windmill projects, which could influence both citizens' concerns and attitudes. Pol et. Al (2006) proposes that NIMBYism is, to an extent, normal, meaning that when individuals perceive risks, such as a depreciation of property values, it would generate self-defence behaviour.

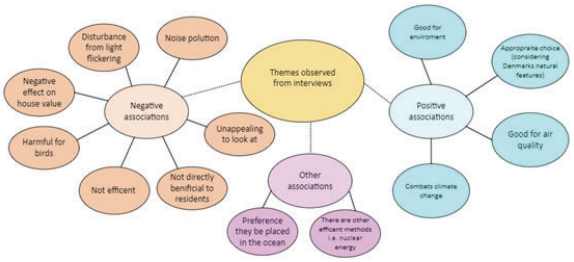

Figure 2: Associations with windmill projects in close vicinity from interview results with citizens.

A few of the interview and survey replies showed that citizens would like information about how the windmill projects will benefit them and the local community. An interviewee stated: *"Yes, and information about the benefits, not just benefits for environment, but what is in it for the common people."*

More Citizen Involvement

The results from the survey show that a vast majority of citizens believe that they should have influence on the decision-making process, and that they would like to be involved in windmill projects near their residence, as shown in figure 3 and 4.

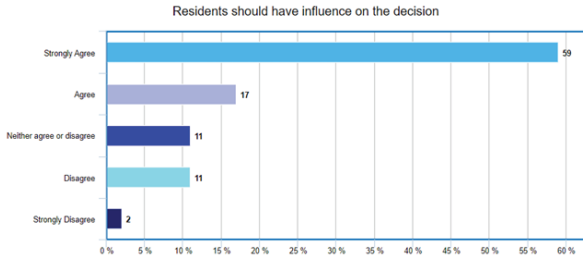

Figure 3: Scale of influence of decision making from "strongly agree" to "strongly disagree" from survey results with citizens.

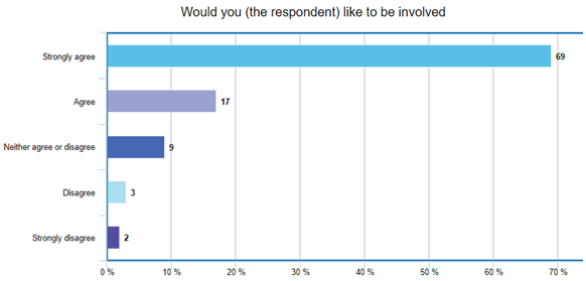

Figure 4: Scale of willingness to be involved from "strongly agree" to "strongly disagree" from survey results with citizens.

The table 2 shows the recurring reasons as to why citizens would want to be involved in windmill projects near where they live.

Why would you want to be involved?	
To be listened to and have an influence on the process	21
To received correct information	7
To address noise concerns	4
To address health concerns	6
To address concerns about nature, animal, and views	6
To address concerns about economy and house	7
Local ownership and buying shares	3
Put them out at sea	5
Do everything to avoid project	5

Table 1: Citizens reasons to be involved from survey with citizen. The results are categorised themes from quantitative data, and the most common results are shown in the table.

The research and results strongly suggest that citizens have sincere concerns about local windmill projects, and that citizens should be involved more in the projects, to address these concerns. (Haffmann, 2020) Based on the

results, it is recommend creating more citizen involvement through:

- Addressing the concerns meaningfully on a personal level
- An official linked to the project that locals can turn to
- Improved and ongoing dissemination of information
- Improve trust and transparency (make them feel heard)
- Include and inform citizens from the beginning

The table 3 shows the most common ways that citizens would like to be involved in windmill projects.

How would you want to be involved in a windmill project in your local area?	
Citizen involvement	8
Influence, decision making, to be listened to	10
Ongoing information	6
Citizen meetings and hearings	7
Directly involved, for example apart of a citizen group	7

Table 3: Wanted ways of involvement from survey results with citizens. The results are categorised themes from quantitative data, and the most common results are shown in the table.

Early Involvement

The results from our survey and interviews with citizens show that citizens feel that local residents should be informed from the beginning of a project before plans are completely set. Research indicates that this could help build trust and support for the project. Early involvement is also recommended by Capion senior analyst and Damsø Project Leader from Concito, Denmark's Green Thinktank, who say that earlier involvement has benefited municipalities in the past (2022).

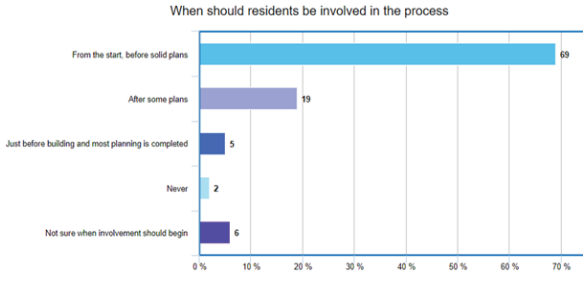

Figure 5: Scale of the stages of citizen involvement from survey results with citizens.

Economics

Many citizens from the interviews and survey believe they need to financially benefit from the windmill projects. One interviewee explained about their concerns: "*I think you would be more willing to accept a bit of noise, if you were involved in the windmill projects, for example, receive an offer for cheap electricity or shares.*"

Fischel (2001) argues that homeowners are more likely to exhibit Nimbyistic behaviour because homes tend to be the only financial asset they have aside from their pension. This investment cannot be diversified, and one cannot insure against this type of depreciation. There is the possibility for compensation regarding housing depreciation. Capion and Damsø also suggest expanding the existing VE Bonus system, that compensates neighbours of green energy projects within certain parameters. For example, the VE bonus system will only compensate a homeowner for lost property value if they meet the requirements, like living within six times the windmills heights radius (Promotion of Renewable Energy Act, 2008). Applicants will be denied if the windmill is under 25 metres in height or offshore. However, homeowners who live beyond the radius could still be affected by the windmills and could still see an effect on their property value.

Is It Green?

Lack of trust in technology and/or project management are noted as being triggering factors for NIMBYism (Matheny and Williams, 1985). Some citizens are sceptical that windmills are environmentally friendly, citing that they are made of unrecyclable materials, or mention concerns related to local nature and biodiversity. One interviewee stated: "*Hopeless to bet only on wind. They only last for 25 years and we do not have a solution for what happens when they are used up. The energy density is too low.*" This concerns signal a lack of trust in the technology.

Put Them in The Sea

One citizen believes it is important to build more windmills, however, states "*from my perspective only offshore windmill farms. Offshore windmill farms generate a larger output than onshore due to Megawatt output.*" This was a recuring theme from the survey, showing that there was a preference for offshore windmills as opposed to onshore windmills, as shown in table 1 and 2. Varde Municipality also shared this preference because then they are not within the municipality's jurisdiction. Offshore windmills can be more energy productive than their onshore counterparts. At the same time, the construction of offshore windmills is more costly and would translate to higher energy costs (Capion and Damsø, 2022).

Municipality Findings

For our municipality survey, we received six replies from Tønder, Hjørring, Vejen, Mariagerfjord, Ærø, and Lolland

municipalities. All municipalities responded that residents had been involved in previous windmill projects, mostly through citizen meetings. 50% of the municipalities believe they should or will do more citizen involvement in the future, whereas 50% believe they already do enough citizen involvement. Significantly, 100% of the respondents believe it can be an advantage to involve citizens in the planning process.

An official from Varde Municipality gave an in-depth interview. One key insight from the interview was a scepticism over how meaningful a municipality hearing is in terms of involvement and agreed that more involvement could be in part a solution. However, improved involvement would require more resources be set off for required activities and personnel. Varde Municipality has taken the stance that companies should share the burden of interacting with residents. They now require windmill developers acquire written approval from the majority of residents who live near the projects proposed location. This requirement must be fulfilled before an application can be made. This input could be useful to other municipalities, in order to share the burden of expenses and tasks to increase citizen involvement.

DISCUSSION

The project never reached the intended level of citizen science that it had aimed to, which would have been a large-scale level 1 involvement, so that we could define the issue and its many features. The majority of municipalities in the region of southern Denmark and other related organisations were approached, but they did not partner with the project. Several factors contributed to this lack of partnership. Firstly, timing the project would need to take place in the development phase of a wind farm project, at least before planning is complete. Secondly, the topic is very politically sensitive for municipalities, as the city councils are responsible for deciding whether projects may proceed, and they are also concerned about the desires of their constituents. Many municipalities would not like to entangle themselves in a topic that residents do not favour. Varde Municipality stated that they took a break for several years on taking wind farm applications due to political fallout from their last project.

Approaching citizens was also difficult, as many were uninterested because they felt that it irrelevant to their lives. The data captures the ends of the spectrum much more than the middle. We primarily attracted survey respondents from Facebook groups with vested interests in the topic. There is also a limited amount of literature on the issue, which made the task of designing a plan and framework difficult.

Going Forward

The data obtained from research was both rich and insightful and is a good basis for future projects if not continuation. Upscaling the project to the municipality-level would help this project achieve the desired level of citizen science. The project needs a partnership to succeed in the testing of the research question. Using the Public Conversations Project Dialogue method and focus groups configuration previously mentioned in methods to explore improvement of involvement, the project would need collaboration between stakeholders (municipalities, residents, companies, and other relevant parties), and facilitate problem defining.

Why Should This Research Go Forward?

Cross collaboration could answer many questions, define the roles of stakeholders, and help citizens have more trust in management and technologies. Findings could help inform and strengthen legislation and improve project management. This would contribute to the literature gap and help others research this phenomenon.

The rural community network believes "NIMBY" is a disparaging term that stigmatizes those who debate renewable energy projects and ignores the legitimate concerns they hold (buildingchangetrust.org, 2016). It is also the goal of this research to destigmatise the debate surrounding windmill projects, as all parties have legitimate claims and should be involved stakeholders. This goal is in line with sustainable development goals (SDGs) 11) sustainable cities and communities and 16) peace, justice, and strong institutions. Also, if this research can help provide solutions to windmill project management, Denmark can achieve its 2050 CO^2 goal. Carbon neutrality achieved via increased renewable energy production is in line with SDGs 7) affordable clean energy and 13) climate action.

CONCLUSIONS

Although the topic is difficult to research, it is necessary to mitigate issues with local acceptance of windmills and other renewable energy projects. The methods of involvement that municipalities currently use are inflexible and infrequent. There is a lack of channels and resources for citizens to ask questions and get information. The study supports involving citizens more and during the early stages of windmill project development. Improved involvement would mean more communication, information, and collaboration. This is desired by citizens and suggests that it plays a key role in local acceptance and improves how citizens' concerns are addressed.

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Could improving citizen involvement help increase local acceptance of windmill projects

Could improving citizen involvement help increase local acceptance of windmill projects

PATIENT AND PUBLIC INVOLVEMENT IN RESEARCH: A QUALITATIVE STUDY WITH NON-DANISH NATIVE SPEAKING RESIDENTS IN DENMARK

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ABSTRACT

Non-Danish native speaking residents in Denmark's involvement in health research is an advantage to make research more relevant and useful for the patients.
The purpose of this study is to gain an in-depth understanding of the residents' perceptions and attitudes towards the patient and public involvement in healthcare research. We engaged 19 participants from different nationalities and age-groups in our study.
The methods used in this study are part of the Citizen Science methodology, and therefore the focus was on collaborating with citizens as well as educating about patient and public involvement in research. We aimed to engage in conversations with citizens in a workshop and open-question interviews. The resulting paper will be shared with interested participants after it's been published.
Conducted interviews were recorded, transcribed, and analyzed based on the themes *Why should I get involved? What makes the involvement troublesome?* and *how do I get involved?*
Through the conversations we noticed that the lack of knowledge about Citizen Science, time investment and trust towards research projects prevent patients to get involved in participatory research.

KEYWORDS:

Patient and Public Involvement, Citizen Science, Health, Immigrants

INTRODUCTION

Patient and public involvement (PPI) in research is referring to the incorporation and the mobilization of the patients as research partners in different phases of the scientific research process. It is also viewed as research carried out together with or by patients instead of to/for or about them (Skovlund et al., 2020). PPI is about including patients into research beyond the basic role of participation, with recognition of the perception, and lived experience as an asset and competence. By empowering patients to become researchers and thereby letting them navigate the research direction, the patients can ensure that the study is relevant and that their priorities are being dealt with.
PPI in research has become part of the Danish research policy which demonstrates an increasing interest of PPI in health research in Denmark (FORSK, 2015). Until 2018 more than 50 research projects have been conducted in the field of Patient and Public involvement in Denmark. The following areas have been investigated; cancer (side effects and rehabilitation), neurodegenerative diseases (Alzheimer and Parkinson), psychiatry (recovery), diabetes, cardiology, and orthopedics (Hørder, 2018).
PPI in research is known to enhance the research quality and increase the sense of self-worth, confidence and new skills gained by PPI contributors (Blackburn et al., 2018). Furthermore, increased sense of empowerment together with the more cost-effective choices of interventions and improved health outcomes are observed for the participants who are pursuing PPI (Vahdat et al., 2014; Skovlund, 2020). There are many possibilities for patients to be actively included in many aspects of the research process and the lack of PPI can suggest several obstacles holding back the process.
Ocloo et al. (2021) identified several barriers and enablers to PPI, present on several organizational levels: "*personal/individual; attitudes; health professional; roles and expectations; knowledge, information and communication; financing and resourcing; training; general support; recruitment and representation, PPI methods and working with communities and addressing power dynamics*".
In the context of the immigrant patients, cultural issues, stigma, and being perceived as the patient group that healthcare professionals often find challenging to "*approach, communicate, collaborate and find solutions with*" can hinder their involvement into health research (Radl-Karimi et al., 2020). Through the thorough literature search, only one study that explores the co-production of healthcare service together with patients with immigrant background is identified (Radl-Karimi et al., 2020). The study has identified six factors that are playing a role in the relationship with the researchers and immigrant patients in

co-producing healthcare services. Comprehensive evidence-informed practices to alleviate these issues are yet to be determined.

Based on the presented literature that finds that immigrated patients are facing obstacles in pursuing PPI and the many benefits of their participation in research the aim of our study was to explore PPI in the Danish healthcare system from the perspective of non-native Danish speaking residents by gaining the understanding of their perception and attitudes towards PPI.
Furthermore, by using a citizen science approach we aimed to get in-depth understanding on the health care experiences and approaching preferences of non-Danish native speaking residents living in Denmark.

METHODS AND DATA

For this paper, a participatory citizen science approach was used to investigate how the public can be more involved in research. Roy et al. (2012) describes Citizen Science as the involvement of volunteers in science and research projects. Haklay (2013) proposes a typology of four levels of participation in citizen science. On the first level, "Crowdsourcing", citizens participate as sensors (Haklay, 2013). Going to the second level, citizens have the role of basic interpreters whereas on the "participatory science" level citizens participate in the problem definition and data collection of a research project. The highest level of participation is considered as extreme citizen science. On that level, citizens and researchers work in collaboration on the problem definition, the data collection, and the analysis (Haklay, 2013).
In this paper, we strived to work on the second level of participation, called distributed intelligence, for several reasons. First, the patients were encouraged to share their thoughts and ideas on the topic of PPI which would not have been possible if we stayed on the first level of involvement where the citizens only participate as sensors. Additionally, in our project we strived to emphasize the value of collaboration with citizens, and in accordance to that the project members were invited to provide the structure and organize activities, and the patient were invited to share their opinions, and needs on PPI. Finally, within the scope of this project we chose to stay on one level to gather significant number of insights and then later it could be possible to move to a higher level with a few citizens that were highly interested in the project**.** We chose the described approach with the expectation that it would reveal to us a thorough understanding of the citizens' needs and suggest improvements for the researchers, therefore making contributions to both the science community and the public.
In the process of defining our target group, we struggled with trying not to exclude anyone and narrowing the group of "patients". Therefore, we focused on residents in Denmark whose native language is not Danish. This decision was made close to the end of our project, so the initial methods did not take that into consideration**.**
Over the course of the project, we applied different methods ranging from individual interviews to an interactive workshop. We started by talking with three citizens found by convenience sampling about their relationship with the healthcare system In Denmark and knowledge about medical research to get familiar with the topic. The results were summarized in the *citizen portraits* which were used to identify the major themes that evolved during the conversations, namely involvement, recruiting approach and personal experience with the healthcare system. Following that we decided to hold a workshop where we informed the participants about citizen science and gave examples on why PPI is highly valuable and needed, both for them and the wider community. We then engaged them in a visual conversation where they created their own personal *Priority List* to present what would be most important for them to know about a research project and the reasoning behind it (see Figure 1).

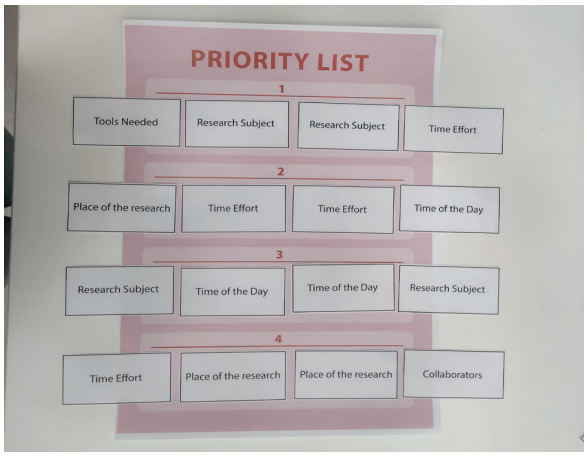

Figure 1: This picture shows the Priority List used for the workshop with the priorities of the participants.

Doing a workshop ensured us observation of engaging conversations between participants who provided us with fresh perspective on the topic. Afterwards, we designed a poster to summarize the observations and participants' insights. This laid the foundation for our final step which was conducting individual interviews with our target group to get a more specific understanding of their perceptions and attitudes towards PPI. The participants were approached at different locations of the University of Southern Denmark and through a post in a Facebook group *Internationals in Odense*. Interviews were conducted digitally or in person and the recording of the interviews were produced for analysis purposes. Based on the knowledge gained through the workshop, and the process of the citizen science program, the research team conducted open-question interviews that were structured into three different themes: *Why should I get involved? What makes the involvement troublesome?* and *how do I get involved?* In total 19 interviews were conducted,

transcribed, and analyzed thematically by the research team. The thematic analysis was used to identify and report themes within a data set (Braun & Clarke, 2006). It consists of six phases 1) Familiarizing yourself with the data, 2) Generating initial codes, 3) Searching for themes, 4) Reviewing themes, 5) Defining and naming themes and 6) Producing the report (Braun & Clarke, 2006). After finishing the interviews, we summarized the transcripts by comparing the data for each theme. After reviewing each theme and identifying sub-themes, we decided on the final names for each theme that are used in the Results section of this paper.

Participants

From 19 participants, 16 spoke a language from Europe (84%), 2 from Asia (10.5%), and 1 from Africa (5.5%). The mean time spent living in Denmark by the time of the interview was 5.9 years. All the participants spoke English on the conversational level, 10 of them have acquired basics of Danish language (52.6%), and 9 of them were fluent in Danish (47.4%), 10 participants (52.6%) were students by occupation, and 9 were full-time employed (47.4%). 10 (52.6%) of the participants mostly used general practitioners for their healthcare needs, 8 used mostly specialists, together with the general practitioner (42.1%), and one person did not want to state their healthcare needs in the Danish healthcare system.

RESULTS

In this section, an overview of the study's results from the conducted interviews is presented.

Why Should I Get Involved?

In terms of previous experience with the levels of involvement, one person participated in a research project on the second level but was not aware that this was already citizen science. The person reported that focus groups, a diary and questionnaires were part of this research project. The motivation for being involved on different levels of participation was dependent on the person's general health. Participants with a chronic illness or health difficulties that require long-term healthcare treatment are willing to take part in extreme citizen science. Yet, some participants without health issues said they would be open to be involved on level three or four if there would be financial compensation as they perceive this high involvement as a job. Another person would be interested in participating on a higher level, if it would be beneficial for their professional career, and only on the lower levels if the topic was interesting enough.

Many of the participants have reported to be more willing to try PPI if they see that the research offers a personal gain; a new understanding or perception on oneself or the issue they or somebody close have experienced. In accordance with that, it is also important for them to know which population is benefiting directly and indirectly from the research. Several participants have identified that the subject of the study would sound desirable to them if presented as relevant to society, their community or if it has a relevance for global health issues.

What Makes the Involvement Troublesome?

Many of the participants did not have a lot of knowledge about PPI and had difficulties understanding what it is. One person associated citizen science with testing drugs on young people and another one thought that s/he already participated in citizen science when donating blood. There was a lack of knowledge noticeable and after the interviewer gave a short introduction about citizen science and PPI in research, most of the participants were highly motivated to learn more and get involved. Furthermore, the interviewer explained the four levels of involvement in citizen science and gave examples for each level. This led to surprises among the participants because most of them did not know that level one and two are already part of citizen science and that patients as non-professional researchers can actually be part of the third and fourth level.

Moreover, participants with negative healthcare experience wanted to *"use their own bad experiences to help others"*, and the participants with positive healthcare experiences wanted to "*share the good experience as an example of how things should be done"*. Some of the participants, that were more frequent users of the healthcare system, shared that they felt like their opinion and perception were not valued enough in the healthcare system, but that they "*would gladly participate if their experiences was valued"*. One participant claimed that they are more willing to participate if it can *"benefit something for themself, gaining a new understanding or perception of oneself"*.

Expectation of Time Investment

Expectation of the time investment is perceived as the most relevant information for the participants in their decision-making process of getting involved. Participants primarily want to know the overall expected time investment in hours per week, per month and for several participants it was desired to have an overview of the time investment per year so they could have an overview of the time burden and reorganise their other plans around it more easily. None of the participants wanted to spend more than 15 minutes a day on a project, if they had to participate every day of the week. The maximum time they wanted to devote per week was one hour. In accordance with their time distribution preferences, all the participants wished to have transparency on the level of research they would take part in, and the description of the demanded tasks. One of the participants had a negative experience with a previous participation in research because the *"researchers were not realistic with the stated expected duration of patient engagement, and they had to participate for more than 1.5 hours even though it was*

stated that it will last for 20 minutes", which influenced the participant's current reluctancy for future involvement.
When introducing the number of meetings related to levels of involvement, several participants claimed that they feel that they deserve some sort of compensation if their participation is required for more than one meeting or more than one hour.
Most of the interviewed participants would not prefer to search by themselves for research involvement opportunities because they *"don't have time for that"* and one participant argued that *"people who are working full-time do not have the luxury of volunteering for research"*. Instead, a few participants stated that they would like an option to subscribe to some kind of newsletter, so they can be informed when a new project starts.

Place of Research

The location of the research was mentioned by the participants as a significant obstacle to getting involved, because it is important for the distance and accessibility for the participants. In the case of transportation that lasts longer than 20 minutes, some participants emphasised that they would want a compensation for their transportation. Due to time consumption in the case of the research being outside of one's city it was highly relevant for the participants to have the flexibility of participating online. However, most of the participants would prefer being involved physically in research that is being conducted nearby to their place of residence instead of traveling even when the topic in the research institution further away sounded significantly more relevant to them.

Safety

A few participants stated that it is important for them to know that the research is safe and that they would prefer to know their rights as research participants. PPI was seen by some participants as *"testing drugs on disadvantaged young people"* and therefore safety as well as transparency have a major influence on the willingness to get involved. In accordance with that, they would like their GDPR rights to be transparent in the description of the project. Some of the participants reported that they would be highly sceptical if they receive an invitation to research over an "open platform" on which everybody can approach everybody. Participants would be less sceptical if the information on the institution conducting the project together with the name and the contact of the project coordinator are openly presented. Research offers presented on "e-Boks" or "Min Sundhed" are considered more trustworthy by the participants because the applications themselves are already official and serious.

How Do I Get Involved?

There is no clear preference visible for just one recruiting approach or platform. However, the participants had strong opinions on which platform is used for a certain purpose (see Figure 2).

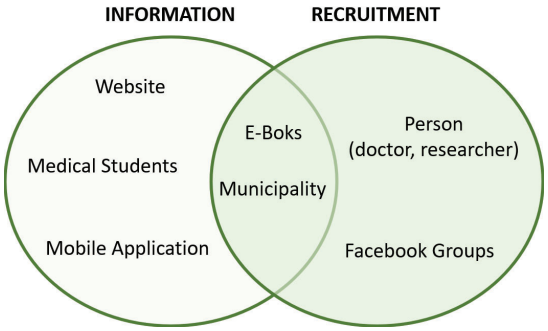

Figure 2: This graphic shows the different recruiting platforms, and for which purpose they should preferable be used.

Facebook groups and doctors are considered a good way to recruit participants for research, but websites or mobile applications are more useful when looking up further information. Nevertheless, most of the participants suggested adding PPI information to already existing applications, for example "Min Sundhed" or "Min Læge" to avoid an overwhelming number of applications.
E-Boks was also mentioned quite often as an *"official and serious platform for health-related matters"*. Participants explained they would be trustable of messages received through e-Boks, compared to other platforms, since not everyone can send messages via this platform. Yet, new Danish residents must be further informed about the functionalities of the applications in Denmark, because otherwise they feel excluded to the system and have little motivation to get involved. The proposal of having a website, where interested citizens can go and search for interesting projects was mostly disliked, because it was too general, not attractive, or too time consuming. One participant additionally mentioned it would not be trustworthy, because it would seem disconnected from the actual official health care system.
Moving from digital approaches to more analogue ones, posters, or brochures in hospitals, for example in waiting rooms, were perceived very differently throughout the participants. One participant argued that informing about PPI in hospitals is too late and *"you should not have to go to the hospital to be included in research"*. Most of the participants who understand a bit of Danish considered posters and brochures helpful, whereas the ones, who do not understand any Danish, would feel excluded by them due to the language barrier. Apart from the language, one participant would prefer a more personalised message instead of a poster that is on display for everybody to see. This also fits into the comments from other participants who would like to get personally approached by their doctor because they would then feel more inclined to get involved. Furthermore, if the respective researcher or doctor would approach the patient, questions could be asked right away, and the patient would already have *"like*

a name and a face to the research". Disadvantages of the previously described methods would be that citizens who use the healthcare system irregularly are excluded from research as the information would not reach them. This could be the moment when the municipalities could have an influence by adding an information sheet about PPI in the welcoming folder for new residents. This could help bringing the research to the citizens and show them incentives for being included in research without being associated with an educational institution. Still, one suggestion was also to include medical students in spreading the word about PPI, but no further elaboration was given on how.

One participant also claimed that if they could see more existing projects when opening the invitation for one, they would only look at them if they are already displayed as an addition to the existing project and that they would not do so if they had to press somewhere additionally to see the other options.

DISCUSSION

Based on the interviews, we identified several barriers that prevent non-Danish native speakers from participating in research. Initially, we expected the language to be the greatest barrier but that was not the case. The language barrier observed was related to the preference of being approached online because of the available automatic translation. Even though there is a possibility of translation and self-translation they all felt that having an English translation of the research would enhance their motivation for participation and would make them feel more encouraged to find out more about possible research opportunities. Furthermore, having a research possibility presented in the written way could be less distressful for possible participants because it would give them time to comprehend information that is relevant for their decision-making. Further studies are needed to understand the influence of language on PPI.

The time effort was shown to be the greatest influence on our participants willingness to get involved in research. Additionally, the experiences with the Danish health care system and resulting feelings of not being taken seriously, also exclude the participants from research involvement. A significant level of skepticism towards data protection and security was found, due to participants not being sufficiently familiar with the healthcare system or being biased by the perception of PPI obtained through the media. We believe this barrier can be traced back to the general lack of knowledge about citizen science and PPI in general.

Moreover, the results illustrate that the purpose and relevance of a certain research project are essential to increase individual's motivation to participate. Researchers should therefore spend sufficient time on formulating this and explaining it clearly to the person they are approaching for PPI.

The results also showed that researchers should take more advantage of the already existing digital infrastructure used in Denmark, by using official applications that were already perceived as trustworthy by citizens. However, this needs to be done carefully and the focus on administrative matters that are usually communicated through these applications should not be taken away.

We noticed a relationship between the level of involvement in research and expectation of compensation. None of the participants expected to get monetary compensated for their involvement on levels 1 and 2 of the research, and 16 of them expect to get financially compensated for the participation in levels 3 and 4 of the research. One participant stated that they wanted a certificate for attendance if participating in levels 3 and 4. It seems like one person that claimed to appreciate a certificate of attendance for PPI felt generally disadvantaged as an immigrant on the Danish labor market and felt that an official appreciation of the contribution would be empowering for their self-esteem. Several participants wanted to participate in the last two levels regardless of a financial gain or written recognition of participation. Rather, they stated they would participate on those levels only if they felt their contribution is highly significant for the wellbeing of a specific population's health and if at the same time, they had a genuine interest in the topic.

Our study was limited as participants were recruited based on the convenient and snowball sampling, and therefore randomization was not ensured, together with the lack of possibility for generalization of the results on the larger population. Furthermore, with more resources the sample size of our study could be increased and produce more granular results. Also, all the participants were either master students or had at least a finished bachelor's degree and were employed full-time which can lead us to think that our results may not be representative for the whole population of immigrants in Denmark. In addition, a portion of the participants volunteered to be part of the study which could have skewed the results, because this shows they already have an interest in research. In that context, we have not covered the marginal groups of the society and have a self-selection bias. Since some of the participants were also healthcare professionals, there is a risk of social desirability bias regarding answering on when and how they would like to be involved into health care research as patients. Furthermore, participants were asked about certain existing platforms that could be used for PPI and not the complete variety.

We believe that people would be more willing to do research on a higher involvement level if they would get more details about the process, time effort and requirements, so they are able to align the research efforts with their daily tasks. However, we acknowledge that there will also be the need for an external motivation and compensation in accordance with the level of participation

and time effort, together with the intrinsic motivation towards the research topic to fully convince citizens to participate on the level of extreme citizen science. Furthermore, internationals in Denmark, might be more willing to participate, if they feel assured that the researchers also want internationals to participate.

CONCLUSION

In recent years it has growingly been acknowledged that patients should be empowered to get involved in the research design, conduct and dissemination. This includes immigrants as well. Besides capacity building for this minority, being involved is also anticipated to rise the research quality and the development of most optimal healthcare solutions for all Danish citizens. For each participating research project, it is important to assess the most optimal level of involvement, in relation to strengthening the immigrants' capacity building and empowerment. Based on our analysis, there is a high preference for using already existing digital applications to inform about PPI and research opportunities. Personal recruiting increases the willingness to participate though excludes non-frequent users of the health care system from research. The same applies for posters or flyers.

The willingness of a citizen to participate on a certain level of involvement depends on the extent and type of the perceived benefits gained through the participation. This implicates that the benefits of PPI should be communicated in a comprehensive and encouraging way. Time investment was identified as the greatest barrier to getting involved as well as the most relevant information to be communicated about a project. Researcher should be careful when stating the required time investment for a study and inform participants as soon as the investment rises.

Overall, this study aimed to get an insight into the opinions and ideas of the non-native Danish speakers living in Denmark. The applied methods led to a variety of results in terms of preferences for how to get involved, why and what potential barriers there could be. Further investigations are still needed to find out if the proposed solutions prove to be useful or if there is a need for further adjustments. Overall, this project showed that there is a necessity to raise awareness for and educate citizens about patient and public involvement in health research.

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EXPLORING STREAMING HABITS IN THE CONTEXT OF DIGITAL CARBON FOOTPRINTS

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ABSTRACT

Digital carbon footprint describes the environmental impact of using the internet. A large portion of which belongs to streaming activity. Streaming as a relatively new topic has become a relevant cause of CO2e emissions, a fact that is largely unknown to internet users. As streaming quality improves, and streaming applications increase it can be anticipated that the proportional damage to the environment caused by data consumption and Its need for high amounts of energy will continue to Increase. This paper uses a Citizen Science approach to understand behaviors and motivations around streaming, discusses approaches and solutions towards a more sustainable usage of digital data consumption. Based on our findings we will propose a tool that works closely together with the target group themself in order to find sustainable alternative activities to streaming and motivate them to environmental action in the field of streaming.

KEYWORDS:

Digital Footprint, Streaming, Citizen Science, Sustainability

INTRODUCTION

The Internet consumes electrical energy and emits large amounts of greenhouse gas emissions, making energy consumption a key environmental, social, and political issue (Baliga et. al., 2007). The total carbon footprint produced by the use of the Internet increases constantly and is set to reach the amount produced by the airline industry, globally (S. Figuerola et al.,2009). The evidence that our digital traces leave ecological traces in the environment simultaneously, might be unfamiliar to most people. There are multiple contradicting scientific calculations available about energy consumption related to video streaming, based on measurable parameters that represent the consumption of the different components such as data centers, network infrastructure, home terminals, and end-user devices (screens). These parameters are predictable and can be measured to a close estimate, however, the concrete way of measuring can differ significantly (Kamiya, 2020). Netflix announced 2021 its plan to become carbon neutral within a year's time frame (Sweney, 2021). However, as current research (Preist, 2019) estimates, the servers and other company internal infrastructure only account for a small proportion of the energy consumption related to streaming. Much higher influences are attributed to the end user viewing devices (TV, laptop, tablet, phone) and the type of end-user network used. For example, streaming in glass-fiber or DSL networks is significantly more sustainable than mobile networks such as 3G or 4G. This kind of end-user activity is hard to precisely measure or predict since there is a lack of information on user behavior (The Carbon Trust 2021).

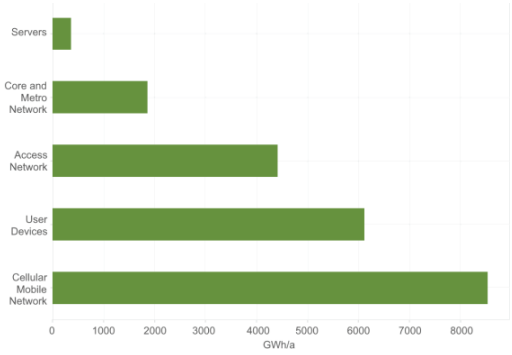

Figure 1: Annual total energy consumption in the example of YouTube (2016-2017) (Preist, 2019)

The kind of device used for streaming video is entirely up to the end-user's choice. The relationship between the consumers' behavior and its impact on energy consumption is complex, and it needs to be approached from a perspective where the habits around streaming are closely observed and understood. There is even more complexity to deal with if one tries to define the personal triggers and the environmental circumstances that influence the 'streaming behavior'. However, the evidence that there is a gap in research as well as the big carbon emission impact of video streaming in relation to the end-user behavior, estimates that most probably:

1. Methodologies used by researchers do not give sufficient results about user behavior related to streaming.

2. People are not aware of the impact that streaming has on the environment/our planet.

RESEARCH QUESTION

Having identified the potential gap in research, it would be good to act on choosing methods that might bring some good insights when it comes to the user's perspective and involvement within the topic of streaming and energy consumption by means of the produced CO2 emissions. We need a methodology that will bring people, the users, closer to the topic of research in a way that instead of them being just another number in the data reports, they do contribute to allowing us to deeply understand their motives, actions, and choices. Therefore, we propose the following question:

Can the Citizen Science approach give results when exploring people's streaming behaviors and how they relate to the knowledge of the resulting carbon emissions?

METHODS

Citizen Science can be described as "public participation in scientific research" (Hand, 2010).

In our research, we wanted to position ourselves between level 2 and level 3 of the citizen science ladder. During our research, we opted for participation in data interpretation, which supports our research method chronology. Initially, we asked our participants to send us their streaming data and then we asked them to compare the visualization of their own data with their statements during a focus group interview.

The motivation to implement level 3 of citizen science is based on our findings, which point in the direction of further citizen involvement in problem definition and data collection for future research.

In order to achieve level 2 of Citizen Science, we opted to implement the following methods.

Data Visualization

Data visualization is a graphic presentation of complex data, which provides layers of details that generate deeper dimensions of insight and new layers of understanding. Next to this, this method of presentation can be interactive and aesthetically striking (Durecvic, 2019).

We have used data visualization as a steppingstone in our data collection process. We asked our participants to download their Netflix viewing history. We then translated this information into graphs to visualize the participants' streaming history. The graph included all participants and was presented to them in a focus group to act as a catalyst for conversation and to create a deeper understanding of our participants' habits.

Focus groups

A focus group is a technique that involves the use of in-depth group interviews on a specific topic. The participants are selected on the criteria that they would have some input and knowledge on the research topic, within the same age range, and have similar socio-characteristics. Next to this, the participants should be comfortable talking to each other and the interviewer during the session (Rabiee, 2004, s. 655-656).

We have used focus groups as a qualitative interviewing method to better understand our subject's streaming habits and streaming environments, in order to outline the landscape in which we are researching. Moreover, aimed to facilitate dialogue between the participants, which could help us understand the benefits of online streaming and the challenges of breaking the habits. In order to understand what we saw in the shape of graphs and tables from the quantitative reports, we invited 9 people that complied with the focus group criteria, for in-depth qualitative data collection. We organized 3 focus groups each with 3 participants and received new perspectives on the topic. The participants were from diverse academic, cultural, and ideological backgrounds which was thought to represent different interest groups in society and to enhance the exchange. The participants were shown a graph of their combined Netflix viewing history during the interview and were expected to interpret the data and comment on how they can be explained. Similarly, in our second focus group, we introduced the participants to the topic by asking them to rate themselves on a physical axis. They positioned themselves according to questions like "Who do you think would survive without streaming the longest?". In our last focus group, we presented facts about streaming to politically interested participants and let them discuss the issue from their point of view.

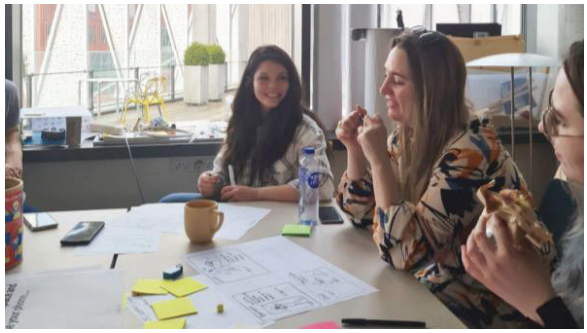

Figure 2: Focus group interview

Dimensional Analysis

In order to facilitate dialogue between the participants, we opted for dimensional analysis as an alternate method of creating grounded theory (Kools et. al, p. 314). Dimensional analysis can be described as an alternate method of articulating and communicating the discovery process of qualitative research (Kools et. al., p. 314). In practice we asked our participants to physically move along a scale with one end marked as "min/least" and the opposite end as "max/most", based on questions being asked about their personal streaming habits and behavior. After each question, the participants were encouraged to elaborate on their answers. The interview was video, and audio recorded.

Quantitative Data Collection

Quantitative data collection is a method in which data is collected and expressed in numbers, which makes quantitative data easy to present, summarize and compare. Our approach to

quantitative data collection was to ask participants at a family festival to physically vote “yes” or “no” to 5 questions. The questions aimed to highlight some common streaming habits, knowledge about the environmental footprint of streaming, and general willingness to change habits.

Figure 3: Data collection station at a Repair and Remake festival in Kolding (27.05.22)

RESULTS

Since we collected data in a wide range of different methods, it led to a diverse set of collected impressions, opinions, and behaviors. In terms of quantitative data, we, first of all, wanted to understand how people behave while streaming. We requested, analyzed, and visualized Netflix streaming reports of 8 participant accounts. The viewing activity revealed average emissions of 0,29t CO2e per person and per year (relative to around 6.8t in total for an average European (Eurostat, 2022)). Factors like the country of origin and the type of device that was used for the streaming have been included In this analysis as the values differ significantly depending on the energy mix of a certain country and if content got streamed on a relatively low-energy-consuming smartphone or a high-resolution Smart-TV.

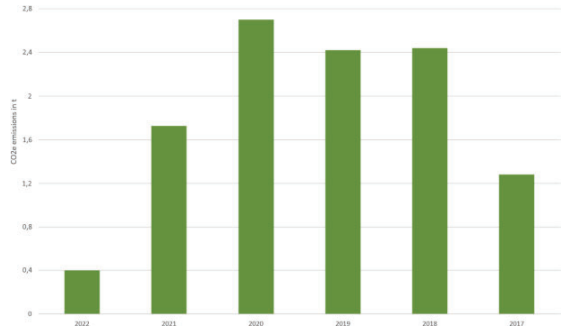

Figure 4: Total CO2e emissions of 8 Netflix accounts between August 2017 and April 2022.

The first focus group was confronted with their own streaming behavior. This gave us valuable insights into why our preliminary findings look the way they do. We found that streaming habits differ significantly for each individual, ranging from passive background streaming while falling asleep to active brain stimulation. Netflix is being used by our sample for educational content, distraction, or in social settings. As well, we could distinguish between purposeful streaming, like watching a movie or series, and accidental streaming, like teasers that run on Autoplay. In comparison, those short clips only stand for a small share of the whole, however in sum all of the profiles we analyzed accounted for together 142 hours and 32 minutes (almost 6 days) of short clips (teaser, trailer, hook, clip). As those raw numbers are difficult to imagine, we calculated equivalent pollutants as the distance traveled in a car that would lead to similar emissions. The average CO2e emissions per person and year of our sample would translate to around 1500km of driving in a regular car.

Even though the workshops all started differently the conclusions were mainly consistent. Most participants have never thought about that topic nor was it clear to them that data consumption is a relevant topic in sustainability. Nearly anyone was willing to reduce their streaming behavior but instead preferred less investing coping methods like turning off the Autoplay, deleting unused data in clouds, or closing unused accounts. On other occasions, proposals were made that involved governmental or legislative action like giving out penalties or bonuses depending on how much data is being consumed. Alternatively, the transparency of the environmental effect should be improved, so that good actions also become more visible. Additionally, families with young children have been recognized as an interesting target group as they are thought to have other motivations, like the mental health of their children, to prevent extensive streaming consumption.

Finally, the previous findings were tested through another round of quantitative data collection. At a festival for all age groups with a focus on families, we made visitors vote for pre-given questions that we aimed to verify. The participants in this survey were asked 5 questions (Figure 5).

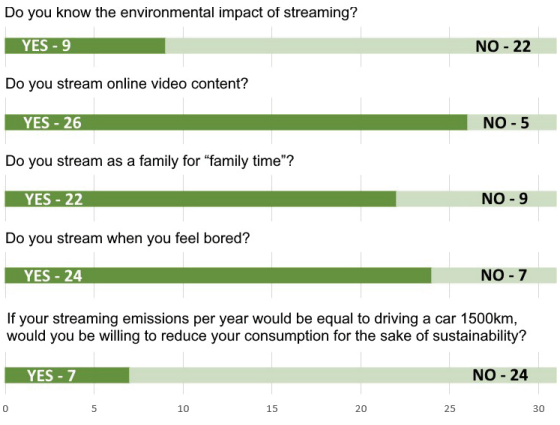

Figure 5: Results from data collection station at a Repair and Remake festival in Kolding (27.05.22)

FINDINGS

The preliminary data demonstrate that our participants stream excessively in concentrated periods. This evidence suggests that our participants' streaming could be categorized as passive streaming, as the participant is not actively engaging with the content or streaming platform and keeps it running for a relatively long period. By passive streaming, we mean people streaming content without realizing it or having the intent of actually paying attention e.g., playing it in the background while scrolling through one's phone or while cooking. We interpret this data point as passive streaming however lacking context we cannot claim it as factual. This might also mean that people actually stayed up and watched Netflix for several hours straight.

Moreover, we were curious by the number of hours our participants spent watching one particular video content, since the number of hours spent on watching it was tremendously higher in relation to other content. Our hypothesis was that our participants stream the same content multiple times, which was later confirmed when we carried out the focus group interviews.

To understand the quantitative data, we wanted to ask our participants if they are aware of their personal streaming habits and the environmental footprint of online streaming. During the focus group interview, our hypothesis was confirmed, as the participants said to have passively streamed content. Throughout the workshop, one of the participants kept mentioning the different settings they passively stream in e.g., while eating, studying, and showering (Figure 6, Finding 4).

This also helped the rest of the participants open up about common settings in which they passively stream too. Some of the most common ones were while performing some other relatively dull tasks like cooking or cleaning. Some of the more unusual ones included while driving or attending a class.

Through our focus group interviews, we discovered that the majority of our participants did not know what impact their streaming habits had on the environment (Figure 6, Finding 1 and 2). Once participants were made aware of the environmental footprint of their streaming habits, most expressed willingness to change their habits. Two of our participants were highly eager to rethink their streaming habits and were actively trying to propose ideas on how to raise awareness around this issue e.g., developing an app that would inform you about your streaming-related carbon footprint or bringing communities together to organize events like movie nights to decrease the collective carbon footprint.

As for the rest of the participants - even though the motivation was there, many pointed out that since this is such an invisible issue, they would need to see the extent of the impact their individual streaming habits have on the environment - in terms of CO_2, compared to other people, compared to other habits e.g., eating meat (Figure 6, Finding 1 and 2). Additionally, some participants said they would be eager to change their habits only if there was a similar alternative to streaming. Since their intent for passive streaming is to relax and “turn off” their brain after a long day (Figure 6, Finding 3 and 4).

Additionally, we discovered that participants were not aware of how much they stream until they were confronted with it. Once they had to examine their streaming behavior many realized that streaming has become more of a habit or even an addiction. As one participant opened up about not being able to fall asleep without having some sort of video content running in the background (Figure 6, Finding 1, 2, and 4).

To collect more data and involve a more versatile target group we created a data collection station at a Repair and Remake festival in Kolding that was targeted toward families with kids as mentioned in the results section.

The answers we got overall confirmed what we had gathered so far. Lack of awareness is still one of the most common issues when it comes to this topic. We propose that for change to start happening within this field lack of awareness is the first problem to tackle.

83.8% of our respondents reported streaming video content online. Perhaps a more surprising outcome has been that 70.9% of our respondents reported to stream content as part of their family time (Figure 6, Finding 3 and 4).

Nonetheless, streaming video content while being bored is highly common as 77.4% of our respondents reported to have fallen into that category. However, only 22.5% reported willingness to change their streaming habits if the consumption would equal 1500km of driving a car in terms of CO_2 emissions. This certainly was a contrast to what we had heard in the focus group interviews, perhaps being confronted face to face makes people more remorseful and ashamed about their habits and it might be much easier to be candid when opinions can be expressed anonymously.

To explore this particular set of data further and understand the context our next step would ideally be to interview the same respondents or respondents from a similar age group and family status.

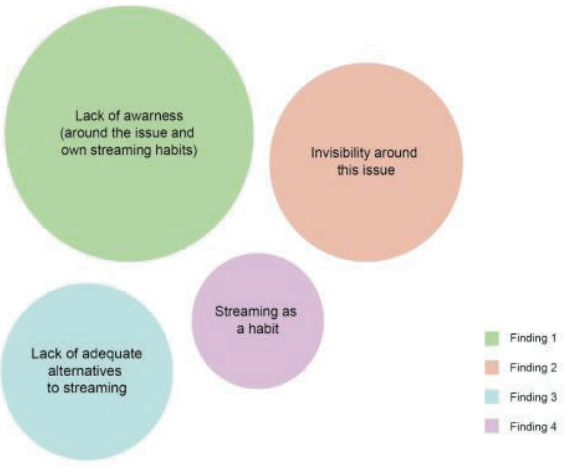

Figure 6: Findings from the data collected

DISCUSSION

High energy consumption in the form of internet usage, especially in the streaming sector, is a contribution to climate change that few users of the internet are aware of. We learned that already the process to create more awareness is difficult as there is no observable effect of pollution nor conceivable savings. Nearly all the participants in our research do not have an overview of their internet consumption which is critical to understanding one's own role in contributing to the emissions. The first step after becoming aware of the problem is to become self-aware of one's own behavior. In order to facilitate this, it could be beneficial to increase the visibility of a user's digital carbon footprint. Ideally, the raw numbers should be translated into real-world contexts that are easier to grasp.

After the awareness comes the motivation to change one's behavior on the internet. From what we learned in our focus groups, it is relatively improbable that understanding the problem will cause people to abstain from streaming. For this phenomenon, we collected several explanations throughout our research. One argument is certainly the visibility. Neither the users themselves nor their peer groups can see any improvements, not even on the smallest scale. Other than purchasing environment-friendly products, calling oneself vegan, or using public transport one does not do good by actively using an ecological alternative to a high-polluting standard. Instead, doing the good simply means a holistic renunciation of something that else provides pleasure. This type of environmental action misses out on positioning oneself as a hero both to other people and in self-reflection. On top of that, Internet usage is often connected to habits or even addictions which makes a voluntary withdrawal even less likely.

We learned that in most situations where people stream alone it is a consequence to feeling exhausted or searching for easy stimulation without sacrificing much energy. Alternative free time activities like reading, doing sports, or social activities are not appropriate substitutions for streaming, as they operate on other levels and are thought to satisfy other desires. Watching a series or movie is often connected with little brain effort. In those situations, one does not question if an activity is sustainable as by the mere decision to stream, one often accepts to renounce one's duties, like studying. The term guilty pleasure has been termed in that context, originally related to health and procrastination, one can now extend the definition and also include negative environmental consequences (De Fejter et. a., 2016). If already one's own health and duties are not strong enough to prevail against guilty pleasure, how can the highly complex and invisible digital carbon footprint be an argument for people to stream less?

An alternative would need to be low-energy tasks, effective against being bored, sustainable, and available at the moment one would fall into the habit of streaming. Our suggestion is to further climb the citizen science ladder and include citizens in the problem definition and ideation. Users of streaming services are, according to this suggestion, expected to come up with interesting alternative tasks such as challenges that can be done without lots of effort. Those suggestions will be collected in a browser extension that pops up when opening a streaming service and offers one of the alternative engagements. Users can then again upvote effective alternatives and reward the creator behind that idea. Like this, citizens themselves create, refine, and vote on the tool and will over time make it effective. Additionally, environmental action becomes visible by 1) having the extension 2) actively doing something good instead of streaming, and optional 3) by collecting points for handing in good tasks that can be seen by others. This tool could thereby increase the transparency and visibility that reminds users of their environmental impact, as well as provide a solution that makes one feel like doing something for society instead of a more painful self-imposed ban on something pleasurable. Seeing, that like-minded people engage in the same way of sustainable action could be able to create a collective motivation that can be easily upscaled.

The results of this approach are thought to give an overview of effective alternatives to streaming that serve the same purpose but lead to a reduced carbon footprint and possibly even support people's mental health and time management.

We suggest that the methods used in this research project are sufficient, as they fulfill the criteria of level 2 of citizen science. However, based on our findings we discovered new directions that the research could take, which encourages new methods that invite our participants to play a bigger role in problem definition and solution ideation.

CONCLUSION

The overall results of our research project have demonstrated that citizen science approaches have the potential to be useful in defining problems and adjusting the direction of the study. We conducted our research by implementing methods in which our participants were basic interpreters, however, our results and discussions revealed that higher citizen involvement is necessary in order to create more awareness of the environmental footprint of online streaming that could potentially lead to a change around streaming habits.

ACKNOWLEDGEMENTS

We want to dedicate this section to all citizens that contributed to the present research. Beyond that our thanks go to our science advisor Kerstin Fischer, our coach Henry Larsen and the talent program directors Jacob Burr and Thomas Kaarsted, not to forget Dorthe Andersen who pulled the strings in the background.

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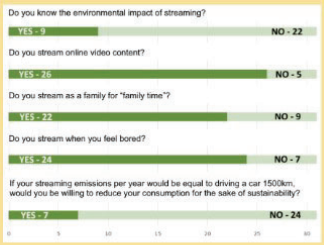
APPENDIX

Physical Survey at Festival

Data Confirmation & Target Group

Quantitative Data collection

Results



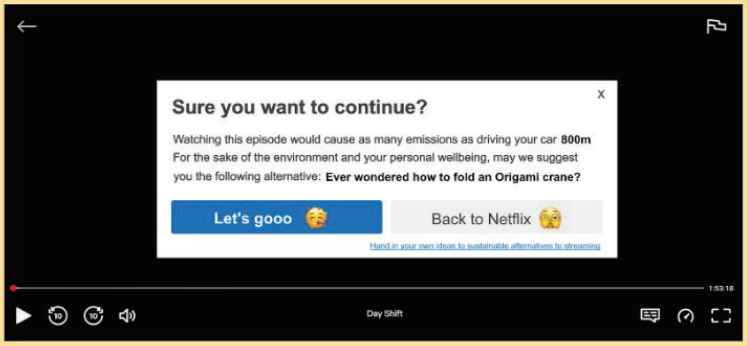
Findings

Lack of awareness

Contrast in opinions (compared to what've heard in focus group interviews)

Suggestion for further CS work

Browser Extension (alternative/low effort tasks)
Instead of a painful self-imposed ban
Environmental actions visible
Implicit and explicit rewards
Climb the CS ladder / Collaborative Platform
Citizens as contributors



A STUDY ON THE EFFECT OF KNOWLEDGE ON CITIZENS´ CONFIDENCE TOWARDS DRONE TECHNOLOGY

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ABSTRACT

Use of new technologies, such as unoccupied aerial vehicles, are emerging in the modern society. Through citizen science methods, the study investigates the effect knowledge has on citizens' attitudes towards unoccupied aerial vehicles in society. The methods included a workshop, codesign through two focus groups and a participatory intervention. Findings suggest a positive effect of knowledge on the feeling of confidence for participants. These findings are discussed related to methodology and future potentials of this approach to use for similar studies.

KEYWORDS:

Drones, Citizen attitudes, Citizen Science, Impact of knowledge, Future of flight

INTRODUCTION

Unoccupied aerial vehicles (UAVs) are an expanding technology which is rapidly spreading to every type of end user. Early examples of UAVs (afterwards denoted drones) has been in military deployment since 1917 (Kindervater, 2016). However, as technology has advanced the application of drones has ventured from military equipment to many other functions such as remote sensing, transport, agriculture, and private uses (Budiharto et al.; Canal & Negro, 2018; Naviair, 2022; Wulfovich et al., 2018). Today, the use of drone technology has continued to increase worldwide. In Denmark there is estimated 20.000 registered drones and 30.000 registered drone users as of 2021, with an estimated increase in both parameters of 40% annually (Naviair, 2022). However, as drone technology emerges and implementations grows, legislation simultaneously needs to evolve to encompass this development. Barriers between drone users, legislators and the public could potentially arise as this development progresses. One example could be legislators failing to make laws useful for drone pilots, while also accounting for the safety and concerns of the public. Potential barriers like the aforementioned, could create knowledge gaps for the general public on e.g., technological drone opportunities and possibilities within the law.

One approach to investigate these barriers is through citizen science methods which may empower the general public by inclusion, thus creating a sense of community and contribution to global research. Citizen science has the ability to expand and diversify public access to research as it is a cooperation between general public and professionals, therefore creating new-thinking ways of facilitating knowledge (Hecker et al., 2018). Through codesign with citizen scientists, the research question of this study aims to investigate the effect of knowledge on public citizens confidence towards drone technology and how this could act as a barrier.

METHODS AND DATA

Three activities were developed based on the Citizen Science methods of Haklays participation level model (Hecker et al., 2018) and Golumbic method (Golumbic et al., 2017). Haklays participation level model was especially relevant during the initial phase of this project. The model was used to determine which level of participation to apply for this study. The study aimed to reach level 2 "Distributed intelligence" and level 3 "participatory science", and these levels were reached throughout the study which is further explained in the following sections. The contribution of the Golumbic method to this study was based on the challenges of engaging participants and specifying a relevant research question. The Golumbic method includes three steps: inclusion, contribution and reciprocality, making it ideal to combine with focus groups for codesign.

This study was shaped through the inclusion of citizens in 1 future workshop, 2 focus groups and 2 interventions.

Workshop

The purpose of conducting a future workshop was to create a baseline of the knowledge on drones of the citizens who participated, while creating a platform for the citizen to share their opinion and thoughts on the topic. Five citizens participated in the workshop and were recruited through personal relations and by creating a public Facebook event without participation criteria. The workshop consisted of 3 activities. The first activity gave the participants the opportunity to unfold their opinion critically, followed by a way to express their fantasy idea of use of drones and finally a chance to reflect on their own role and contribution to realize their fantasy. The first activity gave the participants the opportunity to unfold their opinion critically, followed by a way to express their fantasy idea of drone's potentials and finally a chance to reflect on their own role and contribution to realize their fantasy. For the second activity of the workshop the participants were pictures of different types of drones and were asked to write their thoughts about the drones last activity the participants the pictures of drones according to invasiveness, most potential and necessity.

Focus groups

Due to the broad aspects of the workshop and participants consisting of mainly "experts" (i.e., engineers and professional drone pilots), it was decided that the next appropriate step was to conduct focus groups. Insights from the workshop showed that experts tended to dominate dialogues and outcome of activities which could create misrepresentation of the general population as seen in similar studies (Macnaghten, 2016). Thus, criteria for participating in the focus groups were set, where experts were excluded. Participants reached a total of 8 citizens which then were divided into two groups of 4. In contrast to the workshop, the focus groups and intervention activity were conducted in Danish to minimize language barriers. Through semi-structured interviews, citizens specified potentials and barriers that lie within the use of drones and codesigned which direction of the future study was most relevant to continue within.

Intervention

The intervention was based on the main findings of the focus groups which can be found in the result section. The intervention took place in the pedestrian street in Odense and Kolding. The setup design can be seen in *Figure 1*.

Figure 1: Setup of live intervention in the pedestrian street in Odense.

The aim of the intervention was to measure if providing knowledge influenced the citizen's initial attitude towards drones. The intervention included eight statements slightly modified for easier reading from the European Union drone regulations (Danish Transport Construction and Housing Authority, 2021) chosen based on topics found relevant in the previous focus groups *(Figure 2A+B)*.

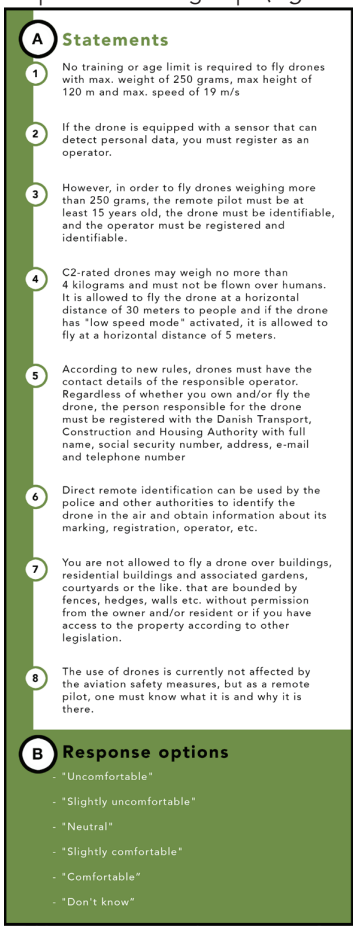

Figure 2: A. Eight statements chosen from the European Union drone regulations B. Six response options available for participants

Before presenting the statements for the participating citizens they were asked about their initial attitude towards drones on a rating from 1 - 5 (1= uncomfortable and 5= comfortable). Furthermore, data on gender, education and age was collected. Afterward the citizens were presented with the eight statements, which they, after reading, placed in a box with six different response options based on how the statements affected their initial attitude towards drone technology (Figure 2B). The response options were converted into index scores as seen in Table 1.

Confidence	Uncomfortable	Slightly uncomfortable	Neutral	Slightly comfortable	Comfortable
Index score	-2	-1	0	1	2

Table 1: Confidence index scores according to feeling of confidence

The effect of the knowledge statements on citizens initial attitudes is therefore defined as their confidence index. This was calculated as the average score of confidence for the total amount of index scores from each read statements for each participant. The interventions had a total of 31 participants. Responses in the "don't know" category were considered as unanswered and therefore excluded from the confidence index score. Finally, a confidence level was calculated for each statement to determine the impacts of each statement in the responses of citizens reading them.

RESULTS

The following section includes results from the focus groups and the intervention. The applied methods of citizen science placed this study on the second or third level of Hacklay's participation ladder (Hecker et al., 2018) as citizens contributed as interpreters and volunteered thinking while also participating in problem definition of the study. Additionally, Golumbic method proved to be very useful in codesigning and "unpacking" of confidence due to more elaborate possibilities for inclusion, contribution and reciprocality.

Co-designing the study

Throughout the focus groups the topic of confidence (danish: tryghed) towards drone technology and implementation was a substantial part of the discussions. Concrete examples from each focus group are given in the following:

Participant: *"Could be great if a bit more knowledge on pros and cons came out, if you can legislate and how. To concretely investigate what is needed. Frames of action to feel confident"*

Interviewer: *"What is the barrier then?"*
Participant: *"That there is no registration and control on the area"*
Interviewer: *"And is that the barrier for your feeling of confidence?"*
Participant: *"Yes, I think so."*

Additionally, both focus groups agreed that the main direction for the study to take in the future was to investigate how more knowledge might affect the feeling of confidence. All participants expressed that the lack of knowledge is one of the biggest barriers in relation to drone technology and the future of drones in society. In the first focus group the participants were asked for concrete examples of how to design the procedure for examining the barrier. Selected responses can be seen in *Figure 3*.

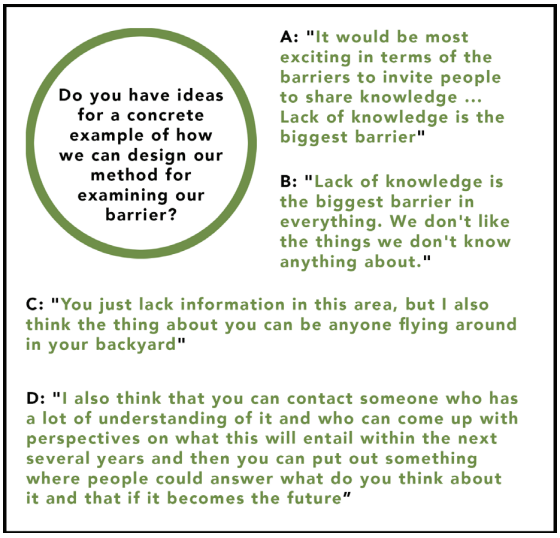

Figure 3: Conversation between participants in focus group 1.

Here the responses emphasize the role of knowledge as a barrier and that sharing of knowledge might mitigate this barrier. In the second focus group the participants were asked to select a direction for the future project which they think might be relevant to investigate. The responses can be seen in *Figure 4*.

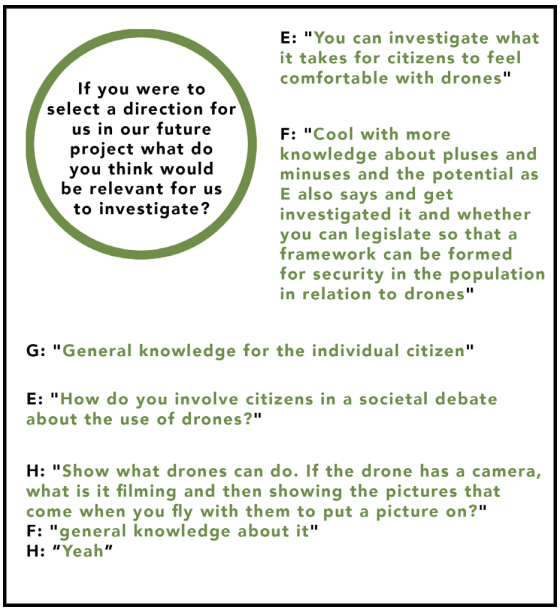

Figure 4: Conversation between participants in focus group 2.

Similar to the responses of the first focus group, knowledge was once again concluded as the main barrier to investigate. The engagement of the participants in the focus groups made it possible for codesigning the next approach of the study, which is further describes in the next section.

Unpacking 'Confidence'

Based on the findings of the focus groups main topics (knowledge and confidence) as the most relevant,

interventions were carried out combining the two topics. The results are demonstrated in Figure 5, which shows an increase in confidence towards drone technology after reading the knowledge statements. This is indicated as most participants have positive confidence index values. The only two negative index values observed in this study was for two participants between age 60-80 years. No clear trends according to age groups, initial attitude or gender was found.

Furthermore, the calculated average confidence values for each statement can be seen in *Figure 6*. Similar levels of confidence were found across statement 3 to 7, with a positive change in confidence value of approx. 1.5. Statement 8 is the only statement which on average produced a negative confidence index score for the participants. However, as indicated by the associated standard deviation, there was a large variety within the confidence index scores from this statement.

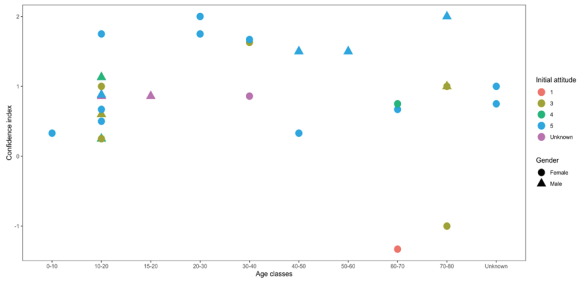

Figure 5: Distribution of age, gender (shapes) and initial confidence (color) towards drones as a function of confidence in drones after reading the eight statements presented to participants (confidence index). Placement represents confidence after reading the statements. Above zero means positive

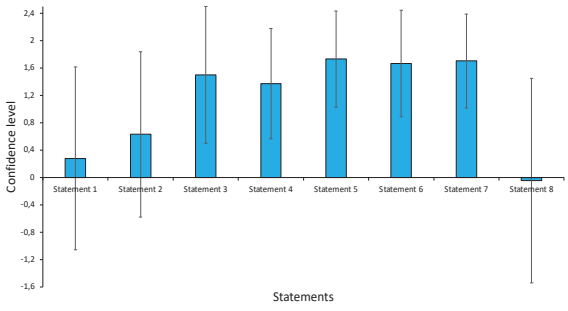

Figure 6: Average confidence values calculated for each of the eight statements including associated standard deviations

DISCUSSION

In this study, we found by co-design from focus groups that the most relevant barrier to explore was the knowledge gap between general citizens and drone regulations, implementations, and technology. After further investigating this barrier, the results of this study showed the majority of participants (across gender, education, age, and initial attitude) to feel more confident after reading the knowledge statements compared to their initial state of confidence. These findings suggest an effect of knowledge on the general feeling of confidence for general citizens towards emerging drone usage. Similar tendencies have been seen through history regarding other technologies (Enderwick, 2000; Silva, 2003). Within and around most developing technologies there will most often be first movers and early adopters (Rink & Swan, 1979) who will push to implement the new technology or innovation in question. However, to accommodate all involved stakeholders and facilitate the distribution of new technology and innovation while also considering safety, the laws and regulation must be formulated, which, on the subject of drones was introduced in Europe for the first time in 2015. These laws define the legal use of drones and thereby ease the distribution of understanding and knowledge of said use.

However, to completely assess this effect of knowledge, further studies should be conducted in larger scale. One of the limitations of this study is the participants size of 31 individuals, which is questionable as a representative group. One way to upscale this study and thus improve the representation of society would be to increase the number of participants and their geographical range. 30 of the 31 participants in the intervention were from Odense, while the other one was from Kolding. The confidence level calculated for each statement (Figure 5) was an important measure to include since not all participants read the same number of statements. This could have created a bias, however most of the statements showed similar levels of confidence potentially minimizing the bias.

Another consideration could be to include more professional groups in separate focus groups and interventions. Potential professional groups of interest could be legislators from the Danish Civil Aviation and Railway Authority or professional drone pilots. Since the study excluded experts after the workshop, other potentially important barriers might have been overlooked. By including these groups separately, it could encompass all perspectives of the usage of drone technology while also building bridges between the different stakeholders.

The study strived to reach level 2 - 3 on the Haklay's participation level, however it can be argued whether the study reached level 3 ('Participatory science') due to citizens contribution ending with problem defining. Since the citizens did not contribute to data collection the study therefore mostly remained on level 2 ('Distributed intelligence') where the citizens contributed as interpreters and thinkers. On the other hand, the citizens contributed to shaping the final steps for the study and also disseminated information in form of drone laws while also being able to express opinions and needs. Despite the limitations of this study, the findings are nonetheless relevant and can be important for designing further studies on this subject and on other technologies. In the modern society citizens are continuously faced with new technologies, while legislators are forced to develop and implement laws which are able to mitigate these

developments while also being relevant for researchers and professional. Citizen science seems to be a promising method for conducting new studies since it has the opportunity to initiate first perspectives on new projects and challenges, while also building community participation. Meanwhile it is ideal for creating strong collaboration between professionals and citizens which are essentials for making relevant changes in society.

CONCLUSIONS

Through citizen science methods including codesign and citizen participation, this study suggests a general tendency for knowledge to have a positive effect on citizens feeling of confidence towards drone technology. Citizen science seems to be an appropriate method for investigating barriers within implementation of new technology in society, making it relevant for future studies.

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DO YOU HAVE THE GUTS? USING CITIZEN SCIENCE FOR SAMPLE COLLECTION IN A MARINE FOOD WEB STUDY

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ABSTRACT

Our oceans are undergoing severe changes and modifications caused by anthropogenic pressures and climate change resulting in ecological degradation and ecosystem unbalance. Studies have been discussing how these alterations seem to favor jellyfish populations. A development further underlining the problematics of a historic knowledge gap on the role of jellyfish as prey for fish. As the world might be facing an increase in jellyfish biomass, the importance of studies on their ecological role is more and more clear. This study reports on the initial collection of samples of fish stomachs in Danish waters using a Citizen Science approach as a method to further investigate jellyfish's part of the marine food web. Recreational fishermen participated in this project by donating freshly collected fish stomachs for later analysis on the content to examine presence of jellyfish predation. A total of 47 fish stomach were collected during six weeks in the autumn of 2022 from four different locations within Danish marine waters. The results from this study support a Citizen Science approach as a valid and promising method for conducting marine ecological science.

KEYWORDS:

Citizen Science; Jellyfish; Fish Ecology: Food-web

INTRODUCTION

All life on earth relies on the ocean. For humans the ocean provides ecosystem services such as food provision, climate regulation and economic activity. However, in recent decades the marine systems of the world have been facing multiple threats such as ocean warming, ocean acidification, habitat loss, widespread distribution of invasive species, overfishing and nutrient pollution. These threats are results of anthropogenic pressures and climate change, causing alterations on natural marine ecosystems and ecological degradation including reductions of biodiversity and shifting food-webs (Bax et al., 2003; Doney et al., 2020; IPCC, 2022; Lu et al., 2018; Sabine, 2004). On the other hand, these modifications are discussed to favor jellyfish (here defined as the pelagic medusa life stages of the phyla Cnidaria and Ctenophora) populations with reports of increased bloom frequencies (Lynam et al., 2006; Mills, 2001; Purcell, 2005; Richardson et al., 2009). The opportunistic lifestyle of jellyfish with high reproduction rates, broad diets and tolerance of low-oxygen levels are thought to drive this so-called "jellyfish joyride" giving jellyfish success in otherwise troubled ecosystems (Arai, 2001; Richardson et al., 2009). Despite, a cosmopolitan lifestyle, high diversity and large biomass, the ecological role of jellyfish has been historically overlooked, with only recent attention mostly focused on their role as predators and competitors in the marine food web. In the Baltic Sea, very few studies have focused on the role of jellyfish as prey with the majority of studies on jellyfish as prey of other jellyfish (Stoltenberg et al., 2021). Furthermore, no peer-reviewed studies on jellyfish as prey of fish have been published regarding the Baltic Sea despite studies based outside the Baltic Sea suggesting this interaction might be more common than initially presumed (Stoltenberg et al., 2021). Knowledge on this jellyfish-fish interaction is however important since the marine ecosystems are undergoing the beforementioned changes possibly increasing the jellyfish abundance and temporal appearance while challenging the populations of fish.

Conducting studies and research excursions within marine science is often demanding and expensive with the use of many resources, manpower and equipment, which oftentimes results in a limited spatial and/or temporal data collection. These limitations might be reduced using participatory methods such as Citizen Science. Citizen Science as a collaborative approach for knowledge generation in ecological and environmental studies is increasingly used and acknowledged in life sciences including marine studies. Besides the potential for a cost-effective and spatiotemporal data collection, this participatory approach often adds other scientific values such as enhanced scientific literacy, contribution of local knowledge end strengthened relations between citizens and scientists (Frigerio et al., 2021). Engaging recreational

fishermen as a specific group of citizens scientists have been done previously with success (Azzurro et al., 2011; Fairclough et al., 2015; Støttrup et al., 2018). Collaborating with fishermen in marine ecological studies, like this present study, is beneficial since their expert participation allows for a long-term and high frequency data series of jellyfish's ecological role as prey for fish. Additionally, fishermen have often been working with commercial fishing or recreational fishing for long periods of their life, thus building up a detailed and local-specific ecological knowledge on the marine environments which could contribute to covering the historic gaps of jellyfish ecology dynamics besides what is known from traditional research studies (Azzurro et al., 2011; Silvano & Valbo-Jørgensen, 2008). Citizen Science might therefore be a promising application to examine the role of jellyfish as prey for fish as it mitigates the beforementioned limitations of traditional samplings performed in marine sciences, while bringing other advantages to the table such as local ecological knowledge from participating fishermen. Therefore, this study employs Citizen Science as a method to conduct marine ecological sampling of fish stomachs and intestines by engaging local fishermen to investigate the efficiency and advantages of this participatory approach. The collected stomachs are later planned to be tested using the technique of Polymerase Chain Reaction (PCR) to detect Jellyfish-DNA in the content of the fish stomach and intestines.

METHODS AND DATA

This Citizen Science project began in August 2022 by me forming a, not previously established, network of recreational fishermen in Denmark. Initially, I made telephonic contact to the Danish Sports Fishing Association to obtain their guidance on how to proceed creating and designing a collaborative project. Following their advice, I contacted 14 local societies/unions for recreational fishery located in Jutland, Funen, and Zealand. In the majority of cases, the contact consisted of an initial phone call followed by a descriptive mail including instruction for self-training in sample collection (see Figure 1) or by onsite training of participants. In two situations, I performed onsite training of participants. First onsite training was of a fisherman on Reersoe, who would later independently train a second fisherman from Jutland in the sampling process. Second onsite training by me was of fishermen attending the Danish Masters of flatfish fishing. Of all contacted local societies/unions, five participated so far with sample collection, and as many as nine societies/unions expressed a wish to participate in the project but were unable to due to lack of/low fish catchment success. As this project started relatively late in the growth season, the data collecting was planned to run in a limited time span from September to mid-October. The reason behind this time limitation is the seasonality of common jellyfish in the Baltic Sea since they normally appear in Danish marine waters during spring and disappears as autumn progresses. As the final outcome of this study focuses on the fish-jellyfish interaction, an overlap in seasonality is crucial, leading to the limited timespan for sample collection.

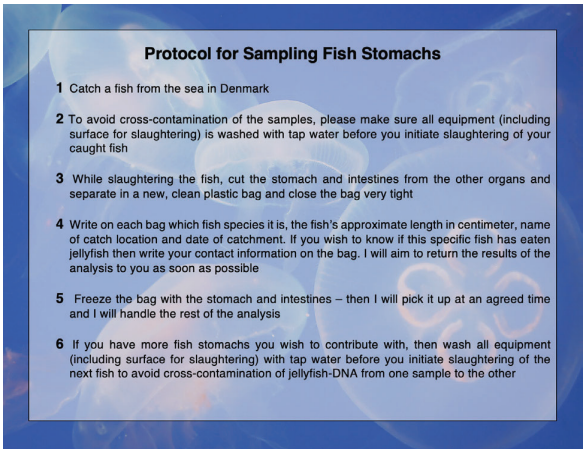

Figure 1: Six step protocol provided to participants for collection of fish stomachs. The protocol has been translated from Danish to English for this article.

All marine fish species caught in Danish marine waters were targeted in this project. Sample collection consisted of collection of freshly caught fish stomachs from fish caught in Danish marine waters. Participants were instructed to separate the fish stomach and intestines as they were slaughtering the freshly caught fish (see Figure 2).

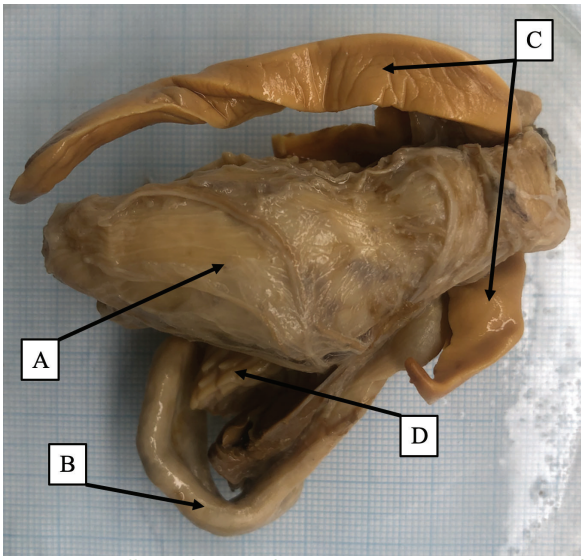

Figure 2: Collected stomach (A), intestines (B), liver (C) and pyloric caeca (D) of an Atlantic cod (Gadus morhua) from the Yellow Reef.

The collected contents were afterwards packed individually in a clean plastic bag. Each plastic bag was marked with the species, total length (cm), catch location

and catch date. The plastic bags were then stored frozen. Before initiating slaughtering of the fish and in-between sampling of several fish stomachs, the participants were instructed to clean all slaughtering equipment with tap water to avoid potential cross-contamination of jellyfish-DNA from one fish to another fish. As this project desires to establish a two-way communication between participants and scientists, the participating fishermen were given the opportunity to write contact information on the marked plastic bags if they wished to be contacted with the results of the specific sample and/or the entire project. All participants were encouraged to contact me for further suggestions, questions or similar, as I also provided opportunities for them to have me participating in local outreach events.

Now, as the collection of samples has been completed, the future aim of the study is to analyze the collected stomach- and intestine content for presence of jellyfish-DNA through PCR-testing. The analysis of the stomach content has not yet been initiated due to delayed shipping of laboratory materials. The targeted jellyfish-DNA is planned to consist of three commonly known jellyfish species in Danish waters. The three species are the Moon jellyfish (*Aurelia aurita*), the Lion's mane jellyfish (*Cyanea capillata*) and the invasive Warty comb jelly (*Mnemiopsis leidyi*) (see Figure 3).

*Figure 3: **A**. The moon jellyfish (*Aurelia aurita*). **B**: The lion's mane jellyfish (*Cyanea capillata*). **C**: The warty comb jelly (*Mnemiopsis leidyi*).*

RESULTS

Until now, a total of 47 fish stomachs and intestines were sampled by participating fishermen and collected for further analysis during September 2022. A total of 13 fishermen from four different unions/societies participated with sample collection across all sampling locations (see Table 1)

Location	Participants (n)	Samples (n)
The Yellow Reef	2	5
The Sound	1	10
The Langelandsbelt	9	25
Reersoe	1	7
Roskilde Fjord	Unknown	Unknown
Total	13	47

Table 1: Number of participants (n) and samples (n) collected per location and in total during the collection period of this study.

These 47 stomachs were collected from four different Danish marine areas including the Yellow Reef in Skagerrak, The Sound, Reersoe in the Great Belt and the Langelandsbelt (see Figure 4). The 47 stomachs were collected from six different fish species normally found within Danish waters including Atlantic cod (*Gadus Morhua*), Altantic herring (*Clupea harengus*), European flounder (*Platichthys flesus*), European Eel (*Anguilla Anguilla*), European plaice (*Pleuronectes platessa*) and an unspecified goby species (Gobiidae sp.). An unknown number of samples are also collected in Roskilde Fjord, but they have been delayed until now.

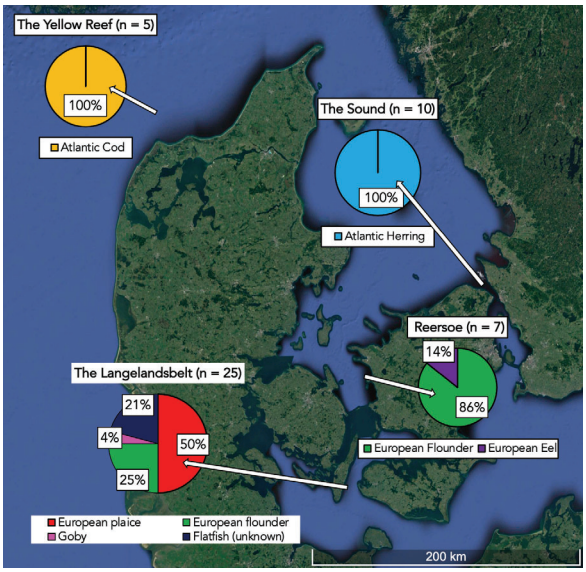

Figure 4: Map of Denmark showing the four different sampling locations, number of samples collected per location and the distribution (%) of fish species per location.

DISCUSSION

The outcomes so far of this project boosts confidence in the use of Citizen Science to perform and accomplish studies within marine ecology. Very effectively, the network of fishermen established in this study managed to collect samples within the first month of this project impressively comparable in numbers to what has been sampled during the first year of other related projects. In Australia, Fairclough et al. (2015) created a project very similar, where recreational fishermen participated in the Citizen Science project "Send us your skeletons (SUYS)" by donating the skeletons of their caught fish to researchers for age analysis and stock assessments along the Australian coasts. During the first year of SUYS approx. 200 skeletons were donated, however in the following years these donations increased substantially to over 3000 donations. These relatively low numbers of samples collected by fishermen in initiating years followed by an increase as the project matures is also seen in other studies (Støttrup et al., 2018). As this project only actively

collected samples in six weeks, the potential for increased sample sizes and number of participants is present, especially comparing to the process of the previously mentioned projects. Another factor which further confirmed Citizen Science as an appropriate method was the engagement and willingness to participate the collaborating fishermen demonstrated. The majority of fishermen I was in contact with, regardless of participation in the project or not, were eager to discuss the process and potential outcomes of the project with me while sharing their knowledge on the subject.

Marine citizen science is not unfamiliar in Denmark. One related example of the potential of a Citizen Science application in marine sciences is project Havblitz which in one day of 2019 engaged 200 volunteers to collect water samples around the coast of Denmark (Agersnap, 2019). This example also shows the power of engaging the public in marine studies and it further confirms, as my project, the Danish public interest in participating and contributing to science. In another project with a similar topic by Lamb et al. (2017) predation of jellyfish in the Irish Sea was investigated during a two year research survey collecting approx.. 2500 fish stomachs. No citizen science method was applied in this study, however the stomach were also analyzed by PCR methods for specific jellyfish DNA. The samples size collected in the Irish Sea is substantially larger than what have been collected in this project using Citizen Science. Despite this, there is some clear benefits from applying Citizen Science methods in projects like these which is often otherwise not included in traditional projects. The first advantage is the cost-effectiveness of this project compared to traditional research surveys. Within six weeks, collected samples covered relatively large parts of the Danish waters without any major economical expenses or resources e.g., the use of a manned research vessel. Another aspect to consider is the expert knowledge the targeted participants of this study contribute with. Not only the expertise in catching fish, but also the local and detailed knowledge on the ecology, habitat functioning, and historic dynamics of their local waters obtained from doing fishing activities in the area. This benefits the project by providing a pool of local ecological knowledge from the fishermen, which adds details to the knowledge of the participating scientists in the project. Future plans for this project includes tapping into this knowledge of fishermen to gain their expertise and insight on the results of the stomach contents in a analytical and comparable way as done by Silvano and Valbo-Jørgensen (2008). This approach might also help to mitigate and stitch the historic gap in the knowledge of how jellyfish populations might have changed in recent decades.

Engaging fishermen in top-down projects not directly focused on specific fisheries-interests such as fisheries management, monitoring the state of fish population and marine waters, or improving fish habitats could potentially be challenging. However, after initiating this project and completing the sampling, only one contacted local union for recreational fishery were unwilling to participate. The other 13 contacted societies/unions expressed an interest in the topic of the project and many discussed potential outcomes of the analysis with associated reasons. Several of the contacted unions/societies also forwarded the projects contact information to mutual fishermen or vice versa, thus expanding the newly established network of recreational fishermen. In two instances, the contacted union/society even participated in training of other participants in sample collection. In addition, all participating unions/societies requested to have the results of the PCR-analysis forwarded back to them. This engagement and interest is extremely valuable to projects like these as they establish a two-way communication between researchers and society with outreach of recent science and contribution of local-specific knowledge which researchers otherwise would not necessarily obtain. Further and greater collaboration with the society of Danish fishermen, recreational or professional, might give researchers access to an otherwise untapped pool of insights on the state and ecology of Danish waters. The success of the study also further underlines Citizen Science as a promising approach for conducting powerful and quality studies.

CONCLUSIONS

The collection of samples obtained in this project shows a large spatial distribution of samples, successfully donated by voluntary recreational fishermen. The results further underlines the great potential of Citizen science as an application in marine sciences. The future plans for the project include PCR-testing of the stomach content for specific Jellyfish-DNA and inclusion of voluntary recreational fishermen in the analysis of results.

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DATA IS COMMUNICATION

ENHANCING CITIZEN SCIENCE PROJECTS THROUGH DATA VISUALIZATION

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ABSTRACT

Data visualization, such as data representations, dashboards and infographics, plays an important role in citizen science projects and comes with numerous benefits for the overall citizen science experience. Citizens' comprehending of complicated scientific research increases and results in higher motivation to participate, scientists' discussions become livelier and communication with administration and policy makers can be facilitated greatly. However, scientists often do not feel responsible or capable to implement data dissemination strategies. Good data visualization requires a certain level of expertise and commitment. Adding data visualization to existing citizen science models will therefore raise the necessary awareness of the importance and benefits of data visualization.
This paper briefly analyzes three attempts of data visualization in real citizen science projects and makes recommendations on how to improve them. It also discusses why data visualization needs to be taken more seriously and how all citizen science project can be enhanced by applying suitable communication strategies including appropriate data visualizations.

KEYWORDS:

Citizen Science, Data Visualization, Communication Strategies

INTRODUCTION

"Reporting science clearly and accurately is a fundamental part of the scientific process […]." (Plavén-Sigray et al., 2017) In their 2017 study, Plavén-Sigray et al. uncover the growing decline of readability in scientific papers. Specifically, research methods and results oftentimes are described with complicated use of language including abbreviations and jargon that both citizens and academic colleagues struggle to comprehend. Citizen science in its core is a research approach that builds bridges between ordinary citizens and researchers (Rüfenacht et al., 2020).

"Citizen science is any activity that involves the public in scientific research and thus has the potential to bring together science, policy makers, and society as a whole in an impactful way." (EU-Citizen.Science, n.d.)

Considering the important role that citizens play in citizen science projects, it should be a priority to insure understanding of scientific data in citizens. Visualizing scientific data is a tool that could fill this role. Data visualization facilitates accurate and efficient communication of complex scientific data (Gandhi & Pruthi, 2020). After all, pictures sometimes tell a story just as well, if not better.

As a tool, data visualization has proven to be useful in many scientific fields. In public health, data visualization helps among many other things with decision making (Park et al., 2022); in sports it helps with gaining competitive advantages (Perin et al., 2018); in meteorology it facilitates communication to lay audience (Masson & van Es, 2021) or in social media analytics it emphasizes analytics-based knowledge claims (Laaksonen & Pääkkönen, 2020). In citizen science however, data visualization has not been explored as a tool to communicate scientific data.[2]

In the following text, I will be arguing for why data visualization should be added to existing citizen science models and communication strategies and how citizen science projects can benefit from focusing on data communication and dissemination.

Data Visualization Essentials

Data visualization is *"the representation and presentation of data to facilitate understanding"* (Kirk, 2016). Understanding according to Kirk consists of three steps: perceiving, interpreting and comprehending - visualizing data facilitates all three steps. Further, good data visualization is useful, desirable, and usable (Yuk & Diamond, 2014).

Well-known types of data visualization include data

[2] As of the writing of this paper, no relevant literature can be found in the Google Scholar database or the Citizen Science Association article archive.

representations (e.g., bar graphs, timelines, pie charts, etc.), dashboards (combined data representations) and infographics (illustrated data representations). Valkanova et al. (2015) explain that such visualizations used to be exclusively for expert users in scientific fields, but that recently they have also been used for public and artistic purposes. They specify additional purposes for visualizations, e.g., social visualizations, artistic visualizations, ambient visualizations and urban visualizations.

In citizen science projects, there is both qualitative and quantitative data that affects all stakeholders during and after the various stages of the projects (Rüfenacht et al., 2021), e.g., participation numbers, budget numbers, interview transcripts, questionnaire results, lab reports, prototypes, workshop products, etc. Some of this data is more suitable for specific stakeholder groups than others. Scientific data in the form of an excel sheet may be more interesting to the researchers and their administration than to the citizen participants.

Within the context of citizen science projects, I distinguish therefore between internal and external data visualization:

- **Internal data visualization:** Data visualized within the project team, e.g., researchers, administration and other staff. Examples of such data are participation numbers, budget plans, work logs, deadlines, etc. Visualizing this data facilitates organizing and conducting the project but also creates the opportunity for researchers interpret the data in new ways. It is optional to share this type of data with external stakeholders.
- **External data visualization:** Visualizes data that is shared with external stakeholders, e.g., participating citizens, media, ambassadors, etc. It is meant to enhance communication with those stakeholders, to give them insights into the project's results, to enhance understanding of the data and easier creation of new knowledge, to encourage participation and to increase motivation.

Data visualization is not a focus in any of the existing citizen science literature and models. However, many citizen science models include communication with external stakeholders to some degree. *Reciprocality* is one of the main features of citizen science in Golumbic et al. (2017) which includes the *"dissemination of scientific information to the public"*. The fifth principle in Robinson et al. (2018) recommends *"Citizen scientists receive feedback from the project"*, and in the seventh principle they expect *"Citizen science project data and metadata are made publicly available"*. Garcia-Soto et al. (2017) include *good communication* as one criterium for a successful citizen science project. They specify that the *"Dissemination and sharing of should include all contributors, participants and wider society"*. Bonney et al. (2009) recommend in their model for developing a citizen science project to *"Accept, edit, and display data"* and to *"Disseminate results."*.

Data visualization is a tool that facilitates communicating in citizen science projects. There are no specific models in the current literature that emphasize internal data visualization. Furthermore, the existing models do not explain how to include data visualization in citizen science projects. Hence, despite the numerous recommendations for active communication, many projects do not communicate with their stakeholders.

THREE DATA VISUALIZATION EXAMPLES IN CITIZEN SCIENCE PROJECTS

The following three examples showcase how data visualization is often attempted but not used to its full potential in citizen science projects.

Orchid Observers (UK)

Orchid Observers was a project organized by the Natural History Museum in London and the Zooniverse platform in 2015. Citizens were asked to photograph orchids in the wild and upload the images to the platform where they were described and categorized. During the project, updates were posted on the project blog (*Orchid Observers*, 2016) targeted at everyone involved in the project, but mainly at citizens (see Figure 1).

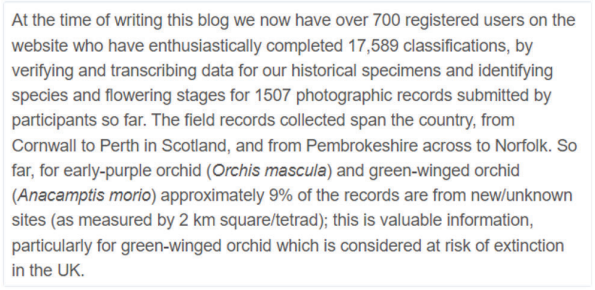

At the time of writing this blog we now have over 700 registered users on the website who have enthusiastically completed 17,589 classifications, by verifying and transcribing data for our historical specimens and identifying species and flowering stages for 1507 photographic records submitted by participants so far. The field records collected span the country, from Cornwall to Perth in Scotland, and from Pembrokeshire across to Norfolk. So far, for early-purple orchid (*Orchis mascula*) and green-winged orchid (*Anacamptis morio*) approximately 9% of the records are from new/unknown sites (as measured by 2 km square/tetrad); this is valuable information, particularly for green-winged orchid which is considered at risk of extinction in the UK.

Figure 1: A text update on the Orchid Observers blog during the project.

At the end of the project, a final update was posted including some brief insights into some of the produced data, e.g., a map showing the location of the taken photos (see Figure 2) and an overview of the general statistics and results of the project (see Figure 3).

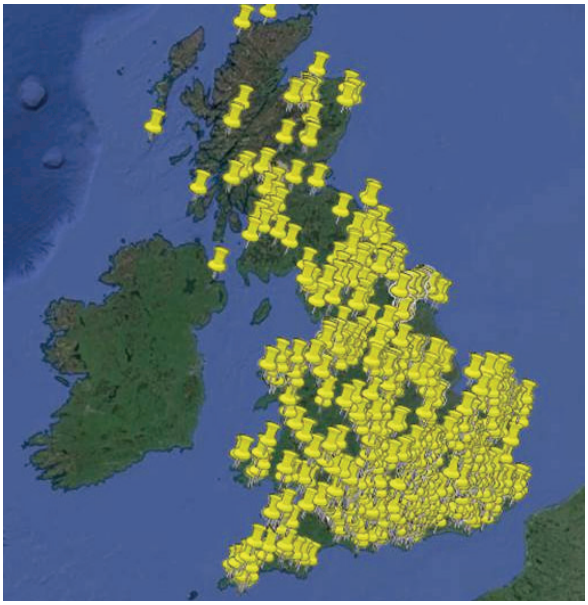


Figure 2: An update including a map on the Orchid Observers blog after the project.

Results at a glance

- Over 2000 volunteers taking part
- More than 1800 new observations of wild orchids
- Around 200 new locations, where particular species of orchid hadn't been recorded before
- 50,948 classifications on the *Orchid Observers* online platform
- Orchid photographs taken all over the UK, from the Shetland Islands in the far North, to the Isles of Scilly in the far Southwest.

Figure 3: Another update on Orchid Observers blog after the project.

Publishing the visualized data on the map during the project on the blog could have enhanced the project, e.g., by motivating participants to look for orchids in places that had not been covered on the map, yet. Furthermore, visualizing some of the results data could have improved the communication with stakeholders.

Frit Lejde (Denmark)

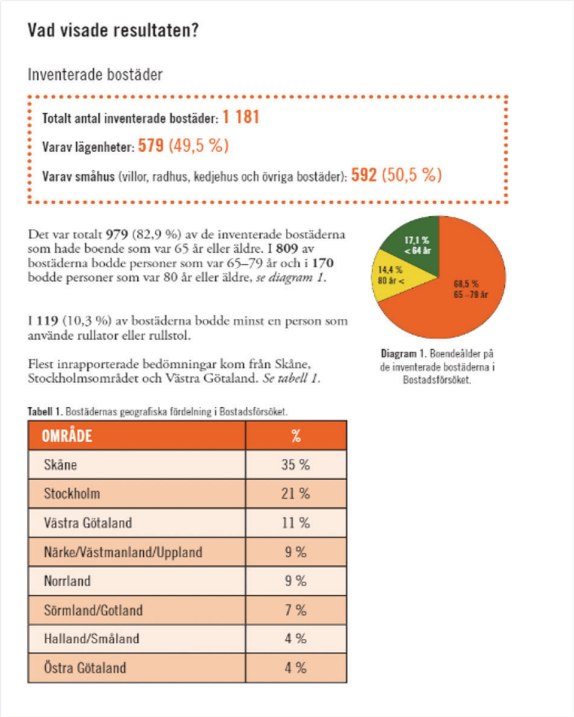
Frit Lejde was a Danish citizen science project organized by researchers at the University of Southern Denmark. The goal was to engage the general public in exploring their behavior regarding their used electronic devices and how those devices may be recycled. The project was covered by local media in a mini-series consisting of about 20 web video clips and several online news articles (*Frit Lejde*, n.d.). Whilst this news coverage created a gateway to communicating with the general public (including the participating citizens), no collected data was shared during or after the project.
A handout was created to inform citizens of the purpose and reasoning of the project (see Figure 4).

Figure 4: Frit lejde handout.

The handout did not include any visualizations at all. Optimally, some data could have been visualized on the handout, e.g., data about other successful circular economy projects or previously collected data such as questionnaire data. Visualizing relevant data both in the miniseries or on the handout could have enhanced the project, e.g., by exposing the citizens to it and asking for their feedback and motivating them to participate.

The Housing Experiment (Sweden)

The Housing Experiment explored how accessible Sweden's housing is for elderly people. Citizens all over the country were invited to measure their homes and share the data by adding it into an app. At the end of the project, a final report was published on the project's website. The report included many data visualizations, mostly data representations such as graphs and tables (see Figure 5).



Vad visade resultaten?

Inventerade bostäder

Totalt antal inventerade bostäder: 1 181
Varav lägenheter: 579 (49,5 %)
Varav småhus (villor, radhus, kedjehus och övriga bostäder): 592 (50,5 %)

Det var totalt **979** (82,9 %) av de inventerade bostäderna som hade boende som var 65 år eller äldre. I **809** av bostäderna bodde personer som var 65–79 år och i **170** bodde personer som var 80 år eller äldre, *se diagram 1*.

I **119** (10,3 %) av bostäderna bodde minst en person som använde rullator eller rullstol.

Flest inrapporterade bedömningar kom från Skåne, Stockholmsområdet och Västra Götaland. *Se tabell 1*.

Diagram 1. Boendeålder på de inventerade bostäderna i Bostadsförsöket.

Tabell 1. Bostädernas geografiska fördelning i Bostadsförsöket.

OMRÅDE	%
Skåne	35 %
Stockholm	21 %
Västra Götaland	11 %
Närke/Västmanland/Uppland	9 %
Norrland	9 %
Sörmland/Gotland	7 %
Halland/Småland	4 %
Östra Götaland	4 %

Figure 5: Final report after the project.

This is a positive example of how data visualization can be done effectively, however, the report was only shared on the website and nowhere else. To reach the intended target group, the citizens, the results could have for example been published on social media platforms such as Facebook or Instagram. The organizers of the project do have accounts on such platforms, so does the university that conducted the study. Other visualization types could also have been made use of, e.g., infographics. Infographics are significantly more effective when the general public is the main target group.

DISCUSSION

Citizen science fails without its citizens. Communicating data clearly, accurately and efficiently will among many other benefits encourage and motivate more citizens to participate in projects (Nov et al., 2012; Rotman et al., 2014) as a broader audience can be reached (Lee et al., 2020). It is therefore essential to recognize the important role of data visualization in citizen science projects and implement it into the projects' communication strategy. Making data more accessible for facilitates the achievement of Level 4 citizen science projects (Haklay, 2013). Citizens will be able to analyze and discuss data with more confidence and ability which in turn allows for higher quality influence on the project. Overall, allowing citizens to participate more in the process of scientific work strengthens the democratic aspects of citizen science as a research method. It also supports the principles of open data.

Internal data visualization especially will enhance the quality of the data as scientists will engage in a livelier discussion of their data with colleagues and administration. Why then is it still not a standard practice?

Data visualization is often not perceived as part of communication strategies. It is not specifically being mentioned in any of the existing literature, so a lack of awareness is not surprising. However, many scientists simply do not feel responsible for the communication of their data (Golumbic et al., 2017). They are also not trained to disseminate data (Rüfenacht et al., 2021). Mizumachi et al. (2011) name five factors for the reluctance of scientists to engage in a more active and proactive dissemination of their data:

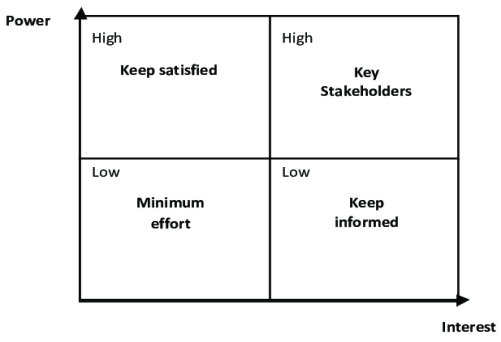
1. The work is troublesome or time consuming;
2. scientists feel that they may not be good representatives of science;
3. engagement is outside the scope of their work;
4. scientists perceive no benefit; and
5. scientists are apprehensive about dialoguing with the public.

Advising scientists on the benefits of data visualization could provide a different outlook on disseminating their data and findings. The benefits of data visualization have been proven as was stated above (Park et al., 2022; Perin et al., 2018; Masson & van Es, 2021; Laaksonen & Pääkkönen, 2021).
Assigning the task of visualizing the data to a colleague with expertise in data visualization, could be a solution for scientists to escape the responsibility. However, knowledgeable experts are rare, a problem that has been recognized by the Danish e-infrastructure Cooperation who published a rapport about the rising amount of missing data stewards and an urgent need for a suitable education program (*Rapport Sætter Fokus På Fremtidens Uddannelse Af Data Stewards*, 2022).
Following a structured but simple workflow (e.g., as suggested by Rüfenacht, 2021 or Kirk, 2016), may establish an easy entry point into data visualization for scientists.

To systematically analyze the projects' stakeholders and data to then create appropriate data visualizations, I suggest a four-step process based on Kirk (2016) consisting of stakeholder analysis, data collection, communication strategy and visualization creation. Following these four "steps" should allow anyone to start the process of creating useful data visualizations.

Stakeholder analysis

The first step is to find out who the stakeholders for the projects are. This information must be prioritized to establish which stakeholder groups should be focused on and which other stakeholder groups do not immediately or regularly need to be provided with data visualizations. A helpful stakeholder analysis tool to begin with is Mendelow's (1991) Power-Interest matrix (see Figure 6) which categorizes the stakeholder groups into four groups: *key stakeholders, keep satisfied, keep informed and minimum effort.* These categories come with predefined settings that help to lay out a plan. For example, key stakeholders need to be communicated with on a regular basis, whereas minimum effort stakeholders do not have to be kept up-to-date all the time. Another useful stakeholder analysis tool is a Stakeholder Salience analysis that includes power, legitimacy and urgency. This analysis model goes more into detail and divides the stakeholder groups into several more categories. Compared to the Power-Interest matrix, it is more complex and therefore more time-consuming.



(Figure 6: Power-interest matrix, Mendelow, 1991)

Data collection and prioritizing

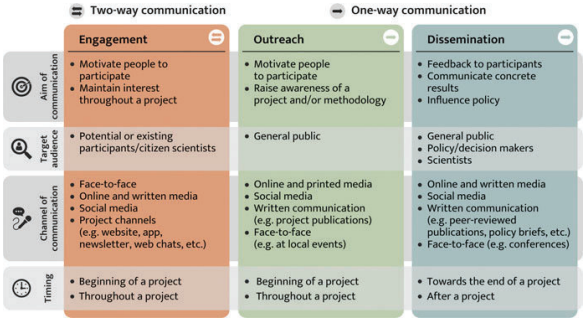
The second step of the process is data collection and prioritizing. The data needs to be made available by the researchers in order for it to be visualized. This can happen during, throughout, towards the end or after the project. For the researcher themselves that of course means that they need to have collected the data first. After that, the data should be prioritized – ideally by the stakeholders themselves. One possible approach here is to ask the stakeholders, for example the researchers or representative participants of the project, to participate in a simple prioritization activity. They are asked to prioritize the data points from most to least interesting. The most interesting data points should then be focused on and be visualized and shared with the respective stakeholder groups. Asking stakeholder groups for their preferred data points will tell which data should be visualized for them. This is helpful in the sense of creating relevant and interesting data visualizations instead of spending valuable (and often expensive) time on irrelevant and uninteresting information that none of the stakeholders actually are interested in. If talking to the stakeholder groups is impossible for whatever reason, the data still should be prioritized by what may be relevant and interesting to them. Participants often want to see the results and implications of their contributions, whereas administration and management are more interested in the statistics of the project, for example participation and budget numbers.

Communication strategy

The third step of the process is to apply a communication strategy to the collected and prioritized data. The first question that needs to be asked is: *What is the purpose of the data visualization?* The communication strategy model that I highly recommend to use in this case is the communication model by Rüfenacht (2021) specifically intended for citizen science communication (see Figure 7). The three possible answers to the question are: *Engagement, outreach and dissemination.* The model consists of four categories:

1. The aim of communication,
2. The target audience,
3. The channel of communication
4. The timing.

Based on which data will be visualized for which stakeholder group, this model then guides through the rest of the analysis process. According to the model, different target audiences require different actions. Citizens for example prefer infographics shared on social media or face-to-face discussions. Scientists and their project administration in most cases prefer simple yet effective data representations presented in dashboards or in presentations. Data will be visualized and presented differently according to the above mentioned four inputs.



(Figure 7: The recommended communication strategy model by Rüfenacht, 2021.)

Visualization creation

The fourth and last step in the process is to visualize the data. Many people probably think that creating data visualization requires some sort of graphic design skills, but in fact, with the help of today's technology, this step is simpler than expected and does not require any additional skills. Once the communication strategy is in place, the data visualizations can be created. The three most used visualization types are data representations (for example charts, graphs, timelines, etc.), dashboards (a combination of different, comparable data representations that show live data and often can be interacted with, for example by filtering the data, zooming into a map, etc.) and infographics (visual illustrations of the data or complementing the data). Data representations can easily be done with free programs such as Figma.com or Canva.com; dashboards need more advanced programs such as Tableau.com or Microsoft Power BI; infographics on the other hand can be created with Canva.com or programs such as Photoshop or Illustrator. Other more complicated methods could for example be producing videos containing data visualizations or 3D interactable models. However, those advanced methods more than often are not necessary for the purpose of data visualization in citizen science projects.

CONCLUSIONS

Citizens are at the center of any citizen science project. Visualizing the project's data and sharing it with them comes with great benefits that all too often get overlooked. In fact, data visualization enhances the entire project's experience and outcome. Visualizing data internally for the people directly involved with the project's realization also holds enormous benefits such as better-quality data.

However, many scientists do not feel responsible for data visualization or do not have the necessary dissemination skills. Including the visualization and communication of data into citizen science models will raise awareness of the importance of data visualizations and its implementation. Communication guides are an effective way of guiding researchers or every other project associate to applying

the correct communication strategy to the visualization process.

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