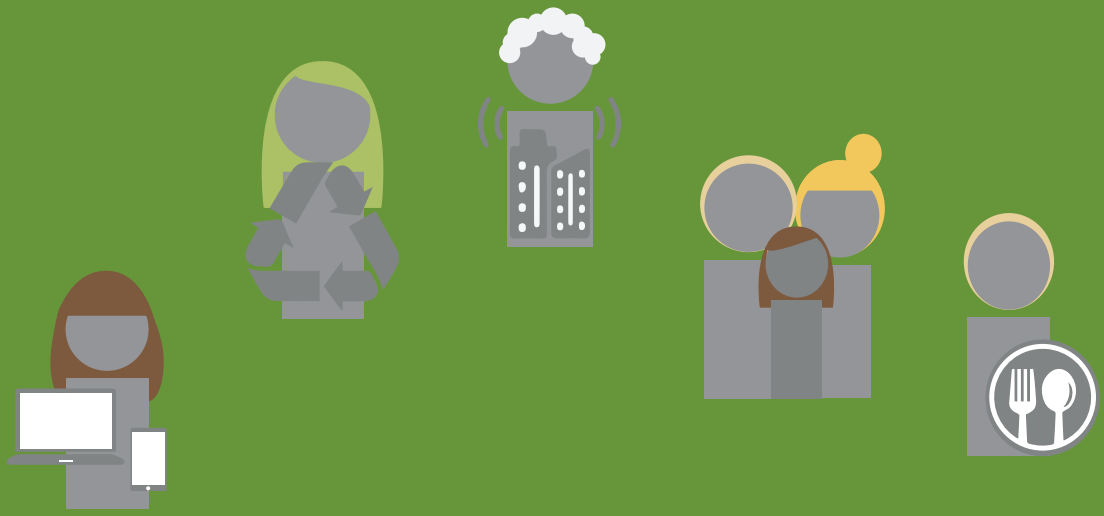
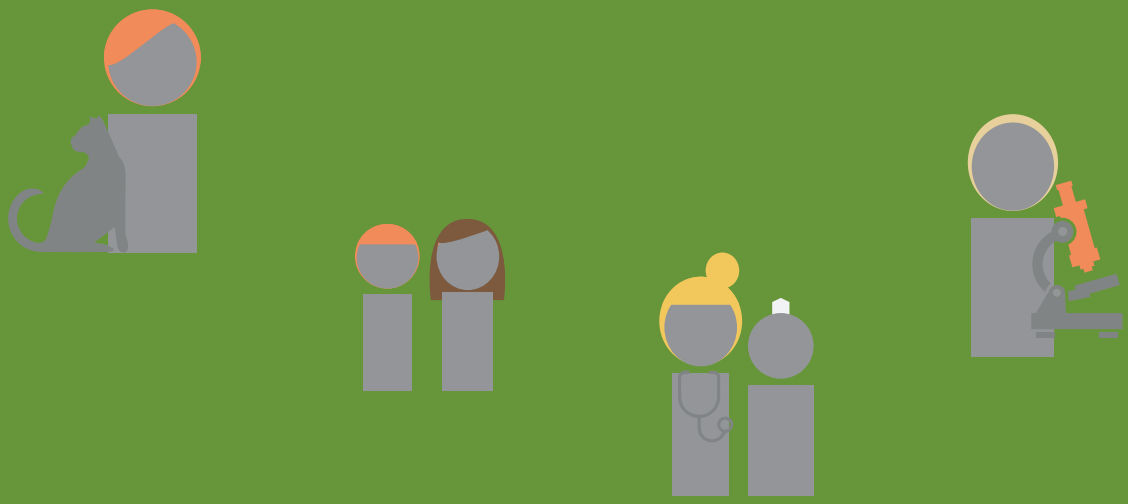


EXPLORING CITIZEN SCIENCE

NINE TALENT STUDENT PROJECTS



SDU Talent Programme Citizen Science

Exploring citizen science - Nine talent student projects

Jacob Buur – Professor, Department of Design and Communication

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Grafisk Center, SDU - Print

Christina Fyhn & Selina Sara Eisenberger – Graphic design

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SDU

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WHO ARE THE CITIZENS - Figurines
1. Pick a figurine for eachkind of citizen relevant for your project.
them with post-its. Who do you already know?
figurines on a landscape. Document with a

intoA University Talent Programme on Citizen Science

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Department of Design and Communication

Thomas Kaarsted
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Citizen science has proven vastly beneficial for a wide range of sciences. Engaging citizens not only expands the volume of research data, it also helps ensure relevance of the research endeavour. However, how to best train university students in organizing citizen science projects is not so straight forward. This requires both a solid grip on the science in question and the ability to communicate with citizens. At the University of Southern Denmark, we developed a talent programme as a means to spread the citizen science competence across all faculties. This booklet presents the results of the first programme: Nine papers writen by 27 graduate students selected for their scientific proficiency, urge to experiment, drive to take initiative, communicative skill and social engagement.

The initiative for the citizen science talent programme came from the university Citizen Science Network, a partnership between all faculties (natural sciences, engineering, health sciences, social sciences and humanities) and the university hospital. The network is organised by the university library.

The programme banks on experiential learning in live citizen science projects, which the students establish from the ground up over the semester-long programme. We support them with master classes, weekend workshops, a summer school and several coaching sessions. But the core learning really happens in the teamwork of actually designing and organizing citizen science activities, supervised by science advisors. The students are challenged to find citizens interested in their project, to engage them in new ways of gathering and analysing data, and to make sense of results.

Cross-fertilizing science traditions

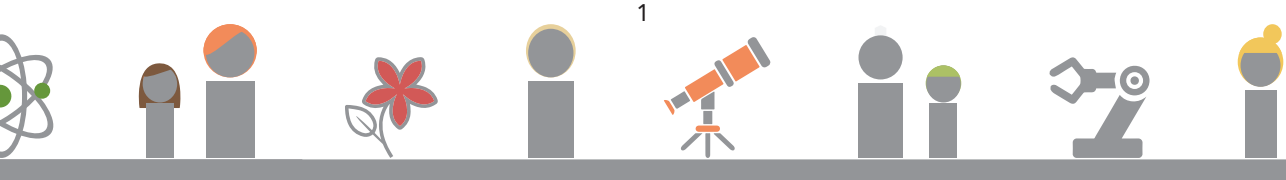
Even if the students have only just completed their bachelor degrees, they already have ingrained vastly different science methods. These backgrounds they bring into the programme: 'hard sciences' mix with media, design, journalism, sports etc. Building mutual respect under such conditions is a challenge.

In small teams of three, the students attack citizen science challenges across the full spread of university faculties. The projects have been proposed by proactive researchers in each faculty, who also act as science advisors for the teams. The programme faculty brings together professors from five supportive disciplines: Design (participatory processes), Media Science, Data Science, Journalism (science communication), Sports (community development).

The clash between science perspectives happens on two levels: between members within each student team and between the spread of teams, who, even if they all share an interest in citizen science, each struggles with very different scientific aims and practices. They realise that there is no standard method that works for all.

Arguing Citizen Science benefits

The science advisors all have prior experience with engaging citizens, but while committed to supervising a citizen science project, there are often challenges of convincing close colleagues that citizen science is beneficial to the scientific endeavour. This prompts the students to hone their skills in arguing benefits. So does the prospect of future jobs within the students' own field, and here arguments will differ, depending on their profession:



Natural Science students can refer to a 20-year history and a growing trend of citizen science in research. They will find it an advantage, when pursuing a research career.
Engineering students, more likely, will find it is the competence of engaging citizens in people-centric co-design of new products and technologies, which can boost their attractiveness to company employers – and their cross-disciplinary teamwork skills.
Health Science students need to bank on their new-found competencies in patient public involvement and their improved skills in communicating complexities.
Business students must work hard to translate their citizen science competencies into a business lingo of open innovation, crowd sourcing, lead-user innovation, even quantitative market studies. Skills wich are core in a gloval market with sustainable entrepreneurship on the rise.
Humanities students will see an opportunity to carve out a role of safeguarding societal relevance of research and even opposing the trends towards a post-factual society.
As part os the programme, we participate in the European Citizen Science Association Conference to further get a feel for the Citizen Science practices in various science traditions.

Bridging the digital and the physical

While many citizen science projects are only possible because of Internet connectivity, there is a constant tension between the physical doing and meeting of citizen scientists, and the on-line presence and participation. The Corona restrictions made this tension particularly palpable in the 2020-programme. The participants struggle with the same tension between physical presence in master classes, workshops and discussions, and on-line preparations and team discussions between members often from different geographical campus locations.

Writing into science traditions

While it would be relevant to close the projects with reports *on* citizen science, showing which methods were chosen, and how they worked out, our ambitions are to raise the bar higher: We ask the participants to write scientific papers on their results achieved *with* citizen science. This mirrors the situation of a full-fledged researcher, but it also adds the challenge that the participants need to check their writing up against the scientific traditions of each field. The nine papers in this edited volume are a result of a process built on the writing experience of the science advisors, including several rounds of peer-reviews.

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



Twelve master classes

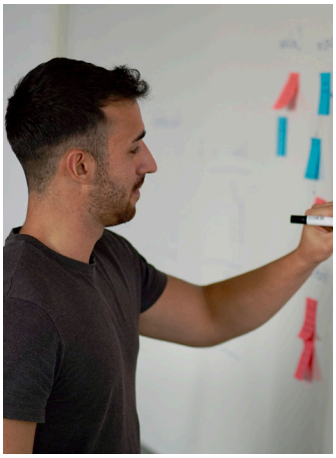
Kristian Hvidtfelt, Aarhus University:	Science of Citizen Science
Rosy Mondardini, CS Centre Zürich:	CS and the Sustainable Development Goals,
Thomas Kaarsted, University Library:	Open Science and CS
Jacob Buur, Design and Communication:	Ethnographic studies & co-sensemaking,
Peter Bro, Journalism:	Powers of news media and social media
Kirsten Drotner, Cultural Studies:	Theories and models of CS communication
Niels Gommesen, Cultural Studies:	CS design
Jens Troelsen, Sports Science:	Community development 1+2
Henry Larsen,+ theatre lab, Relationship Mgmt:	Complex responsive processes of relating
Asger V. Larsen, University Library:	FAIR open data & data management
Lotte Thing Rasmussen, University Library:	Media handling in CS

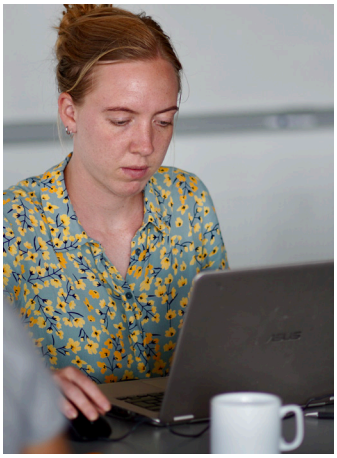
Three weekend workshops

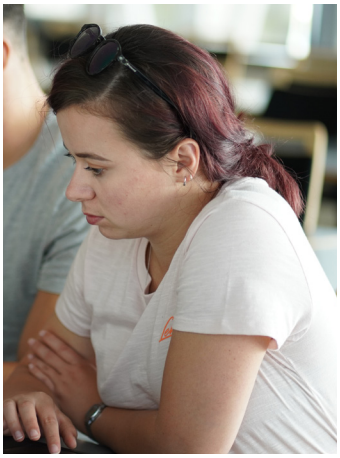
Muki Haklay, University College London:	Extreme Citizen Science
Bastian Greshake Tzovaras:	Collective learning with Open Humans
Thomas Landrain:	Just One Giant Lab
Danielle Wilde, Design and Communication:	DIY Instruments for Biohacking,
Jacob Buur, Design and Communication:	Participatory Design and CS
Jens Troelsen, Sports Science:	CS in Active Living Research
Lotte Thing Rasmussen, University Library:	Science Communication – think like a reporter

A four-day summer school

Carsten Nymand, DR Kultur, Børn og Unge:	CS Inspiration
Bjarne Lind Christensen, University Library:	Writing Workshop
Sara Egemose, Kerstin Fisher, Gabriel Gulis:	Scientific writing traditions







HOW AN INCREASED AWARENESS OF CAT HUNTING BEHAVIOR CAN AFFECT THEIR OWNERS' PERCEPTION

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Faculty of Humanities

Riccardo Piras
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ABSTRACT

Cats' hunting behavior is a known problem worldwide. However, little is known about Danish cats' hunting behavior and the cat owners' perception towards it. Here we aim to demonstrate how cat owners' perception of their pets, might be influenced by documenting the number of preys their cats kill and bring home, in combination with being exposed to selected positive and negative scientific facts about cats.
We used a participatory Citizen Science approach to collect data using questionnaires in the beginning and end of the project together with prey pictures from the participants in this pilot project. The pictures helped gather the total number prey and made it possible to identify the type of prey species cats bring home. The questionnaires contained 5 statements about cats, which participants could strongly agree, agree, disagree or strongly disagree with.
The results show a significant change in the answer distribution to one of the statements "Domestic cats killing wildlife is a serious problem". After the data sampling period 54% more of the participants agreed to some extend with that saying. This indicates that participatory Citizen Science can be used to increase awareness of cat hunting behavior and change cat owners' perception. A shift of perception could pave the way towards a more wildlife friendly way of keeping cats as pets.

KEYWORDS:

Domestic cats,
Owner perception,
Predation,
Citizen Science,
Danish cats

INTRODUCTION

Domesticated cats (*Felis catus*) have no native range and are alien species wherever they occur. When they threaten native biodiversity, they are also considered invasive and can impact native wildlife through predation, competition, disturbance, hybridization, and transmission of diseases (Trouwborst & Han, 2019). Many places throughout the world, the domestic cats' impact on the native biodiversity has been investigated, and their impact is significant. Worldwide domestic cats have been implicated in the extinction of at least two reptile species, 21 mammal species and 40 bird species (Doherty & et al, 2016). In Australia, domestic cats are estimated to kill an average of 377 million birds and 649 million reptiles each year (Woinarski et al., 2017, 2018). And an expert report written for the European Commission also shows that in Europe, domestic cats rank in top-three of the most harmful alien species (Genovesi et al., 2015). These are just a few examples. But how do Danish domestic cats affect the environment they live in? Not much is known about what Danish domestic cats do when they are outside. However, as stated before, it is already known that they can cause problems in the environments that they live in. Even though this is known in some groups of society, cats are one of the most popular pets to keep in Denmark.
In Denmark, the total number of domestic cats kept is higher than that of dogs (Danmarks Statistik, 2000). Lots of people let their cats roam outside, and many others think they are cute, and they do not see their hunting behavior as a problem. Considering that some cat owners are also not aware of the problem, it can be difficult to explain the problems that cats can cause to the biodiversity. It is therefore interesting to investigate cat owners' perception about keeping cats as pets and which factor that can affect it.
Citizen Science is an approach to conduct scientific studies by including different everyday individuals who voluntarily help to gather a big amount of diverse data in a short interval of time. It is also defined as volunteer collection of biodiversity and environmental information which contributes to expanding our knowledge of the natural environment, including biological monitoring and the collection or interpretation of environmental observations (Tweddle et al. 2012).
With this "SDU Cat Tracker Project" we use Citizen Science as an approach to gather scientific data about what kind of prey Danish domestic cats bring home, and on how cat owners' perception changes when they are faced with positive and negative facts about cats' behavior and increased awareness of which kind of prey their cat(s) bring home. We show that by participating in "The Cat Tracker Project", cat owners were more likely to agree with that cats killing wildlife is a serious problem. Despite this, the participants are in average after the project not willing to keep their cats at their own properties during the day.

METHODS AND DATA

The main method that defined The Cat Tracker Project was participatory Citizen Science, where the volunteers contributed with observations and effort
The level of participation in this project, based on Muki Haklay's "*Levels of participation*" table, is level 2 which is called "*Distributed intelligence*" (Hecker et al. 2018). The citizens participated as basic interpreters and they used their volunteered thinking to gather the needed data for the project.
The Cat Tracker project had two main phases: "*Recruiting process"* and *"Engagement and data sampling"*

RECRUITING PROCESS

We published a poster the 1st of May 2020 to recruit cat owners with outdoor cats. The poster invited potential participants to help with answering the questions: "*What prey does your cat bring home?*" and "*What Is your opinion about cats as pets*". The

poster was published on several Facebook pages and published in many local newspapers. The interested people were asked to send a picture or a very short video to the project's email to apply. In the email they also provided basic Information about themselves and their cats (gender, age, area, sterilized/non-sterilized). 17 participants were gathered, along with 28 cats. 12 cats were males and 16 cats were females. Only one female cat was not sterilized.

ENGAGEMENT AND DATA SAMPLING

The four weeks of data sampling started the 25th of May 2020 and finished on the 21st of June 2020. Before this period participants received a questionnaire to fill out with the aim of investigating their attitude towards the impact of hunting cats and possible management strategies. The same questionnaire was handed out after the actual four weeks of data sampling to explore if their perception of cats hunting behavior has changed. This questionnaire was inspired by a similar approach presented by McDonald et al. (2015). During the data sampling period participants collected prey data through pictures, were exposed to positive and negative facts regarding cats as pets and did fun weekly tasks.
As main vehicle of communication during the project emails were send out. Moreover, a webpage was created to offer all the necessary information about the project and to share highlights of every week together with results from the project. (https://www.thecattrackerproject.com/). A Facebook page was also built to make updates about new posts on the webpage, since it is a very commonly used social media platform.

PREY PICTURES

Participants were asked to take pictures of the prey their cats brought home and send them to us by email. The pictures should be taken on a white piece of paper with a ruler next to It. Alternatively a coin could be placed next to the prey, since it has known measurements (Figure 1). This method has earlier been used in a citizen science project about Danish domestic cats by Hansen, 2016.

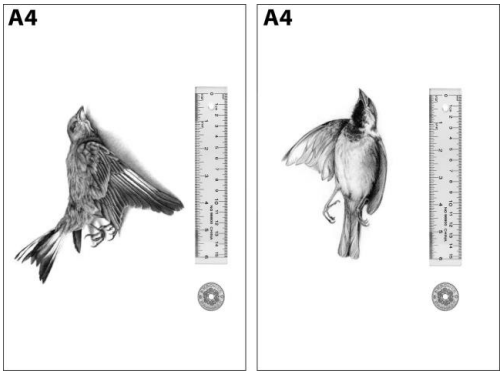

Figure 1: The guide of how to take prey pictures.

POSITIVE AND NEGATIVE FACTS ABOUT CATS

Each week during the data sampling period participants received an email with a booklet containing two positive and two negative facts about cats as pets. This was so done, so we could increase the owners' knowledge about cats. There was an equal amount of positive and negative facts to avoid shaping the participants into a specific perception direction. Examples of the facts can be seen below under the title **"*Did you know*?":**

"That even though cats not necessarily hunt in nature they still affect the wildlife by just being present
A study from 2005 showed that if a stuffed cat briefly confronted a blackbird close to its nest, the following feeding in the nest would be reduced with one third of the normal time length. This also meant that the chicks were left more alone and were more vulnerable to predators such as corvids."
(Preisser E.L. et al. 2005)

"***That it is a benefit for older people to have a cat***
A study from 1990 found that older people with pets became less stressed by major adverse life events than non-owners. Moreover, they made fewer subsequent doctor visits. Health-related, a cat is therefore a good partner through your entire life! (*Siegel, J. M. 1990)"*

ENGAGEMENT

The booklets that we send out also contained a section with a "*weekly fun task*". In the weekly tasks the participants were encouraged to document fun stories about their cats under headlines as "*Master of Sleep*" and "*What is your cats' superpowers?*" It was then possible for us to share these stories on our Facebook page and on our webpage. Then the participants got the chance to know other participants' cats.

STATISTICAL ANALYSIS

A chi-squared test to a goodness-of-fit test was carried out in the computer program R, to test if the distribution of answers for the 5 statement questions has changed between the initial - and final questionnaire. A significant difference between the two answers were accepted when the p-value was below 0.05. Moreover, it should be noted that if one of the answer options contained zero answers in the initial questionnaire that category was group together with another one. The same two categories were then grouped in the final questionnaire results as well, when the statistical analysis was made.

RESULTS

During the data sampling period the 28 cats caught a total of 32 pieces of prey, which is an average of 1.14 prey catches per cat. Around 60% of the prey were mammals. The mammals include 4 different species and a group with unknown ones, where identification is not possible. Some pieces of prey are not possible to identify down to species level due to the condition the cat brought them home in. Other pieces of prey, especially birds, were still young and for that reason difficult to identify precisely. 40% of the prey brought home are birds. For half of them the species are unknown while the rest of the birds are categorized into two different species (Table 1).
The participants were in general good at predicting the amount of prey their cat(s) would bring home during the four-week data sampling period. 9 out of 15 participants predicted the right number of prey or with one piece of prey wrong. Only two participants guessed far away from the actual number of preys brought home. These two are counted as outliers. When the outliers are excluded, the R^2 value for a fitted linear line for expected number of preys brought home contra actual number of preys brought home is 0.906 (Figure 2).

Table 1: Caught prey from the 28 cats during the sampling period

Prey species	Number of species	Number of prey brought home	Percentage of total prey count (%)
Mammals	4	19	59,38
Field vole (*Microtus agrestis*)		3	9,38
Yellow-necked mouse (*Apodemus flavicollis*)		3	9,38
Bank vole (*Clethrionomys glareolus*)		1	3,13
Common shrew (*Sorex areneus*)		2	6,25
Unknown		10	31,25
Birds	2	13	40,63
Great tit (*Parus major*)		5	15,63
Eurasian blue tit (*Cyanistes caerulus*)		1	3,13
Unknown		7	21,88

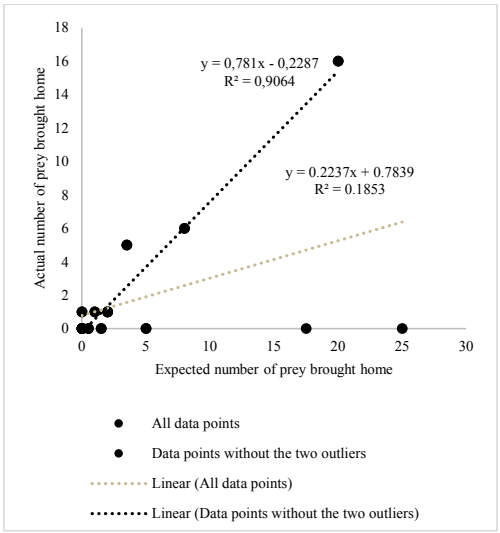

Figure 2: Expected number of preys brought home for the study period in each household compared to the actual number of preys brought home. The dotted grey line indicates the tendency line for all the data, while the dotted black line indicates the tendency line for the data without the outlier points at (17.5;0) and (25;0).

13 participants completed the initial and final questionnaires. The percentage distribution among question answers was calculated for each question in the initial (i) and final (f) questionnaire (Figure 3). The chi-squared tests show that there are no significant differences in the answer distribution in the questions (Q) Q2, Q3, Q4, Q5 in the initial questionnaire compared to the final questionnaire. The p-values from the chi-squared tests for these Q's are all above 0.05.

Q1 (*Domestic cats killing wildlife is a serious problem*) is the only question were the answer distribution changes significantly during the data sampling period (P-value = 0.002). It is also seen that a large percentage of the participants have changed their answer from "*Disagree*" to "*Agree*" in the final questionnaire. In the initial questionnaire 23% of the participants in some extend agreed with Q1. This percentage increased to 77% in the final questionnaire (Figure 3).

Figure 3 also shows that more than 80% of the participants agree to some extend with that all cats should be neutered (Q3) in both the initial and final questionnaire. However, in the final questionnaire under 40% of the participant agree to some extend with the management strategies that cats should be kept on their own property (Q4 and Q5).

DISCUSSION AND CONCLUSION

We demonstrate here that by participating in "The Cat Tracker Project" cat owners' perception about cats' hunting behavior changed. After the data sampling period, cat owners were more likely to agree with that cats killing wildlife is a serious problem. The results show that after the four weeks of data sampling, the participants changed their mind significantly regarding Q1 "*Domestic cats killing wildlife is a serious problem*". There was a 54% increase in the answer options containing the word "*agree*".

The idea is that this change can be caused from participants gaining more knowledge from the booklets or from being more aware of the amount of prey their cat(s) bring home. Figure 2 shows that most of the participants were aware of the amount of prey that their cat(s) normally bring home. Their expected values for the number of preys their cats will bring home during the study period, were therefore very close to the actual values. This shows that it has not been a surprise for the owners to see the amount of prey that their cats bring home. It is therefore probably not that, which have made them change their attitude regarding Q1. Furthermore, it should be noted that most of the cat owners overestimated the amount of prey their cat brought home. This indicates that it is probably the booklets which have caused a change in the cat owners' perception. By giving the participants the booklets, we tried to give them more knowledge on which effects cats have on the environment they

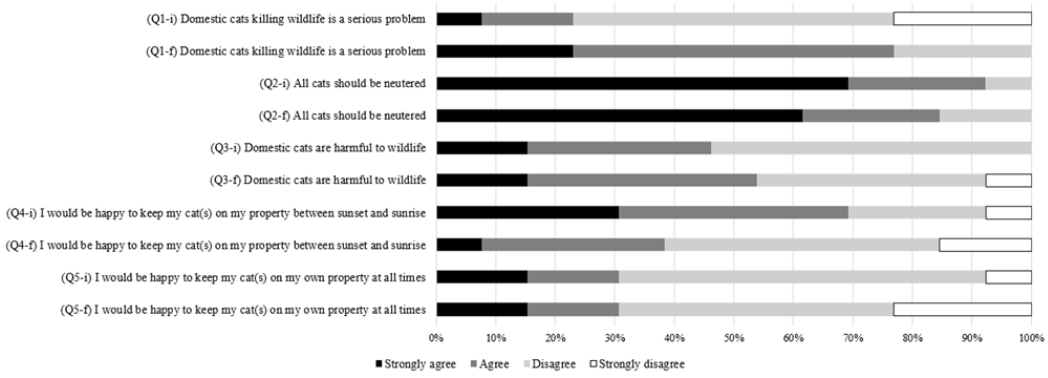

Figure 3: Distribution of answers for the five questions (Q) in the initial (i) - and final (f) questionnaire among the 13 participants who answered both questionnaires.

are a part of - both positive and negative. When this method is looked at separately it can be described as the deficit model (Hecker S. et al., 2018). However, lots of literature shows that simply giving more information to people does not necessarily change their view (AAAS, 2016).

A change in people's opinion can therefore also be a consequence of the Citizen Science project in total. When people feel like they are a part of something, they tend to be more engaged in the process. It therefore gives more value to this project that it was carried out as a citizen science project, and it is probably that factor there has caused a change in cat owners' perception of having cats as pets.

To make a citizen science project work it is important to engage with the participants, so they find it interesting and keep being a part of the project. We tried to engage with our participants through multiple ways. The webpage was created to make an active and continuous engagement with the participants, so that Facebook was not the only way of communication. Emails were sent out every week to give updates, fun tasks, reminders and booklets. Even though these mails were consistent, the feedback from participants were not that constant. This resulted in having only one participant who completed the weekly task in the second week. A way to improve this would be to send more emails out during the week. Maybe two to three emails each week to remind the participants to stay active and observant. E. M. Hansen, 2016 had made a comparable study about Danish domestic in 2016. Her 14 months long study also found it hard to keep participants engaged and she experienced that 44% of the participants left the study. She used monthly newsletters and activities such as "*Predator of the week*". This also supports the fact that citizen science projects need a lot of updates, engagement and activities to keep participants interested. We had 4 participants out of 17 who did not complete both questionnaires. This means that 23% of the participants did not complete the study even though it was a short 4-week pilot study. In general, this kind of projects are carried out over longer time than ours. The article "*Reconciling actual and perceived rates of predation by domestic cats*", was conducted for over 14 months (McDonald et al., 2015)

Q2 to Q5 regarding neutering cats, are they harmful to wildlife and are participants willing to keep their cat(s) at their own property did not show any significant differences in the answer distributions for the initial - and final questionnaire. Maybe if the citizen science project went on for longer, it would have had an impact on these opinions as well. People first must agree with that it is a problem before they are willing to do something about it. The perception change regarding " *Domestic cats killing wildlife is a serious problem*" indicate that the participants now in general agree with that statement and there are therefore options for further development. The next step could be to find management solutions for domestic cats that cat owners would support. The answers regarding whether participants are willing to keep their cat(s) at their own properties indicate that this is not a management strategy they in general support. Further developments of this citizen science project could therefore include deeper collaboration with cat owners to find sustainable management strategies. Maybe strategies from other areas could be tested as well, such as letting the outdoor cats wear bells etc.

The prey caught during the project also show that the cats actually catch something and thereby have a role in the environment they are a part of (Table 1). None of the species caught were red-listed (Institut for Bioscience, 2019) The data about species brought home can continue to be gathered to gain more knowledge about what cats hunt in Denmark. Since this is only a 4-week pilot project factors such as season, weather etc. are not taking into account. A participant also wrote that the amount of prey brought home by her cat normally depends on the weather. Moreover, the number of prey that cats do not bring home are an unknown number, when studies are carried out this way. Therefore, cat-mounted video cameras should be considered for future work to fix this problem.

The pilot project "The Cat Tracker Project" showed that an increased awareness of cat hunting behavior could affect their owners' perception, so more participants after the study agreed with that cats killing wildlife is a serious problem. This is probably due to that this study is carried out as a citizen science project were participants have been engaged in the whole project. However, there is potential for even more engagement with the participants to avoid dropouts. A suggestion could be deeper collaboration with participants to codevelop sustainable management strategies for pet cats.

REFERENCES

American Association for the Advancement of Science (AAAS). (2016). *Logic Model for Public Engagement with Science*. Washington, DC: AAAS

Danmarks Statistisk 2000 Familiernes kæledyr. 40 pct. af familierne holder kæledyr. Nyt fra Danmarks Statistik Nr. 499

Doherty, T. S., & et al. (2016). Invasive Predators and Global Biodiversity Loss. Proceedings of the National Academy of Sciences of the USA 11261.

Genovesi, P., Carnevali, L., & Scalera, R. (2015). The Impact of Invasive Alien Species on Native Threatened Species in Europe. ISPRA and ISSG.

Hansen, EM (2016) Hunting behavior of Danish domestic cats. Unpublished MSc thesis.

Hecker, S., Haklay, M., Bowser, A., Makuch, Z., Vogel, J. & Bonn, A. 2018. Citizen Science: Innovation in Open Science, Society and Policy. London: UCL Press. https://doi.org/10.14324/111.9781787352339

Institut for Bioscience. (2019, August 18). *Den danske Rødliste 2019*. Retrieved from https://bios.au.dk/forskningraadgivning/temasider/redlistframe/soeg-en-art/

Kays, R. W., and A. A. Dewan. 2004. Ecological impact of inside/outside house cats around a suburban nature preserve. Anim. Conserv. 7:273–283

Loyd, K. A. T., S. M. Hernandez, J. P. Carroll, K. J. Abernathy, and G. J. Marshall. 2013. Quantifying free-roaming domestic cat predation using animal-borne video cameras. Biol. Conserv. 160:183–189.

McDonald, Jennifer L., Maclean, Mairead, Evans, Matthew R. & Hodgson Dave J. 2015. Reconciling actual and perceived rates of predation by domestic cats. Ecology and Evolution 2015; 5(14): 2745–2753 Doi: 10.1002/ece3.1553

Preisser, E. L., Bolnick, D. I., & Benard, M. F. (2005). Scared to Death? The Effects of Intimidation and Consumption in Predator-Prey Interactions 86 Ecology 501; Loss and Marra

Siegel (1990) Journal of Personality and Social Psychology, s. 1081-1086

Trouwborst, A., & Han, S. (2019). Domestic Cats (Felis catus) and European Nature Conservation Law—Applying the EU Birds and Habitats Directives to a Significant but Neglected Threat to Wildlife. Journal of Environmental Law, s. 1-25.

Tweddle, J., Robinson, L., Roy, H. & Pocock, M. Guide to Citizen Science. (2012). doi:10.1038/nn1010-1151.

Woinarski, J. C., & et al. (2017). How Many Birds Are Killed by Cats in Australia? Biological Conservation. Vol 214, pages 76-87.

Woinarski, J.C.Z, Murphy, B.P., Palmer, R., Legge, S.M., Dickman, C.R., Doherty, T.S. Stocked, D. (2018). How many reptiles are killed by cats in Australia? Wildlife Research, 45(3), 247-266.


EGEKILDE

THE POTENTIAL OF CITIZEN INVOLVEMENT IN DATA COLLECTION FOR URBAN LAKE RESEARCH IN DENMARK

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ABSTRACT

This pilot study explores potential for involving citizens in knowledge generation and data collection for urban lake research. Denmark has numerous urban lakes as part of the country's stormwater management strategy. These lakes are situated in residential areas where they are accessible to the local community. Little to no data on how habitats evolve in urban lakes exists. The paper finds potential for Citizen Science methods to engage citizens in collecting research grade observational urban lake data using an open data platform, and suggests a model for continued engagement.

KEYWORDS:

Citizen Science, Urban lakes, Climate lakes, iNaturalist, Citizen engagement

INTRODUCTION

Climate change has proven to be a major challenge in the northern temperate zone, causing intense rain events due to a warmer atmosphere. Consequently, stormwater is increasingly catching attention, due to impacts like increased frequency of flooding, deterioration of water quality in local stream risk to the downstream ecosystems (Sharma et al, 2016).

Urban lakes which are stormwater management structures, are designed to slow down the flow of stormwater and filter pollutants before they reach the receiving water or local streams (ILEC,2005).These lakes are periodically maintained by cleaning out the sediment build up in order to ensure that they continue serving their function (Egemose, 2018).

The filter function as well as the water flow capability are decreased if 1) sediment accumulates 2) the outlet is blocked 3) invasive plants take over the habitat and 4) the catch basin shape is distorted (Environmental Protection Agency, 2009). These problems can be prevented if urban lakes are monitored more closely.

The development of urban lakes is generally not monitored after the lake has been built and results in “unknown” lake status. A possible solution to this is Citizen Science, which is defined as any form of active public participation in the process of research to generate science-based knowledge (Brouwer et al, 2018). Through citizen science, anyone can gather/collect observational data to generate information about urban lakes and inform future policy. According to Aceves-Bueno (2017), the cost- effectiveness of citizen science data offers the potential for scientists to tackle research questions with large spatial and/or temporal scales. Citizens can be recruited to collect and load observational data about urban lakes. This allows for a cost-effective and efficient way to monitor urban lake status. Haklay (2013) defines the activity of involving citizens as sensors, basic interpreters, and contributors of urban lake data as contributory citizen science. The possibility of engaging local citizens in the process of monitoring urban lakes for better stormwater management purposes, appears to be a promising trajectory. According to Johansson (2020), opportunistic observational data from urban lakes collected by citizens is as equally valid as the observations made by research scientists.

Pescot et al (2015) concludes that the data collected by biological recorders working within monitoring scheme frameworks will continue to produce datasets that are highly valued by governments, scientists, and the volunteers themselves. Suter II (1993: 505) in Pescot et.al (2015: 509) defines monitoring as the ‘measurement of environmental characteristics over an extended period of time to determine status or trends in some aspect of environmental quality’.

This pilot study explores the potential of citizen engagement in monitoring the existence of indicator species for the purpose of measuring water quality. In addition, the data would be valuable for research into the field of urban lakes as habitats. By evaluating samples from urban lake observational data, as well as qualitative datasets derived from participatory activities, the paper concludes there is potential for citizen involvement at a larger scale. All data has been collected in the municipalities of Kolding and Esbjerg, in the region of Southern Denmark.

PILOT DESIGN

Potential participants were instructed to “join our project on iNaturalist.org, find a climate lake, take pictures of any plants, insects or animals you find in or around the water and upload them to our project page on iNaturalist.org”. In this paper we refer to stormwater ponds as urban lakes. The term “climate lakes” is not a broadly used term for describing a stormwater pond, but the term was used when engaging with participants, mainly due to its connotations with climate awareness.

Figure 1 represents overall ideas for designing the pilot, based on results from the ThinkCamp and shows three main levels of participation in an urban lakes citizen science project. The “local

citizen" is defined as a participant that interprets data during workshops, "contributing citizen" refers to a participant that contributes and loads observational data to an existing scientific research platform, and the "local expert" refers to a participant that interprets the climate lake development and based on that identifies problems which can then be shared with policy makers. It is important to examine participation in terms of high and low levels of knowledge and engagement as it reveals different types of value in each project (Haklay, 2013)

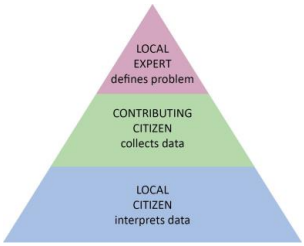

Figure 1: Levels of participation in urban lake data collection inspired by Haklay's engagement model (2013)

DATA COLLECTION METHODS

Online Workshop

In order to assess citizens' existing level of knowledge on stormwater ponds, Eight participants were recruited using convenience sampling and participated in a pilot workshop where participants were invited to comment on pictures of urban lakes using sticky notes on the web based collaborative application "Google jamboards".

ThinkCamp (online)

In order to generate ideas on how to design the pilot, a citizen science ThinkCamp was organized to brainstorm on how citizens would like to be involved in an urban lake project, and what kind of data they would imagine collecting, if they were to participate in the pilot. The eight participants that were part of the workshop included local citizens, biologists from SDU and a municipality representative from Kolding.

Questionnaire

Based on the results of the ThinkCamp, a multiple choice questionnaire was designed and shared on Facebook. Respondents were selected by convenience sampling. This questionnaire served to test the assumptions based on the results from the ThinkCamp on what kind of data citizens would be likely to be most interested in contributing with. It also served as an invitation to learn more about the project.

WWW.NATURALIST.ORG

For the pilot test main data management infrastructure, the open data platform www.inaturalist.org was chosen. iNaturalist is an open data platform for sharing and uploading observations of flora and fauna among iNaturalist users, citizen scientists, and biologists. Our main considerations for choosing this platform were:

1) The ability to share observations with other participants
2) All image meta-data being kept intact when uploading
3) www.iNaturalist.org has strong gamification elements built into the design, providing participants a feedback mechanism by which to encourage continued engagement. The leaderboard feature on the platform also provided a method by which to assess the potential for engaging with people already interested in contributing with environmental data in the local area. This data is presented under future work. The pilot study iNaturalist observations can be openly accessed and compared through the "inaturalist umbrella project" where links to both the Esbjerg and Kolding dataset can be found.

VALUE OF URBAN LAKE DATA COLLECTED

The information that can be deduced from these observations include types of species observed at the urban lakes, location of the urban lakes and what data citizens upload the most. The location of the lake gives the information of the geology of the lake as well as an indication of the amount of urban lakes. For example, cities that are built on consolidated rock with low permeability (e.g. clay till in Kolding) will likely have more urban lakes due to a high quantity of stormwater (Barfod et al, 2016).

INDICATOR SPECIES - MEASURING WATER QUALITY BY PROXY

The lake fauna and flora observations can provide warning signs for researchers about lake health in general. These observations provide the researcher with basic water quality information (i.e physio-chemical information such as pH, dissolved salts and dissolved oxygen).

The presence of alien invasive species can be detected as well. Island formation within the lake provides the researcher and authorities with information about sediment build up and informs maintenance action. Vegetation overgrowth can be detected and cleared to avoid blockage of the inlet and outlet of the lakes.

PILOT RESULTS

At the time of writing, 11 citizens signed up for membership of the iNaturalist project, and 795 observations were shared, from a total of four observers. Main taxonomies represented in the dataset insects (64.4%), plants (20.1%) and birds (9.1%). One participant contributed 4 observations from Esbjerg, one contributed one observation from Kolding, and another participant contributed 791 observations from Kolding. Out of 795 observations 464 were "research grade", meaning positively identified by the iNaturalist community.

In figure 2, pictures taken at "Mølledammen" (Kolding) are presented.

Both species are usually found along waters that flow. Duckweed survives at pH between 5 and 9 but grows best over the range of 6.5-7.5 and is often found in nutrient rich environments. Calopteryx Splendens is found where water flow is fast. Duckweed was observed at the lake itself, while Calopteryx observation was made along the stream that is connected to the lake. The observations shown in Figure 2 represent a research opportunity in the observational data. Mølledammen, originally a mill pond, was scheduled to function as a stormwater pond, as the last part of a larger scale local drainage of rainwater project by the end of 2019. However, according to local news media, this part of the project has been halted. The observations from the area in 2020, could potentially function as a baseline measure of local biodiversity in the ecosystem around Mølledammen. However, according to local news media, this part of the project has been halted. The observations from the area in 2020, could potentially function as a baseline measure of local biodiversity in the ecosystem around Mølledammen.

Duckweeds / Subfamily Lemnoideae
Observed: Jun 18, 2020
9:45 PM SAST
Lat: 55.478994
Lon: 9.296844
Accuracy: 8m
Geoprivacy: Open

Banded Demoiselle / Calopteryx Splendens
Observed Jun 22, 2020
5:43 PM CEST
Lat: 55.487883
Lon: 9.301556
Accuracy: 57m
Geoprivacy: Open

Figure 2: Observation of flora and fauna indicating water quality at Mølledammen, Kolding. Adapted from Source: https://www.inaturalist.org/observations/50081208

https://www.inaturalist.org/observations/50597905 Image attribution: Ellegaard Photography, all rights reserved

EVALUATIONG PILOT RESULTS

The results are in line with Haklay (2018), according to whom, 9 percent of registered citizen science participants submit little data, and 1 percent of the registered participants submit most of the data. Some of the 795 observations are closer to water tables than others. Smartphone GPS data can have up to 50 metres of error accuracy. The observational data from iNaturalist would suggest that indicating a "buffer zone" around the urban lakes, within which to gather the data, would be useful for filtering the results once they are gathered. This can be done by the participants themselves, by being instructed on how to use the "place mapping" feature on INaturalist. Bias in citizen science monitoring schemes can arise in a number of ways. For example, organizers may find it challenging to persuade participants to visit random locations, particularly in an intensively managed landscape where the chances of encountering many target species may be low. But a participant may also have an interest in one particular species, which again can create a bias in the dataset. (Pescot et.al 2015:511) One such potential bias was encountered in the dataset, as there were 20+ observations of moths from the same participant in one day. Biases can also arise from the simple fact, that some species are easier to capture with a camera than others. Windy conditions might also influence the distribution across taxonomies being observed, if any at all, and during the time of our pilot test, local winds averaged up to 10mps.

EVALUATING PARTICIPANT RECRUITMENT PROCEDURE

The hybrid ThinkCamp event format is well-suited to citizen science and can diversify participation, support knowledge sharing and engage a wider audience in the development of new ideas and projects. However, our results show that engaging potential participants in a ThinkCamp event does not per default ensure participation in data collection from the participants in the event, as was our assumption. From a CS communications perspective, it makes sense to address two main categories of participants. 1) those who are interested in knowing more about climate/urban lakes. 2) those who merely find it a fun activity to gather observations of flora and fauna, as a recreational activity, as is indicated by the comments in Table 1.
Facebook was used as the main participant recruitment platform. The content shared, included strong learning and awareness raising. Education around urban lakes and data collection was the primary objective. According to Haklay (2018), this would allow participants with little expertise in the field to participate and provide relevant data.

Table 1: Pilot workshop participant responses on pictures presented during the workshop.

Type of lake	*"How would you use the lake?"*	*"Would you identify it as a climate lake?"*
 In recreational area	Recreation Walking around To look at	Yes, because there are bricks and inlets
 Residential area	Watch birds Enjoy time with family Enjoy the view Walk around	Probably, because it has an inlet and can contain a lot of water
 Next to a road	Would not really look at, because its not pretty Not useful beyond its function	yes, it probably catches stormwater from the roads uncertain not sure
 Industrial area	Would not visit Not useful beyond its function	Yes, most likely, it seems man-made, it is located near a substation
 On a golf course	For playing golf	Not sure, seems made to design a pretty landscape, and it doesn't really look like it could contain very much water. Although clearly, it is not a natural lake

The growth of Facebook members was non-linear (fig.5), One increase in facebook members is seen during a time period, where invitations have been posted in other Facebook groups. Another increase can be seen from the 4th of July, correlating with when invitations to join the group were sent out via the private message function on Facebook. The peaks of engagement were moments when (multiple) links were posted. One peak (25 active members) is found on the 1st of June, when links to the iNaturalist page were posted. Another peak is found at the 7th of July (24 active members), when the urban lake website was posted. None of the members of the Facebook group "www.facebook.com/groups/climatelakes were "converted" to contributing participants. The contributing

participants became members of the Facebook group after having contributed with observational data on iNaturalist.
This indicates that the Facebook group served as a platform for continued engagement (as illustrated in Figure 6), but not as an adequate Invitation to contribute with observational data.

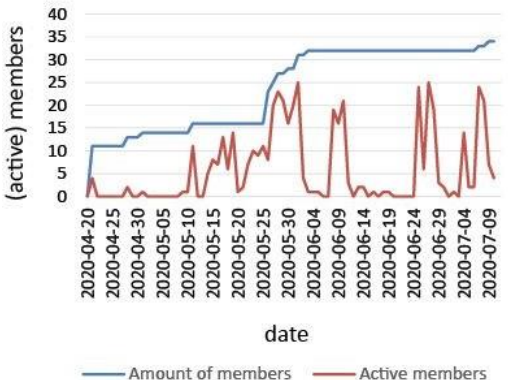

Figure 5: The growth in the number of members of the CSTP20 Facebook group and active members, measured in terms of comments, shares and clicks

A mapping of the potential "user journey" was explored to investigate difficulties that participants might face, after being introduced to the iNaturalist page. Findings are summarized in Table 2 These indicated, in line with our findings from the online workshop and ThinkCamp, where participants indicated uncertainty in identifying all types of urban lakes as stormwater ponds, main barrier to contribution are likely to be a lack of detailed directions to the nearest urban lake. Collecting observational data demands a relatively high level of engagement compared to other forms of crowd-sourcing data collection, because participants need to physically visit a lake before they can upload observations on iNaturalist.

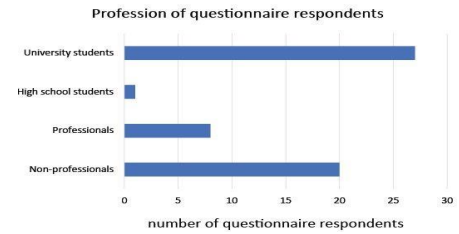

Figure 3: Profession of questionnaire respondents
As with the ThinkCamp, respondents included scientists and students who had a higher level of education, which may have influenced the level of complexity by which we communicated the invitation to contribute.

The highest percentage of respondents ranked "lake animals" as the most desired variable to measure (Fig. 4). A smaller percentage of participants ranked "water level" as the most desired variable to measure. This gives the researcher an idea of what data type to focus on when engaging with participants. It also provides the researcher with an opportunity to design a data collection method that will encourage the participants in participating.
The extensive FAQ section on iNaturalist would suggest that there could be a number of user-experience barriers to adding an observation on iNaturalist. According to Buur & Windhum "*motivation means that the user is prepared to offer more time and more mistaken attempts to get to know the product*" (Buur & Windhum, 1994: p.44) It is possible that the iNaturalist platform might be more relevant for those who are already highly motivated. Following the above argument, the solution would be to focus more on participant motivation for getting involved, and moving from local citizen to contributing participant.

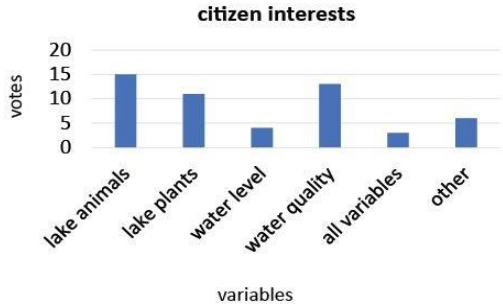

Figure 4: Urban lake data participants are interested in collecting as indicated by questionnaire.

A CITIZEN ENGAGEMENT MODEL

According to Haklay (2018) it is important to give participants support throughout participation so that they can continue participating. Based on our interpretation of the ThinkCamp results, combined with the balanced participation model by Thoft et al, (2018), important factors for participating were identified and categorized in four stages (fig. 6).

Figure 6: Citizen involvement model, based on ThinkCamp results combined with balanced participation model by Thoft et al, (2018)

Whilst participating

The participants of the ThinkCamp reported that when participating, they would like it to be a flexible activity so that it

can easily fit their daily routine. They also mentioned that the ability of implementing their skills and hobbies would increase their motivation of participation. In line with Thoft et al, (2018) several of the participants of the ThinkCamp mentioned a need to get feedback on their collected data.

Thanking participants

Acknowledgement was also mentioned as a parameter. Participants of the ThinkCamp mentioned that they like to see (unfinished) results and like to know how and when their contributed data is used. This can be in the form of sharing the published article which they can then share with family and friends.

Participating again?

Encouraging repeated participation/contribution yields more data. A user who contributes with an average of more than 30 observations during a three week time period is here defined as a super user. A community platform encourages super users to share their knowledge with other super users. Social media channels can be used to support the community.
Support and feedback according to Haklay (2018) required for low expertise participants who are highly engaged. A possibility to educate, which is according to Haklay (2018) important to address low expertise.
The hypothesis that participants have a need for learning more about urban lakes (Fig.6) before they are ready to contribute with observational data, would need to be tested. Whether participants find participating easier if they can choose a lake from already identified lakes, or if participants are invited to add their data from any urban lake they can find, would also be of interest for further work.

Table 2: Barriers to registered pilot study contributions

Competence required for participants to register their observations	Familiar with how to locate a "climate lake"	Unfamiliar with how to locate a "climate lake"
Familiar with uploading observations on iNaturlist.org	Contributes High Potential for re-engagement:	Does not contribute High Potential for engagement
Opportunity for re/engagement:	Feedback	Locate any urban lake
Unfamiliar with uploading observations on iNaturlist.org	Does not contribute	Does not contribute
Opportunity for engagement:	Instructions for uploading pictures	Locate any urban lake

It is important to consider other factors, such as a strong connection with the message and invitation to contribute - that are not covered in the model. However, the model in Fig 6, provides for a mental scaffolding by which to design communication for the different stages of participation.

Figure 7: "Branding" of the pilot invitation, based on insights from potential participants drawing upon the experiences of being awake and outdoors at daybreak.

FUTURE WORK

Looking at the total number of active users on iNaturalist.org during the timeframe for our pilot study, it emerges that there could be a larger potential for recruiting users on www.Inaturalist.org, than relying only on recruiting through related interest groups on Facebook. This is inline with the idea of "hitching a ride on existing networks" when recruiting participants for a citizen science project.

Table 3: Scalability in Kolding: local observations submitted during period of pilot-test, not connected to the urban lakes project

Kolding	*3,468 observations*	*1,158 species*	*424 identifiers*	*196 observers*

When viewing the iNaturalist "leaderboard" feature, we see that 14 Naturalist users active inKolding contribute with more than an average of 20 observations per week, and can described as "enthusiasts". The others as "dabblers" (Haklay, 2018) here, with less than 3 observations contributed in total per week. In Esbjerg the pattern is similar, although there are only 7 users who have more than 20 observations during the selected timeframe (may 22 - august 12th). The same calculations are available for all areas of Denmark, where urban lake data collection is of interest to collect. In addition, there are several local projects, where continued engagement is already high, such as "LunderskovsNatur"
https://www.inaturalist.org/projects/lunderskovs-natur which contain observations from the wetlands, could potentially join., another related project could be "Plants in Denmark", where local participants can be identified through filtering local observations by geolocation.

CONCLUSIONS

The findings from our pilot study demonstrate that it is possible to involve citizens in collecting scientifically valid opportunistic observations of flora and fauna, in and around the local ecosystems associated with urban lakes in the region of Southern Denmark.
Barriers to contribution were identified as; Lack of clear directions to nearest lake, Being unsure of the significance of the data contributed; Considerations in terms of a larger scale test include: 1) Engaging with super-users 2) Using social media as community building platform 3) Engaging with existing networks of potential "urban lake data collection super users" 4) Inviting

participants to collect "urban lake data", without first needing to identify the lake as an urban lake. It would require further inquiry to adequately conclude whether it would be possible to engage a larger number of participants in frequently collecting observational data of relevance to stormwater pond maintenance management planning, for an extended period of time to determine status or trends in water quality. Overall, this pilot has highlighted the value for citizen involvement in urban lake monitoring so that in the future it will be possible to provide a true picture of the development of habitats in urban lakes in Denmark.

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REFERENCES

Aceves-Bueno, E., Adeleye, A., Feraud, M., Huang, Y., Tao, M., Yang, Y. and Anderson, S. (2017). The Accuracy of Citizen Science Data: A Quantitative Review. The Bulletin of the Ecological Society of America, 98(4), pp.278-290.

Barfod,A.S.,Christiansen,A.V. and Møller I.(2016). Compiling a national resistivity atlas of Denmark based on airborne and ground-based transient electromagnetic data.Journal of Applied Geophysics,134,p.4

Brouwer, S., van der Wielen, P., Schriks, M., Claassen, M. and Frijns, J. (2018). Public Participation in Science: The Future and Value of Citizen Science in the Drinking Water Research. Water, 10(3), p.284.

Buur, J & Windhum J. MMI Design, Man-Machine Interface (1994). Danish Design Center, Copenhagen.

Egemose, S., Sønderup, M. J., Grudinina, A., Hansen, A. S., & Flindt, M. R. (2014). Heavy metal composition in stormwater and retention in ponds dependent on pond age, design and catchment type. Environmental Technology, 36(8), 959-969.

Egemose, S. (2018) Removal of particulate matter and phosphorus in sand filters treating stormwater and drainage runoff: a case study, Urban Water Journal, 15:4, 388-391

Environmental Protection Agency.(2009). Stormwater Wet Pond And Wetland Management Guidebook. United States of America: Environmental Protection Agency, p.7.

Gold, M., & Ochu, E. E. (2018). Creative collaboration in citizen science and the evolution of ThinkCamps.

Haklay, M. (2013). Citizen science and volunteered geographic information: Overview and typology of participation. In Crowdsourcing geographic knowledge (pp. 105-122). Springer, Dordrecht.

Haklay, M. (2018). Participatory citizen science. In Hecker, S., Haklay, M., Bowser, A., Makuch, Z., & Vogel, J. (Eds.). Citizen science: innovation in open science, society and policy. UCL Press.

ILEC.(2005). Managing Lakes and their Basins for Sustainable Use: A Report for Lake Basin Managers and Stakeholders. International Lake Environment Committee Foundation:Kusatsu, Japan.

Johansson, F., Heino, J., Coiffard, P., Svanbäck, R., Wester, J. and Bini, L.(2020). Can information from citizen science data be used to predict biodiversity in stormwater ponds?. Scientific Reports, 10(1).

Kolding Netavis, 15 december 2019 https://kolding-netavis.dk/kloakeringen-i-lunderskov-i-vanskeligheder

Lunderskov Folkeblad, 14-15 November 2019 https://lunderskov-folkeblad.dk/pdf/uge/lund46_1_8_19.pdf

Pescott, Oliver & Walker, Kevin & Pocock, Michael & Jitlal, Mark & Outhwaite, Charlotte & Cheffings, Christine & Harris, Felicity & Roy, D.B. (2015). Ecological monitoring with citizen science: The design and implementation of schemes for recording plants in Britain and Ireland. Biological Journal of the Linnean Society. 115. 505–521. 10.1111/bij.12581.

Sharma, A., Vezzaro, L., Birch, H., Arnbjerg-Nielsen, K. and Mikkelsen, P.(2016). Effect of climate change on stormwater runoff characteristics and treatment efficiencies of stormwater retention ponds: a case study from Denmark using TSS and Cu as indicator pollutants. SpringerPlus, 5(1)

Suter GW II. (1993). Ecological risk assessment. Chelsea, MI:Lewis Publishers.

Thoft DS, Pyer M, Horsbol A, Parkes J. The Balanced Participation Model: Sharing opportunities for giving people with early-stage dementia a voice in research. Dementia (London, England). 2018.

WHY DON'T YOU DO AS I RECOMMEND? PATIENT BARRIERS TO HEALTH RECOMMENDATIONS

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ABSTRACT

Background: Chronic diseases are on the rise and optimizing patient-doctor communication to ensure that patients follow health recommendations from their doctor has never been more relevant to society.
Methods: The present study used a participatory design to identify barriers as experienced by the patients and employed a cross-cultural perspective using Danes, Germans and Nepalese residing in Denmark.
Results: The present study identified 12 themes with minor differences between nationalities.
Discussion: The barriers identified in this study are similar to the ones from previous literature, however additional barriers emerged
Conclusion: The present study shows initial barriers experienced by patients in Denmark, but further research is needed for more representative data.

KEYWORDS:

Citizen Science, Participatory design, Healthcare, Chronic Illness

INTRODUCTION

Globally, chronic illnesses such as diabetes, ischemic heart disease, arthritis and respiratory illnesses account for the largest share of mortality rates (Yach, Hawkes, Gould, & Hofman, 2004). In Denmark, 30-50% of the adult population alone are diagnosed with one or multiple chronic illnesses (Hvidberg, Johnsen, Davidsen, & Ehlers, 2020). Furthermore, the healthcare costs are burgeoning as chronic illnesses comprise of almost 80% of healthcare expenditure in Denmark (Hvidberg et al., 2020).

Many chronic illnesses can be prevented and even managed to cause little disturbance in an individual's life (Strong, Mathers, Leeder, & Beaglehole, 2005). By making lifestyle improvements, the individual can improve their quality of life (Megari, 2013) as well as the trajectory of the illness itself (Strong et al., 2005). However, despite the substantial evidence for these improvements and benefits, many individuals in Denmark do not follow the health recommendations. This can be seen by the high rates of unhealthy behaviors such as high alcohol consumption, unhealthy diet, smoking and inactivity that Danes engage in (Rosendahl Jensen, Davidsen, Ekholm, & Illemann Christensen, 2018).

The General Practitioner (GP) is the first point of contact in Denmark when it comes to prevention and management of chronic illnesses, given that the GP refers patients to specialized doctors. Therefore, the GP in Denmark often ends up being the communicator of health recommendations and it is vital that these health recommendations are delivered in an optimal way to ensure the highest level of compliance and adherence (Beck, Daughtridge, & Sloane, 2002).

An international systematic review by Beck et al., 2002 investigated doctor behaviors and its correlations with patient outcomes such as adherence to medication, compliance with recommendations and patient satisfaction in the doctor-patient relationship. The doctor behaviors that were shown to correlate positively with patient outcomes were behaviors of empathy, positive reinforcements, addressing problems of daily life, listening behaviors etc. (Beck et al., 2002). Likewise, the study found 14 doctors' behaviors that negatively correlated with patient outcomes which included one-way information collection without feedback, directive behavior, irritated mood, dominance, expression of opinion during physical examination and so forth (Beck et al., 2002).

These results indicate that the doctor's behaviors, phrasings and approach can function as both a facilitator and a moderator for adherence to health recommendations. However, the study by Beck et al., 2002 was correlation-based and did not include the perspectives of neither the patient nor the doctor. To this date, several studies have been conducted that qualitatively explore the doctors' perspective on what barriers exist in the doctor-patient relationship when giving health recommendations (See: Arasu, Moran, Robinson, Boyle, & Lim, 2019, Luquis & Paz, 2015) However, to the authors' knowledge no study has yet explored the barriers from the patient's perspective.

The present study seeks to explore the patient's perspectives on barriers that prevent them from following health recommendations in Denmark, using a citizen science participatory design. Furthermore, the present study will include a cross-cultural perspective given that Denmark is a country with around 10,5% immigrants (Statistics Denmark, 2020a, 2020b) and investigate cross-cultural differences between expats and natives. The aim of the study is to identify barriers that exist in doctor-patient communication. The findings of the present study could potentially be utilized for further studies that could lead to tangible recommendations on how to deliver health recommendations that also considers the cross-cultural perspective.

METHODS AND DATA

Citizen Science Approach

The study employed a qualitative participatory design, which entails that citizen scientists actively participate in data interpretation and making sense of the barriers int doctor-patient relationship. The present study firstly conducted a preliminary study with the aim to identify initial barriers in cooperation with citizens. Then a secondary study used the barriers from the preliminary study to conduct in-depth semi-structured focus groups to further validate an add to the findings with the help of the citizens.

Preliminary study

The preliminary study was an open-ended survey using 15 participants. The participants received a written scenario as can be seen below.

> *"You just received the news that you have arthritis in your hands and fingers. You are in pain, and there is no cure, only painkillers to treat the worst of the pain. There are, however, lots of lifestyle changes like weight loss you can make, to make the disease easier on you and decrease the pain. So, in summary, you have a painful disease that has no cure. However, you can help yourself by losing weight and living healthier. How would you prefer the doctor tell you?"*

Based on the preliminary study, several themes and barriers emerged.

Focus groups

Three focus groups were then conducted using the same arthritis scenario and question presented. The themes from the preliminary study was used to prompt discussions and an in-depth discussion. The focus groups included three participants each and were conducted in the participant's native languages, Danish, German and Nepalese. Afterwards, the focus groups were transcribed and translated into English by native speakers and analyzed. The objective was to validate the findings from the preliminary study and find additional barriers.

Analysis

A thematic analysis was then used to examine themes and doctor-patient barriers within the translated transcripts. The authors familiarized themselves with the data, identified 12 different barriers, sorted significant statements into these barriers and performed triangulation to ensure validity.

Nationality	Age	Gender	Occupation	Time in Denmark (years)
German	20	M	Student	2
German	25	M	Student	2
German	25	F	Unemployed	5
Nepalese	39	F	Kitchen assistant	12
Nepalese	37	M	Chef	8
Nepalese	32	F	Cleaning assistant	3.5
Denmark	27	F	Unemployed	
Denmark	24	F	Student	
Denmark	24	F	Student	

Table 1: Workshop participant demographic

Participants

In the preliminary study, a total of 15 participants responses were collected. The respondents' ages ranged from 17-84, 9 women and 6 men. The scenario was presented in both English and Danish to decrease potential miscommunication problems. 10 Danes, 3 Germans and 2 Nepalese participated.
In the focus groups, there were 3 participants in each. Their demographics can be seen below in table 1. The participants' ages ranged from 20-39. The participants consisted of 3 Danes, 3 Germans and 3 Nepalese, 3 men and 6 women. The expats spent an average of 5,4 years in Denmark.

RESULTS

The study results can be found in table 2. Some overall trends can be found in these results.
Only Danes emphasized the need for the doctor to balance his arguments between emphasizing the positive aspect of implementing lifestyle interventions while also making the negative aspects about not doing so.
Nepalese did not emphasize that lack of concrete ideas or plans as to how they should start implementing these lifestyle changes, was a barrier.
Germans were the only ones who did not mention that feeling discriminated against could be a possible barrier. One Dane mentioned the doctor discriminating based on weight and thus making assumptions about unhealthy lifestyle whereas all female Nepalese agreed that discrimination of them as expats could be a barrier for them at times.
The most important barriers across all participants were feeling forced to implement lifestyle changes as well as feeling like the doctor was rushing them through the system and not taking their time to do proper examinations or to listen.
Both Germans and Nepalese mentioned that translational difficulties could potentially be a barrier in the patient-doctor communication.
Almost every woman in the study mentioned that empathy and feeling that their doctor was friendly was important to them.
German and Danes expressed distrust in the doctor's abilities as a barrier to implementing lifestyle changes whereas Nepalese did not.

DISCUSSION

In the present study we found 12 emerging themes that were expressed to be barriers for the participants when given health recommendations by their doctors. Danes alone agreed that imbalance of positive and negative arguments used by the doctor could be a barrier. Furthermore, six females from the focus groups mentioned that empathy is of importance whereas one German male directly disagreed with that barrier. This finding could imply that gender could be a reason behind the difference; it could be assumed that females value and expect empathy from doctors more than males. Likewise, while the participants agreed that they would prefer having more time to think about the health recommendations, one Nepalese female said that it is relevant only for severe cases like cancer while the other Nepalese female didn't think that time to think was important to follow health recommendations. This contrast could be because of cultural and nationality differences.

Table 2: Overview of responses

Barriers	Significant statement	Total responses	Nationalities and gender
Lack of Factual Consequences	"I would like to get a little more concrete knowledge about, well how is it - what mechanisms is it that makes weight loss pain relieving if it makes sense, so I can see like why I should do that" – DK-F	7	DE: 2M DK: 3F NP: 1F, 1M
Distrust in abilities	"And I do have a feeling that everything was done according to a scheme/pattern and it gave me some kind of peace, because I felt like I am not the first patient they have, and they know what they are doing" – DE-M	6	DE: 1M, 1F DK: 2F NP: 1F
Unempathetic	… Just giving recommendations bluntly doesn't help perhaps; it's always helpful when the doctor is friendly and I don't mind when the doctor is trying to know about me and my lifestyle. I think that makes me more comfortable and more motivated to follow recommendations – DE-F	6	DE: 1F DK: 3F NP: 2F
Where do I start?	" … something that would be important to me if I had always been overweight would also be how should I do it." – DK-F	3	DE: 1M DK: 3F NP:
Imbalance of arguments	"…. because if you only get to know things you can get, if you lose weight, you may think well yes but is it really worth it I think" – DK-F	3	DE: DK: 3F NP:
Force	"The doctors should be supportive and encourage to follow recommendations. They should not force people to follow recommendations." – DK-F	8	DE: 2M DK: 3F NP: 1M, 2F
Uncooperative	"I think guidance would probably be a key factor in this on how to do it and of course also support and follow-up on how it goes" – DK-F	6	DE: 1M, 1F DK: 3F NP: 1F
On the spot	"When you get such a big message I think it's good to just go home and think about it and what kind of questions you might have" – DK-F	6	DE: 1M, 1F DK: 3F NP: 1F
Medical Jargon	"I also feel uncomfortable asking many times the same question just to be sure that I understood everything correctly, so I don't do that also to not annoy the doctor. But then again it is about my health, so I need to be sure that I understood everything." – DE-F	6	DE: 1M, 1F DK: 3F NP: 1F
Translational difficulties	"When I took my daughter to an ENT specialist after she had an ear infection, the experience was quite confusing and uncomfortable because he was Russian perhaps and he could not understand English and we had a hard time understanding the Danish he spoke." NP-F	5	DE: 1M, 1F DK: NP: 3F
Rushed through the system	"It is often that it is your turn, you have one thing to talk about and when I wanted to ask about something else, I got the answer "No, you only have 10 minutes, next patient please." And that's just it." – DE-F	8	DE: 1M, 1F DK: 3F NP: 2F
Discrimination	"Maybe they don't intend to discriminate but during many circumstances I feel that they show some kind of racist behavior" – NP-F "Maybe he says that you should reconsider eating burgers and french fries every day (when he doesn't know if I do)" – DK-F	2	DE: DK: 1F NP: 2F

Similar to the findings of the systematic review by Beck, Daughtridge, & Sloane, 2002, this study identified lack of empathy and individuals feeling being rushed through the system as important barriers to following doctors' recommendations. However, there are many barriers that the review finds which did not come up in our study. This could be attributed to the fact that the systematic review consisted of a large number of studies that recorded and coded doctors' behaviors. On the contrary, this study is a qualitative exploration of barriers from the patients' perspectives with fewer participants. Furthermore, the present study found additional barriers such as translational difficulties, discrimination and distrust in abilities that Beck et al., 2002 did not.

Culturally, there seem to appear differences in the perceived doctor-patient barriers. Two Nepalese mention discrimination as a barrier, referring to their nationalities, whereas Germans did not mention it is a barrier despite also being expats. Additionally, Germans and Danes see distrust in the doctor's abilities as a barrier, whereas Nepalese did not mention it. It is possible that those differences occur due to divergence in cultures. Denmark and Germany are closer in Hofstede's dimensions (Hofstede, 1980), while Nepal has a different culture structure. Hofstede's dimensions compare countries based on 6 dimensions, power distance, long-term orientation, individualism and more (Hofstede, 1980). Therefore, it is possible that differences in barriers throughout the focus groups occur because of cultural differences as seen by differences in Hofstedes dimensions (Hofstede, 1980).

The present study was conducted as a participatory design study using citizen science theory. This gives the study a strength as the interview guide was based on themes that were co-developed with citizen scientists. This ensures that the barriers suggested in the interview guide were highly relevant. Furthermore, the present study used native language focus-group interviews, eliminating both cultural and language barriers in data collection.

The present study had a limited number of participants (N=9) within a small range of ages (20-39) meaning the participants were not representative of the Danish population and the findings cannot be generalized. Furthermore, the participants were recruited using convenience sampling, making the results somewhat biased.

Future efforts should focus on validating the barriers found in the current study in other populations such as other expats in Denmark or to enlighten barriers in other countries using a citizen science approach. Moreover, the current results could be further developed into a questionnaire which could be distributed to larger populations in order to get data that is more representative of the Danish population. This would make it possible to generalize and use the data to develop tangible

recommendations for doctors who give health recommendations to their patients. The potential of these tangible recommendations can have a tremendous impact for the citizens of Denmark, their quality of life and expectancy, and the public health care expenditure.

CONCLUSIONS

The present study sheds light into barriers Denmark that could be present when doctors' give their patients' health recommendations as seen from the patient's perspective in Denmark. Furthermore, the study gives indications to barriers that may be more apparent and relevant to natives or to expats of different cultures and nationalities.

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REFERENCES

Arasu, A., Moran, L. J., Robinson, T., Boyle, J., & Lim, S. (2019). Barriers and Facilitators to Weight and Lifestyle Management in Women with Polycystic Ovary Syndrome: General Practitioners' Perspectives. Nutrients, 11(5), 1024. doi:10.3390/nu11051024

Beck, R. S., Daughtridge, R., & Sloane, P. D. (2002). Physician-patient communication in the primary care office: a systematic review. The Journal of the American Board of Family Practice, 15(1), 25.

Hvidberg, M. F., Johnsen, S. P., Davidsen, M., & Ehlers, L. (2020). A Nationwide Study of Prevalence Rates and Characteristics of 199 Chronic Conditions in Denmark. PharmacoEconomics - open, 4(2), 361-380. doi:10.1007/s41669-019-0167-7

Luquis, R. R., & Paz, H. L. (2015). Attitudes About and Practices of Health Promotion and Prevention Among Primary Care Providers. Health promotion practice, 16(5), 745-755. doi:10.1177/1524839914561516

Megari, K. (2013). Quality of life in chronic disease patients. Health psychology research, 1(3), e27-e27. doi:10.4081/hpr.2013.e27

Rosendahl Jensen, H., Davidsen, M., Ekholm, O., & Illemann Christensen, A. (2018). Danskernes sundhed: Den nationale sundhedsprofil 2017. In. Sundhedsstyrelsen U6

Statistics Denmark. (2020a). Immigrants and their descendants. Retrieved from https://www.dst.dk/en/Statistik/emner/befolkning-og-valg/indvandrere-og-efterkommere

Statistics Denmark. (2020b). Population in Denmark. Retrieved from https://www.dst.dk/en/Statistik/emner/befolkning-og-valg/befolkning-og-befolkningsfremskrivning/folketal

Strong, K., Mathers, C., Leeder, S., & Beaglehole, R. (2005). Chronic Diseases 1: Preventing chronic diseases: how many lives can we save? The Lancet (British edition), 366(9496), 1578.

Yach, D., Hawkes, C., Gould, C. L., & Hofman, K. J. (2004). The Global Burden of Chronic Diseases: Overcoming Impediments to Prevention and Control. JAMA : the journal of the American Medical Association, 291(21), 2616-2622. doi:10.1001/jama.291.21.2616

Beck, R. S., Daughtridge, R., & Sloane, P. D. (2002). Physician-patient communication in the primary care office: a systematic review. The Journal of the American Board of Family Practice, 15(1), 25.

Hofstede, G. (1980). Culture's consequences: International differences in work-related values (Vol. 5). Beverly Hills, Calif: Sage Publications.

A CITIZEN SCIENCE APPROACH TO HOW SENIOR CITIZENS PERCEIVE TECHNOLOGY

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ABSTRACT

The part of the world's population over 65 has in the last century continuously grown. With less hands to take care of senior citizens, advanced technology could be a solution to help elderly's live longer, healthier and more independent in their own homes. It is shown that the adoption of technology among elderly people is limited in many studies. Therefore, this study aims to investigate how aging citizens in Denmark perceive technology. By taking a citizen science approach to this problem we aim to involve our participants as active collaborators, on how they perceive technology. Senior Citizens participated through in-depth interviews, co-analysis and a discussion forum created by us. A total of 9 participants participated. All of the interviewed participants share different definition with a clear distinguish about types of technology. The use of technology is analyzed through the usage, necessity and how easy to use. We conclude that there is a contradiction between how the perception and the usage of technology among senior citizens is and that a continued citizen science project can limit this contradiction.

KEYWORDS:

Senior Citizens, Technology, Citizen Science, Community Building

INTRODUCTION

The aim of this study to identify how senior citizens perceive technology in their daily lives. This to examine whether technology can function as a mean to increase the independency of seniors.

In 2050 the world population of people above 60 years is expected to reach 2 billion (WHO. 2020). The increase of aging population also comes up with the rising demand for geriatric care, caregivers specializing in elderly care and nursing or assisted living home.

Advanced technology plays a crucial role in many aspects including elderly care. Studies show that technology has the potential to provide timely intervention to assist older adults, keeping them healthier and more independent (Wang et al., 2019). It also helps to reduce the workload of caregivers. Many countries have already implemented advanced assisted living technology in elderly care around the world (Denmark, 2019a, Wang et al., 2019, Peek et al., 2016). Denmark is one of the leading countries in European Union regarding digitalization (Denmark, 2019b). The Danish healthcare system also has a strong focus on supporting and empowering their citizens to maintain their independence, gain control of their own life, and stay healthy in their own homes for as long as possible through the implementation of technology- supported solution (Denmark). Many municipalities and hospitals in Denmark are implementing innovative assisted-living technology to improve the life quality of senior citizens and working environment of healthcare professionals (Denmark, 2019a). Despite playing a significant part in successful interventions, adoption of these technologies has been found to be limited in several studies (Vaportzis et al., 2017). It is important to investigate and understand how senior citizens perceive and use technology to make the age group more in-sync with technology.

This study aims to investigate the perception of senior citizens to find their challenges when using technology. Therefore, it will be more effective if we encourage elderly to point out their own problems as only them know it best. As a result, the concept of Citizen Science (CS) is applied in this study as participants are given opportunities together with researchers to define the problems.

METHODS AND DATA

The study builds on a CS approach. For each of the methods used, the specific approach within CS will be explained.

Online discussion forum

An online discussion forum was made on the platform padlet.com, anonymously asking them how they coped with loneliness during the covid-19 lockdown. This was done to see if technology had an influence on how elderly people interacted, when not able to meet physically, as well as to create a community for the senior citizens. Community building, in accordance with CS, assures a reciprocal relation between scientists and citizens (Golumbic et. al., 2017). We had six respondents, and two of them mentioned some kind of technology. Participants was encouraged to learn and discuss from each other's uploaded photos.

In-depth interviews

Three in depth semi-structural interviews were conducted, to supplement the CS approach, so we could get a better understanding of senior citizens possible motivation. Including criteria was: living in Denmark, age above 65, and no history of cognitive illness. One in-situ interview, including a house-tour, and two interviews over the phone. The three participants where anonymized and called person B, person R, and person S. All the participants are between 70 and 77 years. The interview guide focused on how the interviewed used and perceived technology. Seven topics and themes were elaborated further:

1) Social technology
2) Most used technology
3) Their definition of technology
4) Independence responsibility and technology
5) Technology and how to use it
6) Elders and loneliness
7) Future of technology

CO-ANALYSIS

Based on the data found in initial interview we talked with our participants again. We provided the participants with the list of objects they mentioned being technology, in order to co-analyze and understand their view on technology. This method was inspired by Haklays model showing the different levels of participants engagement in CS (Haklay, 2013) where we reached for a high as possible level of engaging citizens. This by including the seniors in the analysis.
On three different parameters we asked the participants to scale the technological objects they mentioned in the earlier interview. The three parameters were:

a) how technological they found the object
b) how much they used the object
c) how much they needed the object

The participants were asked to place different objects on a line from most to least, regarding the three parameters (Fig 1). The participants then reflected on their perception of the concept technology and their own need and use of it orally at this session.
In all parts of the sessions it was made clear for the participants that it was voluntary and anonymous to participate, and they could retrieve recordings or statement up until the release of this paper. The data was collected in Danish and translated.

Figure 1: Co-analysis with participant B

RESULTS

Definition of technology: What is technology?

To understand senior citizens perception of technology it is relevant to identify how they talk about it. When we asked what kind of technology she has in her home, participant B answers: "*We do not really have any technology other than the phones and the iPad and the computer*". Her perception of technology initially seems clear. During the house tour, when the interviewer points out the TV, the radio and the weather station, respondent B then stated, that these are also considered technology. When asked about the different kinds of technology she has in her kitchen (coffee machine, blender, oven, etc.), she states that these are not technology but rather "*(…) quite normal everyday life things*". She thereby sets up a division between technology and everyday life things. This distinction is though not explicit. This is emphasized when she is talking about technology on a more general level, and states that: "The kind of technology that we have is more everyday life things." In this context the phones, iPad, computer, TV, radio and weather station are thereby also considered everyday life things. These everyday life things, being the technology that she has in her home, contrast what she calls "*fancy gadgets*". These kinds of technology could include a robot vacuum cleaner. Elements which B do not need in her everyday life.
In the case of participant R, when asked about what things she thinks count as technology, there is a clear distinction: ''I think of technology as helping. Both considering entertainment, but also to keep me orientated''. In the elaboration of this statement, things as ovens, cars and radios, didn't count as technology, but can contain technology. Participant S was defining technology as *"[I see] Technology as the communicative interaction between object and human*" while household machinery and transportation where seen as more mechanical objects. There was an awareness of how time and development of technology influences the perception of what technology is, from both participant R and S. Conscious or un-conscious, all of our participants distinguished between different kinds of technology. This whether they distinguish between everyday life things or fancy gadgets or between mechanical objects and technology.

Co-analysis: Technology in everyday life

Use: How much an object is used is ranging from never and almost never used, to daily. Within the daily use there is a distinction between how many times a day it is used, as well as there is a distinction between how it used. This meaning whether it is serviced, which for B includes the television and the coffee machine, or whether she looks at it, like B describes using her alarm clock and weather station.
Necessity: How much an object is needed is ranging from "not necessary at all" to "cannot live without". The objects mentioned in the scaling of cannot live without is ranging from objects as phone, tv and radio to vacuum cleaner and oven. The phone, tv and radio are described by the participants as needed in order to: "*(…) keep me updated*" (participant R) and to be able to "keep up" (participant B). The oven is by all of the participants ranged as one of the most needed objects. This because the function of the oven cannot be fulfilled by other objects nor without the use of technology.
Technological: Ranging the objects in which are most technological and which at least technological, there is an overall understanding in the least technological objects being easy to use, and in contrary the most technological objects are described as the most difficult to use.

TECHONLOGY AND INDEPENDECY

As stated earlier (Wang et al. 2019) the use of technology can help seniors to be or feel more independent. This is partly confirmed in our research. In the interview with participant B, she states that technology is something that they, in their household, implement, when they can no longer handle the

specific activity by themselves. In this context technology is then seen as an extension of their capabilities. At the same time, this statement by participant B, that: "*We have to do it ourselves. As long as we can, we have to handle it ourselves*," can be interpreted as the implementation of technology being a marker of losing independency.
Whether technology by the senior citizens is mainly seen as an extension of their independency or whether the use of technology is perceived as a marker of being less independent can therefore be discussed.

DISCUSSION AND CONCLUSIONS

Contradiction between perception and use

As the results show, the participating seniors make a distinction between everyday things and more fancy technological objects. In this distinction lays an understanding of something being too difficult to use. It is a distinction which is also emphasized in the way, the participants define easy and difficult in the co-analysis concerning how technological they find objects.
It is a perception of technology which we argue can be challenged. By combining how the participants scale the different objects in respectively how technological it is, and how used it is, in one graph, several points emerge.
1) the more an object is used, the less technological it is perceived. This can also be supported by one of the participants stating that Facebook: "*(…) is not that difficult to use anymore*".
2) The more interactions an object takes to be serviced, the more difficult and hence more technological it is considered.
This becomes clear by looking at the objects placed in the top right corner of figure 2. The objects mentioned here are iPad, smartphone and computer. All objects which are used daily, but hence the amount of interactions, they are not considered easy to use. We will argue, that these sorts of objects define the senior citizens perception of technology, though there is a lot of other technological objects, such as weather stations, tv and radio which they consider easy to use.

CS AND ITS FUTURE POSSIBILITIES

The understanding of technology is that it is difficult to use. In the activity of the co-analysis, one of the participants stated, when looking at her completing ratings: "*I know more technology than I thought I knew*". Her perception of how good she is at technology have hence already been challenged. Based on this finding in the co-analysis, on our experiences with the discussion forum and the theoretical benefits of creating reciprocal relationships in the scientific process, we will suggest a bigger focus on community building as a way to challenge the senior citizens perception of technology.
In our first outreach we made a discussion forum for senior citizens, where they could share photos and stories about how, they coped with loneliness and not meeting other people physically, under the covid-19 lockdown. The idea about doing that was to use the situation to catch peoples interests, as we hoped they could relate and find others to build and communicate with, as we wanted to apply as much reciprocity and a way to build community (Goloumbic et al. 2017). Unfortunately, our reach was quiet poor and wasn't enough to create and maintain a community. Based on these experiences we therefore argue that the outreach, as well as the effect, could be more effective if done personal, and not on a media platform. Another challenge we see in creating and maintaining a community, is the communication of the purpose of it: What would, senior citizens get out of being a part of this sort of community. In our project the main challenge could be, that the seniors do not necessarily agree with out insight: that they are better at technology than they are aware of. Moving forward, the question would then be how to approach the senior citizens in an open but yet convincing way?
The ethics of this approach, to de-mystify technology, could also be questioned, because who is benefitting from having senior citizens gaining more technological confidence? On a societal level, more technological assured seniors could reduce the workload of caregivers, keeping seniors independent for a longer period of time. But is this also beneficial for the seniors?

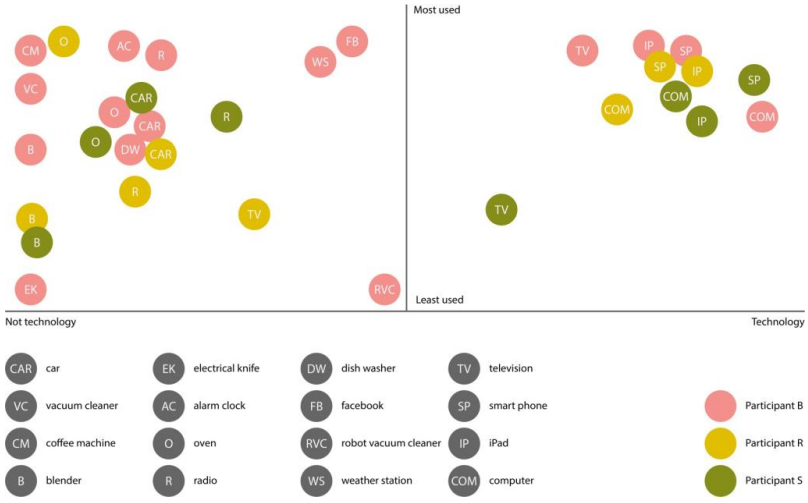

Figure 2: Model showing how participants scale technological objects based on how technological they perceive it (horizontal) and how used the object is (vertical).

Again, we suggest the open data principle from CS as a core of future citizen involvement, so the participants themselves can decide their motivations. It would be beneficial if the seniors in the process also gained some science literacy, so they could interpret the data better.

CS in general, is an approach which method, when used properly, can be very effective to gather data, and engaging participants. This democratization of data- collection, can be limiting, but also be a great asset. In this paper we have tried to reach as high level of citizen participation as possible in Haklays model (Haklay. 2013) and focusing on the parts of reciprocity and inclusion in Golumbic et al's. model (Goloumbic et al. 2017). While not having enough participants, we managed to fulfill the demands of three out of four levels in Haklays model and also doing some analysis with our participants, which is considered part of the extreme CS. To reach an even higher level of citizen involvement, one has to engage people to co-create the research question and follow the full research process

If seen as a pilot, one could scale several aspects to fit a larger project. If a bigger number of participants were found, the co-analysis and interview gathered valuable information that suggest that there is some kind of dissonance between how seniors perceive and use technology.

REFERENCES

Czaja, S. J., Charness, N., Fisk, A. D., Hertzog, C., Nair, S. N., Rogers, W. A. & Sharit, J. 2006. Factors predicting the use of technology: findings from the Center for Research and Education on Aging and Technology Enhancement (CREATE). Psychol Aging, 21, 333-52.

Denmark, H. Elderly care [Online]. Available: https://www.healthcaredenmark.dk/the-case-of-denmark/integrated-care-and-coherence/elderly-care/ [Accessed 2020].

Denmark, H. 2019a. A dignified elderly care in Denmark.

Denmark, M. O. F. A. O. 2019b. Denmark is among the most digital countries in Europe [Online]. Digital Economy and Society Index (DESI). Available: https://investindk.com/insights/denmark-is-among-the-most-digital-countries-in-europe#:~:text=Denmark%20is%20one%20of%20the,five%20in%20the%20annual%20ranking. [Accessed 2020].

Golumbic, Y.N., Orr, D., Baram-Tsabari, A. And Fishbain, B., 2017. Between Vision and Reality: A Study of Scientists' Views on Citizen Science. Citizen Science: Theory and Practice, 2(1)

Haklay M. 2013. Citizen Science and Volunteered Geographic Information: Overview and Typology of Participation. In: Sui D., Elwood S., Goodchild M. (eds) Crowdsourcing Geographic Knowledge. Springer, Dordrecht.

Heinz, M., Martin, P., Margrett, J. A., Yearns, M., Franke, W., Yang, H. I., Wong, J. & Chang, C. K. 2013. Perceptions of technology among older adults. J Gerontol Nurs, 39, 42-51.

Peek, S. T., Luijkx, K. G., Rijnaard, M. D., Nieboer, M. E., Van Der Voort, C. S., Aarts, S., Van Hoof, J., Vrijhoef, H. J. & Wouters, E. J. 2016. Older Adults' Reasons for Using Technology while Aging in Place. Gerontology, 62, 226-37.

Vaportzis, E., Clausen, M. G. & Gow, A. J. 2017. Older Adults Perceptions of Technology and Barriers to Interacting with Tablet Computers: A Focus Group Study. Front Psychol, 8, 1687.

Wang, S., Bolling, K., Mao, W., Reichstadt, J., Jeste, D., Kim, H. C. & Nebeker, C. 2019. Technology to Support Aging in Place: Older Adults' Perspectives. Healthcare (Basel), 7.

World Health Organization. 2020. Strategies and approaches in oral disease prevention and health promotion [Online]. World Health Organization. Available: https://www.who.int/oral_health/strategies/cont/en/ [Accessed 2020].

DO DANISH SCHOOL KIDS FEEL PHYSICALLY ACTIVE AT SCHOOL? - A PROJECT WITH 7TH GRADERS

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ABSTRACT

After a major change in Danish school regulations in 2014, 45 minutes of daily physical activity was made mandatory for each school kid. But how is this regulation controlled, since there is not a clear definition of intensity or type of physical activity. The aim of the project is to increase the understanding of what ''45 minutes of daily physical activity'' actually is, and what the school kids' perception of it is.
A 7th grade of a Danish elite sport school was participating for this paper. Pedometers were handed out to document their daily step counts. Additionally, semi linear surveys were given to the school kids and provided the participants with the opportunity to share a view on their daily lives and thoughts. The school kids' perception of their physical activity level is presented and compared to the quantifiable data of their daily step count. Discussing possible connections between the school kids' favorite places, favorite subjects, their gender, their surrounding environment and their activity level, points in the direction of future citizen science projects including different stakeholders to realize the Danish health ministerium's requirements.

KEYWORDS:

School,
Physical activity,
Citizen Science,
Education

INTRODUCTION

In 2014 a Danish school reform included a decision regarding physical activity of kids at school. It became mandatory for every school to provide 45 minutes of physical activity in average per day per school kid, excluding recess. This law is an approach to make children more active and therefore generate known benefits like the decrease of chronic disease risk (Boddy et al., 2014), the improved motor development (Stodden et al., 2014), classroom behavior (Mahar, 2011), and cognitive functioning leading to higher performance at school (Castelli et al., 2007).
The problem this reform generates is to understand whether 45 minutes of physical activity are achieved on a daily basis. Colley et al. (2012) is a group of scientists who tried to transform minutes of daily physical activity, into a more quantifiable measurement, such as a step count. Research has been done to figure out the quantity of steps needed to distinguish if school kids are physically active especially during the school day (Burns et al., 2015). The quantifiable data showed the most active time period of the average school day for the kids is during recess. The personal opinion and the understanding of the school kids or teachers of physical activity were not included. Environmental factors such as the school yard (Nielsen G et al. 2012), teachers (Cothran et al. 2010), school subjects (Mooses et al. 2017) and the length of the school day plays a role, when it comes to the level of physical activity.
The aim of this paper is using citizen science to increase the understanding of the 45 minutes of physical activity, as well as distinguishing possible correlations between school kids' perception of their surroundings and physical activity in order to compare those with their quantifiable step counts.
In the end we will discuss, if a citizen science approach could contribute to a more active school day, and the achievement of realizing 45 minutes of physical activity per day, required by the Danish Ministry of Health.

METHODS

Most studies within the field explore quantitative data. But as *Hecker et al., 2018*, points out "*citizen science expands public participation in science and supports alternative models of knowledge production*". In our case, we interacted with the school kids in a citizen science level 1 approach (Haklay et al., 2013). The so called "crowdsourcing level" includes citizens as sensors as well as volunteered computing This approach helps us getting first-hand experiences and perceptions. Therefore, we included other methods such as Cultural Probes (Gaver W., 1999) in order to achieve a Citizen Science design. The Cultural Probes included a pedometer and a semi linear survey. These surveys are defined by including multiple choice and creative answers, such as blank spaces to write a sentence and the freedom of drawing pictures.
The semi linear survey has questions such as; "I see myself as,", then the pupils have to rate their perception of their own physical activity level, "How do you describe physical activity?", "Where do you feel most active?" etc.
This approach opened up for collecting qualitative data in the form of written or drawn ideas with multiple choice questions and creative answers, such as blank spaces to write a sentence and the freedom of drawing pictures. This will be matched with the quantifiable approach with the pedometers. And in order to design reciprocally (Golumbic et alt. 2017) social media and interaction methods were applied.
This approach was chosen to provide information that would not be possible for conventional research such questionnaires. We argued that none of the two approaches could stand by itself in this Citizen Science study.

Contact methods

To realize the interaction with citizens and especially with schools, teachers and school kids in times of a national lockdown

(COVID-19), various digital contact and interaction methods were applied.
To reach out to as many participants as possible, Facebook groups that mainly include teachers in Denmark, were used as a communication tool. Additionally, an academic network provided us with necessary technical products (Vivofit 4, Pedometer by Garmin) and connected our project idea to potential schools for participation. The selection process regarding possible schedule crossovers and engagement level narrowed down to a 7th grade of an elite sport school further described as "School A".

Interaction methods

Due to the COVID-19 the interaction with School A was limited to delivering and collecting the data.
Though, the generated data shows that School A consists of 26 school kids, 13 boys and 13 girls. However, throughout the project the sample size varies due to a fluctuating attendance. The step counts of the school kids were measured over three weeks at the end of the Danish school year (figure 1.1).

Analyzing methods

Data from the two approaches gave a fuller picture of the 7th grade kids' physical activity level. Pedometers provide us with information that represents the actual level of activity and can be compared to the school kids' perception regarding their step count.
Due to the fact that the step count does not directly correlate to the minutes of physical activity mentioned in the introduction, an equivalent ratio of step count was set up. This characteristic is based on the information from Burns et al., (2018). It states that 6000 steps per day are an "*optimal […] step count*" for school kids during a school day. This step count represents approximately 45 minutes of physical activity, for a school kid. This corresponds to Pedersen et al. (2016) state that 45 minutes out of the recommended 60 minutes of physical activity a day, should be achieved during the school day.
The research paper (Burns et al., 2018*)* investigated children at the age from 8 to 11. The school kids from 7th grade are in the range from 12 to 13 years, which can be assumed to have a similar and have the same "optimal step count". Based on the "optimal step count" we defined the three categories "low activity" "average activity" and "high activity" as "low activity" equals a daily step count (at school) of everything under 4000 steps per school day. The "average activity" level ranges from 4000 to 6000 steps and the "high activity" level is everything above 6000 steps per school day (table 1).

Table 1: Activity levels defined by school kids' daily step count

Activity level	Steps
High	>6000
Average	4000-6000
Low	<4000

RESULTS

Quantitative data

The steps are used as a measurement to describe the physical activity of the school kids. Overall, the step counts are varying from 1700 steps to 10.000 steps, when it comes to the whole class (Figure 1). However, the graph also shows that the school kids had a high step count on Tuesday (week 24), with an average of around 10.000 steps, due to a PE class. They also had a high step count Thursday (week 26) with an average of around 9000 steps, resulting from it being the last day before summer vacation and irregular lesson set ups.

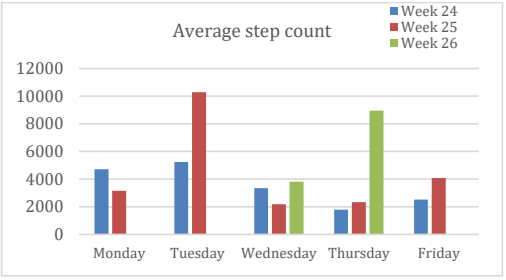

Figure 1: Average step count of the 7th grade of school A during weeks 24-26 2020

To further investigate the school kids' physical activity and their own perception of it, they answered different questions throughout the period of the study.
In week 24 they stated their perception of their activity level being as seen below:
The school kids' perception of their activity level in comparison to the quantified activity level (Table 1) is shown in Figure 2. 31% of the boys stated that their activity level was high, 45% said it is average and 24% describe it as low. Whereas for the girls, 22% of them stated they had a high activity level and 78% said an average level, whereas no one stated they had a low activity level. Looking at their steps for that same week, in reality (meaning step counts collected by the pedometers), 14% of boys had a high physical activity level, 21% had an average and 65 % had a low physical activity level. For the girls 8% of them had a high physical activity level, 24% had an average level, and 68% had a low activity level. This is determined by the categories defined by Table 1.

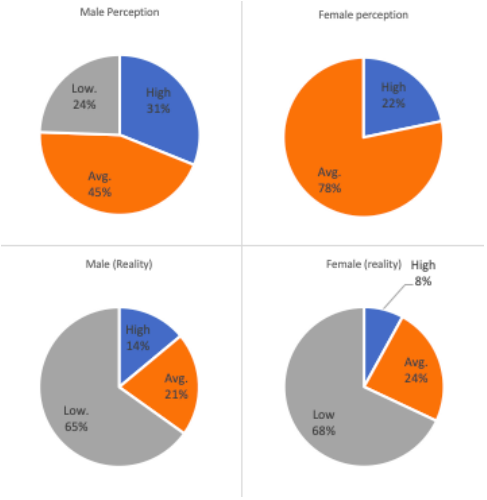

Figure 2: School kids' perceptions on activity levels in comparison to data

Qualitative data

Based on the school kids' answers, gathered from the semi linear surveys we created an insight to what they perceive

as physical activity, where they feel most active, what they would change to be more active, etc.

In regard to "Where do you feel most active?". Every single school kid mentioned a place outside the classroom such as the football court or the school yard in general. On Thursday (week 24) the school kids were asked to describe when they feel most active during a school day. 18 out of 21 school kids answered this question with "During recess" or "PE". Concerning their most disliked subject and "What would you do to make this subject more fun?", we got most of the suggestions turning the subject "to be more active" such as "being outside" or "more activities/games". To the question "Would you like to be more physical active at school?", 75% of the 7th graders answered with ''Yes''.

The last major findings of the survey resulted from the task "design your dream classroom". The school kids' answers (written or drawn) varied from a classroom including beanbags, flat screens and sofas up to suggestions of a trampoline, a pool or simply comfortable chairs and tables able to elevate.

DISCUSSION

The mandatory 45 minutes of physical activity on a school day, equivalent to 6000 steps, often seemed like a challenge to be accomplished by the teachers. The average step count of the school class shows that the school kids achieve an optimal step count of 6000 steps a day, during two of 12 days. However, 75% of them would like to be more active in school. This could be an opportunity for future projects to include school kids into the creative process of realizing new ways of physical activities throughout the school day.

There is no known way to validate the 45 minutes of daily physical activity of kids at school (to this date). Burns et al., (2018) distinguished the "optimal step count" for a pupil during a school day around 6000 steps. Translating this step count into three activity levels (Table 1.1) enables a validation process of physical activity at school.

Overall, the school kids' step count as seen in Figure 1.1 shows that the school kids generally do not achieve the step count goal of 6000 per day. There are only two days over the time period of three weeks in which the average of the 7th grade surpasses the recommended step count of 6000.

Comparing the school kids' perception to their objective level of activity shows that both boys and girls are overestimating their physical activity. For instance, 24% of the boys and 0% of the girls assumed they are on a low level of physical activity, while the objective data shows that it is 65% for the boys and 68% for the girls. This fact means that the majority of the school kids do not fulfill the mandatory goal of 45 minutes of physical activity a day. Even if the optimal step count would have been lowered to 5000 steps a day, it would not change the amount of school kids in the low physical activity category. However, this data is only based on three weeks, one class and was carried out amid COVID-19. A scaled-up research project in normal circumstances would generate a more reliable data base.

The qualitative data gained from the semi linear survey underlines the importance of the cooperation of school kids, teachers and administrators to collectively design a more active school day. Knowing that there is a majority of school kids not reaching the activity level required by the Danish Ministry of Health. The school kids want to be more active and almost 75 % of School A stated that they want to have a more physical active school day. Analyzing the qualitative data, it shows that most school kids are also more active during their recess and PE classes, which means that there is low level of physical activity inside their classrooms. Asking for a more unconventional room setup and requesting more movement throughout classes, school kids are showing their interest in comfortable chairs, tables, bean bags, which tells us more about relaxation and opposes their wish of being more active. To realize a major change in the everyday class structure school kids, teachers and administrators have to cooperate together and overcome borders of miscommunication and hierarchy.

A possible future citizen science project could focus on the interaction of these three parties and their common goal to realize the mandatory 45 minutes of physical activity a day. This future project could also focus more on increasing the knowledge of physical activity and possibilities of implementing them in the average school day. Another future citizen science approach could also include a different level of participation (Haklay et al., 2013*)*. It could change from level 1: ''crowdsourcing" and participants as sensors to a level 3 ''participatory science" project with participants working in problem definition and data collection or level 4 ''extreme citizen science" projects which include a collective work on problem definition, data collection and the analysis. Including a higher number of stakeholders like parents, NGOs and administrative people could lead to a highly productive citizen science project and an active revolution of the Danish school day structure.

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REFERENCES

L. M. Boddy, M. H. Murphy, C. Cunningham et al., "Physical activity, cardiorespiratory fitness, and clustered cardiometabolic risk in 10- to 12-year-old school children: the REACH Y6 study," American Journal of Human Biology, vol. 26, no. 4, pp. 446–451, 2014.

Ryan D. Burns et al., "Prediction of Optimal Daily Step Count Achievement from Segmented School Physical Activity" Hindawi Publishing Corporation, Advances in Public Health, Vol. 2015, Article ID 496248, 6 pages

Susanne Hecker, Muki Haklay, Anne Bowser, Zen Makuch, Johannes Vogel, Aletta Bonn and Carlos Moedas, "Citizen Science - Innovation in Open Science, Society and Policy", Research, Science and Innovation, European Commission, 2018

D. M. Castelli, C. H. Hillman, S. M. Buck, and H. E. Erwin, "Physical fitness and academic achievement in third- and fifthgrade students," Journal of Sport & Exercise Psychology, vol. 29, no. 2, pp. 239–252, 2007.

Rachel C. Colley, Ian Janssen, and Mark S. Tremblay, "Daily Step Target to Measure Adherence to Physical Activity Guidelines in Children" Official Journal of the American College of Sports Medicine 2012

Haklay, Mordechai (Muki) "Citizen Science and Volunteered Geographic Information: Overview and Typology of Participation". In Crowdsourcing Geographic Knowledge:

Volunteered Geographic Information (VGI) in Theory and Practice, Springer, 2013.

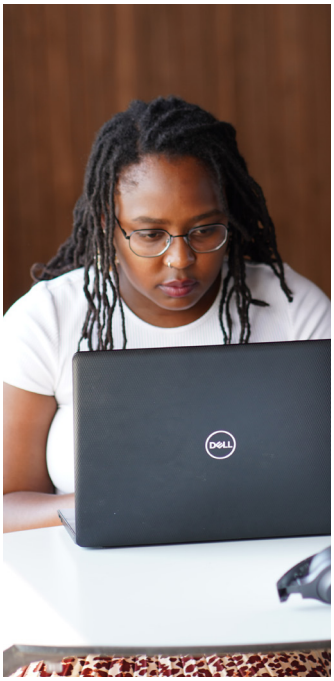
M. T. Mahar, "Impact of short bouts of physical activity on attention-to-task in elementary school children," Preventive Medicine, vol. 52, supplement 1, pp. S60–S64, 2011.

Mooses et al., "Objectively measured sedentary behaviour and moderate and vigorous physical activity in different school subjects: a cross-sectional study" BMC Public Health; London Vol. 17, (2017)

G. Nielsen et al., "School Playground Facilities as a Determinant of Children's daily Activity: A Cross-Sectional Study of Danish Primary School Children", Journal of Physical Activity and Health, no. 9, pp. 104-114, 2012

B. K. Pedersen, et al., "Fysisk aktivitet – Læring, trivsel of sundhed i folkeskolen", Vidensråd, 2016

D. F. Stodden, Z. Gao, J. D. Goodway, and S. J. Langendorfer, "Dynamic relationships between motor skill competence and health-related fitness in youth," Pediatric Exercise Science, vol. 26, no. 3, pp. 231–241, 2014.



REVOLTING WITH THE FLOW – THE DANISH FAMILY IN THE 1960s AND 1970s

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ABSTRACT

The family revolution in the 1960s and 1970s changed family patterns fundamentally. Women entered the labour market and contributed to society in new ways. But how did it actually feel to be part of this change and live in this period of time? By collecting life stories focusing on these developments, the data suggests that changes were not experienced as abrupt as revolutions typically are by the citizen scientists, but a slow opening of options widely supported by the prior generation and enabled by changing welfare regimes. The focus of this generation was not initiating the family revolution, but rather the pursuit of individual fulfilment considering the growth of options.

The way drastic societal change is perceived and experienced in personal capacities gives an insight into the time periods' understanding of gained opportunities and how these affect choices made by individuals. By learning and understanding the dynamics of these changes, we can gain a deeper insight on the foundation for today's Danish family and social constructions.

KEYWORDS:

Family Revolution, Feminism, Gender roles, Family pattern Danmark

INTRODUCTION

The Danish family pre-1950s was rather traditional: men and women would start families in the late teenage years with husbands carrying the responsibility of being breadwinners while wives tended the household - this division of labour towards the household was prevalent in both urban and rural spaces (Work. Live. Stay., 2018). The 1950s were monumental in the restructuring of the Danish family with prior work referring to this period as the "golden era" of the Danish welfare state. Welfare reforms were employed, and social democratic politics were experiencing a rise which paved the way for the modern Danish Welfare State known to Danish society today (Christiansen & Petersen, 2010). The economic and political changes of this time period have therefore been widely covered by the social sciences in literature. What has however been widely overlooked is the personal dimension of this era, in other words, how people personally experienced and coped with changes happening at home in their families.

The family revolution of the 1960s and 1970s saw women being able to take up formal work and formal education (Work. Live. Stay., 2018). These changes would go on to affect previously static gender roles and how families were constructed, as women could join the workforce and earn money to contribute to the household and not only take care of the children.

This paper endeavours to look into how families in Denmark experienced these dramatic changes in society, what individual decisions they made as while the collective changes took place, and how the dynamics of their families on a personal level were affected. It also uncovers the thoughts behind the choice of taking an education as a woman and the impact on family relationships and gender roles (Craig & Mullan, 2010). The informants and citizen scientists for this project are all women born in the 1940s, having the family revolution take place during their twenties - a time when first marriages typically happen (Statistics Denmark, 2020), meaning the informants would need to structure their own new families. As citizen science dictates, the accounts of amateur scientists helped shape the perspective of this paper, looking into how the family revolution was experienced in households, the ethics of gathering and processing data with a potential vulnerable group, and an analysis of applied methods.

TELL US ABOUT YOUR FAMILY

As this is an exploratory study, we employed open-ended, exploratory in-depth interviews (Schensul & LeCompte, 2013). The specific citizen science approach that was taken is participatory science (Haklay, 2018), since citizen scientists did not only respond and contribute with personal knowledge but gave a new direction to the problem definition.

A set of open-ended questions to guide the interview was prepared prior to the first interview and used for all citizen scientists (Barriball, 1994). Of the total number of five semi-structured interviews, two were conducted face-to-face, one using video call, and two were telephonic. One interview consisted of an initial interview followed by a follow-up (Schensul & LeCompte, 2013), which included the review of photos selected by the participant and their presentation, description and explanation of photos to the researcher.

We approached the recruitment in two ways: firstly, a written project presentation was created and posted in different social media platforms hosting groups of elderly people and, secondly, personal contacts were engaged and set on a spread of word-of-mouth. The data has been analysed by first transcribing all audio recordings, whereafter they have been coded according to concepts we identified as recurring, and then compared (Schensul & LeCompte, 2013).

"A LOT JUST HAPPENED RANDOMLY"

The citizen scientists in this study were born and currently live in Denmark as this project set out to explore the history of the experiences through the family revolution in Denmark as employment and education possibilities opened up for women through the 1960s and 1970s. Table 1 gives an overview of the citizen scientists, showing that all citizen scientists took up a profession and have been married.

Table 1: Citizen Scientist overview (M = married, D = divorced)

	Gender	Age	Born in	Profession	Status
1	Woman	73	Finnerup	Specialized pedagogue	M
2	Woman	73	Hvalpsund	Nurse	M
3	Woman	75	Odense	Elementary school teacher	M
4	Woman	79	Copenhagen	Freelance artist	M
5	Woman	73	Ebeltoft	Pedagogue	M & D

The gathered data from the interviews proposes two main findings. The first suggests that the family revolution was a long, ongoing, slowly emerging process that did not propose itself as a specific event in time or a sudden and dramatic shift.

> *"I just wanted to be myself and do my work and enjoy it." - Emma*

> *"...that was not really what suited us so we began the first steps towards my education." - Anna*

Rather, as our citizen scientists indicate, the pursuit of personal fulfilment and happiness was at the center of their experience, which included entering the workforce to achieve a career and a self-sustained life, combining family and household. When recalling major events in their lives such as moving cities to get an education, getting married, or moving to build a family home, the majority of citizen scientists described the process as a chain reaction of events that was not planned as a revolt to existing family patterns, but rather a combination of own choice and "lucky circumstances".

> *"We did not think about it that much back then. To say it mildly. It just went with the flow. We didn't use that much brain work on things like that. Many of the things emerged by coincidence" - Anna*

This 'going with the flow' gave them a sense of freedom and self-fulfilment. However, other citizen scientists indicated that not everyone in their surroundings experienced the same opportunities to pursue a career and go with the stream of opportunities in the same way. Some described observable differences in the labour market in terms of numbers of men and women in different professions, which due to their observation was a slowly changing matter that proceeded over a longer time period, which would propose challenges for them that they had to overcome.

> *"It was not normal to take an education. I was one of the very first, who took an education. It wasn't the norm. Well, there were a few, who became nurses. Else...my whole school, it is not so long ago I looked them up… the women became housemaids, then they got married and had children" - Anna*

Picture 1: Anna & university class, Copenhagen (1970)

> *"No there weren't and there still are not many men that are nurses. But there are some, and they become more and more." - Bella*

This combines to the finding that the experiences were not the same for everyone during this period, but neither was there concrete overarching movement that ignited the citizen scientists' wish to pursue a career. In their own words, they followed the somewhat rough plans they had accompanied by coincidences that impacted choices along their lives, such as moving to other cities for education purposes, as one participant elaborates:

> *"It had been my will and choice the whole time, also when I was younger when I was in a lower grade, It was clear to me that I wanted to become a school teacher." - Christine*

The participant explains that her choice of profession had been clear from a young age and later moved to another place to pursue this education, due to the circumstance that her partner was living there.
Secondly, 4 out of 5 citizen scientists experienced support by their families and parents to explore opportunities.

> *"And I think that is also mainly due to my father and mother because they completely supported me in that and, we wanted to… and it was the most important that we (...) were happy with the things we wanted to do" - Bella*

Two other citizen scientists gave information on financial support by their parents in order to be able to afford an education. On the other hand, the findings thus also showed that people who did not experience this support by parents and family, felt the need to express their need to rebel.

> *"One day we were in the mood for provocation, so we painted black fingers and toes on the wall inside the living room with paint." - Anna*

This was among other things achieved through visual expression in art and personal physical appearance, which could be seen as violent or dramatic by other members of the family and surrounding society.
Summing up, our findings show that the concerned time period was not experienced as a sudden change in people's lives, but rather a chain of personal life choices, based on available options, and coincidences that align to individual life stories and choices that then add up to a time period spanning 20 years, referred to as the family revolution.

THE ANATOMY OF THE FAMILY REVOLUTION

The story of the family revolution that was uncovered from interactions with citizen scientists does not appear to be recalled as neither dramatic nor sudden. Rather, it became clear from participant explanations that the pursuit for self-fulfilment and independence from both genders was at the center of their decision-making. This analysis opts for several points for discussion.

The family revolution appears in contrast to the definition of a revolution as it was not an abrupt change at a certain point in time (Ordnet, 2020), but a very slow and rather subtle evolution over several years, even decades. One possible explanation is the limited geographical movements that people undertook at the time. Holidays and longer stays away from home were held in the countryside within Denmark (Interview Dorthe) and were generally rare. This physically slowed down spreading processes of ideologies and ideas.

Additionally, the differences in the geographical locations themselves seem to have had an impact too as we see in the pictures (Picture 1 & 2). What differentiates them are 5 years in time and different locations in Denmark, as well as social settings they have been taken in. The first one being a baptism in a more conservative, rural area in Jutland, while the other one portrays a university class in Copenhagen, the progressive capital. While the picture of the baptism is showing clear gender roles, as stated by the participant:

> *"What a difference between women and men. It shows that quite clearly in their appearance. There we were in '65. Look. (...) And I am actually sure, the whole line of men there (...) they have never been in a kitchen before." - Anna*

In contrast to that, the picture from university (Picture 2) gives the impression of a unified group without clear gendered ways of behaving, dressing or positioning themselves in the picture.

Picture 2: Anna & family, five years prior, Baptism in Jutland (1965)

> *"Clothing and manner and behavior taken all together, as I remember it, that was at least the first time that I experienced this. We were so similar. There was no big difference between men and women. (...) There was nothing such as things girls had to do that men weren't supposed to do. Not as I remember it." - Anna*

This silent rebellion, in the form of lack of formality, and relaxed attitude even at picture-taking, where you usually showed yourselves in your Sunday-best, made a huge impact on Anna.

Another major point for discussion is if we can really term the developments during this time period as a *revolution*. Since it was widely supported by older generations, mainly the parent generation to the citizen scientists, it would have otherwise been assumed to go against their values.

We came to analyse that out of all our citizen scientists, Anna was the only one that did not experience parental support to pursue a university education and a career was the one who participated in marches, uproars and physical demonstration in terms of visual expression such as art. It is discussable whether we term the revolution as such because of the few examples of people who actively revolted, while the major contribution to the actual changes, namely the diminishing of gender roles and the increased number of women in the labour force, were achieved by the silent masses that are not portrayed and represented as much in media and literature.

This adds to another point of discussion on the border between our methodology and the generated findings. As proposed by the majority of our citizen scientists, the majority were supported in their plans by parents, spouses and family. This raises the question whether there actually was a force to be resistant against or whether it turned out to be a much-needed progress in society that all generations were understandable of. It is arguable whether the widening of opportunities was a result of a resistance and there really haven't been any uproars or revolts against existing norms, or if we are simply lacking data on these accounts.

Methodologically, we came across several other aspects that were ethically discussable and proposed challenges along the project. In the recruitment process we anticipated to include both men and women with a balance of 6 women and 1 man. However, due to health issues one woman and the man had to cancel the interviews. Of these 5 women 1 got hospitalized after the interview, which shows the urgency of conducting a larger scale research before it is too late.

Lacking the male side of the experienced history has further affected our results about the experience of the change in gender roles. Even though we got second-hand impressions of how the woman participant's husbands reacted positively to the changes, this data is highly influenced by the fact that the women asked them for these reflections or interpreted their spouses' behaviors back in the 60'ies and 70'ies - we have chosen not to include this information. Missing the men's side of the story can give the impression that the change in gender roles and family pattern in general were a welcomed change (Scambor et al., 2014), though this is highly discussable and not possible to be assumed at this point.

Another point to consider in relation to this is the self-selection bias emerging from this recruitment method (Lukacs et al., 2010). Among the reoccurring recruitment issues were the fact that people did not evaluate their personal story as "exciting" enough or worth being interviewed about. This also contributed to the group of citizen scientists not being as diverse as anticipated. Due to this, the existing citizen scientists could be assumed to be those who led less ordinary lives or saw themselves as first-movers. Those who thought this change in society and family pattern was wrong somehow, have not contributed with their experience, even though this perspective can be assumed to be existing as well.

In addition to that, the ethical aspect of interviewing elderly as a specifically vulnerable group of citizen scientists proposed a challenge. According to Tee & Lathlean as quoted in Hewitt (2007), the elderly might have troubles with memory loss due to

age or sickness, and therefore might not be completely autonome. Beauchamp and Childress (2001) as quoted in Hewitt (2007) state that an individual is seen as an autonome if they possess the capacity for intentional action and are independent from controlling influences.

If the participant is not completely autonome, it raises challenges on two fronts; Firstly, the consent given to the researcher might become invalid if the participant has gaps in memory and does not remember that consent was given. Secondly, the data given might be faulty or nothing more than anecdotal insights.

One can argue that interviews about things that happened 50+ years ago will, even with a clear mind, mainly be anecdotal insights of that time period. As Anna pointed out: *"...it actually is a long time ago"*. This emphasizes even more the need to collect this data now, if society would like to learn from past generations' way of understanding and coping with big changes in society.

Comparing the different interviews and their depth, we came to realize that a face-to-face interview generated a significantly deeper trust and relation to the participant than interviews conducted over the phone. This showed to have an impact on the length and depth of the conversation. Combining this insight with the challenge that many elderly do not feel comfortable with newer technology or have access to virtual modes of communications, it is clear that face-to-face interviews, for this group, is preferred.

If changes in society dictates minimal contact, as the COVID-19 did, it will be worth the extra trouble to still push for interviews in person, but just do it outside. It might bring even deeper interviews since there will be an enhanced need for human contact.

TALKING ABOUT A REVOLUTION?

As it became evident from the discussion, the question is, whether the developments that took place can be conceptualized as a family revolution or rather as an observed family evolution of structural change over an extended period of time, that has been termed as the family revolution in retrospective by the younger generation. Even though the changes were drastic and impacted society fundamentally, terming it a revolution might be too much of a stretch to the concept. It was experienced as a movement or the beginning of an evolution with still ongoing changes in society nowadays, towards a reduction of gender roles and increasing equality.

Future research on this topic should be done on a larger scale. A larger and more diverse sample of citizen scientists in terms of demographics, geographic position and social background will provide a broader insight into the developments and changes we investigated. It will further be possible to enlighten some of the dark sights, and other perspectives, such as the male perspective, that this study did not capture. Citizen Science as a methodology will be a useful tool to accomplish this. To achieve a higher level of citizen engagement, the study could be done as a school project, where students and elderly actively engage together in producing accounts of Danish society's' history.

As the present work has shown citizens shape the outcome, methodology and approach to such an inquiry, since their experiences and knowledge are shaping the essence and focus of the study.

Based on the narratives provided by the citizen scientists of this inquiry we come to the conclusion that instead of a revolution as a dramatic and somewhat sudden mass movement, the family revolution presented itself as a change process, and evolution shaped and promoted over a long period of time by the members of Danish society.

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REFERENCES

Barriball, K. L., & While, A. (1994). Collecting data using a semi-structured interview: a discussion paper. Journal of Advanced Nursing-Institutional Subscription, 19(2), 328-335.

Christiansen, N. F., & Petersen, K. (2001). The dynamics of social solidarity: The danish welfare state, 1900-2000. Scandinavian Journal of History, 26(3), 177-196. doi:10.1080/034687501750303846

Craig, L., & Mullan, K. (2010). Parenthood, gender and work-family time in the united states, australia, italy, france, and denmark. Journal of Marriage and Family, 72(5), 1344-1361. doi: http://dx.doi.org/10.1111/j.1741-3737.2010.00769.x

Hecker, S., Haklay, M., Bowser, A., Makuch, Z., Vogel, J., & Bonn, A. (Eds.). (2018). Citizen Science: Innovation in Open Science, Society and Policy. London: UCL Press.

Hewitt, J.L. (November 2007) Ethical Components of Researcher Researched Relationships in Qualitative Interviewing. [researchgate.net] 27.7.2020 from https://www.researchgate.net/

Lukacs, P. M., Burnham, K. P., & Anderson, D. R. (2010). Model selection bias and freedman's paradox. Annals of the Inst. of Statistical Mathematics, 62(1), 117-25. doi: http://dx.doi.org/10.1007/s10463-009-0234-4

Ordnet.dk. Revolution https://ordnet.dk/ddo/ordbog?query=revolution

Scambor, E., Bergmann, N., Wojnicka, K., Belghiti-Mahut, S., Hearn, J., Holter, Ø. G., … White, A. (2014). Men and Gender Equality: European Insights. Men and Masculinities, 17(5), 552–577. https://doi.org/10.1177/1097184X14558239

Schensul, J.J., LeCompte, M.D. (2013). Essential Ethnographic Methods: A Mixed Methods Approach. UK: AltaMira Press.

Statistics Denmark. (2020). The average Dane. Retrieved from https://www.dst.dk/en/Statistik/Publikationer/gennemsnitsdanskeren

Work. Live. Stay. (Producer). (2018). Women in Danish Job Market. Retrieved from https://work-live-stay.dk/wp-content/uploads/2018/08/Women-in-the-Danish-job-market-wls.pdf

RETHINKING FOOD
CO-CREATING SUSTAINABLE COOKING HABITS

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ABSTRACT

Food is far more than nutrition for humans. It shapes our culture and practices of our daily lives. Our food traditions and cooking habits have been passed on to us for generations and take part of our daily structure. ReThinking Food takes a co-creative approach to Citizen Science with the aim of identifying possibilities, challenges, and possible pathways of changing our daily cooking and eating habits. Together with participants of the study we make suggestions on how to change our behavior towards more sustainable and biodiverse cooking manners. We study how the design and development of a kit, containing foods proposed to aid positive social, environmental and economic impact, can help the 'common' Danish household into implementing food for healthier people and a healthier planet.

KEYWORDS:

Citizen science, Co-creation, Sustainability, Future 50 Foods, Cooking habits

INTRODUCTION: EATING FOR MORE BIODIVERSITY

The way we eat says a lot about how we act as humans. It comes to show in our preferences, and practices of daily food habits (Šmahel et al., 2018). Some love to cook, while others prefer not to spend a long-time cooking. Some cook together and others cook alone. At the end of the day we all need to eat. No matter how different we may be, similarities can be found in the way food brings people together and how it takes part of our structure of our daily lives. Food is far more than nutrition. It shapes our social lives, cultures, and helps to make us who we are. Our eating habits are bound by traditions and daily practices, which can be hard to change or alter (Nierenberg, 2018). These eating habits have been passed on through generations, but as the world around us is changing, so must we. In order to engage citizens in recognizing their own food habits and their consequences, we explore how common households cook and prepare their food with more sustainable ingredients. This was implemented through the design and creation of a kit for experimentation. The study shows that the participating households and families with children are sympathetic towards a more sustainable diet. Our findings suggest solutions on how to implement a more sustainable and biodiverse cooking habit. Our findings suggest solutions on how to implement sustainable and biodiverse cooking habits.

METHODOLOGY: A CO-CREATIVE CITIZEN SCIENCE STUDY TO ENGAGE DANISH HOUSEHOLDS

Citizen science is a method through which scientists can engage citizens through participation. Both, the scientist and the citizens, learn from each other and find common ground. Co-creation is the action, through which the participants shape the study. The goal is to engage and include citizens in research and narrow the distance between the citizen and the scientist in order to create a common language.

The results aim to provide new methods within data gathering and creating data closer to real life people through public engagement (Hakley, 2013).

The study builds upon the salon 'Food as a sociocultural sophisticated material' by Danielle Wilde, Associate Professor of Embodied Design at the University of Southern Denmark (SDU), Kolding, and the 'Future 50 Foods' report by World Wildlife Federation and Knorr suggesting fifty foods "*selected based on their high nutritional value, relative environmental impact, flavor, accessibility, acceptability and affordability*" (Shaver & Drewnowski, 2019).

Participants of the salon by Wilde, 2020 defined a concern of the implementation of the Future 50 Foods. Building on this concern, we designed a study to uncover a solution. Collectively we identified possibilities, challenges, and potential pathways of changing their cooking habits through the scientific process. In 2013 Haklay defines four levels of engagement within the field of Citizen Science:

Level 1: Crowdsourcing - Citizens as sensors.
Level 2: Distributed Intelligence - Citizens as basic interpreters.
Level 3: Participatory Science - Participation in problem definition and data collection.
Level 4: Extreme Citizen Science - Participatory science in problem definition, data collection, and analysis.

This project moves within Level 3, Participatory Science. The participatory approach to citizen science that we applied brings science closer to the participants and enables them to feel engaged. This allows us to include citizens in the drive towards social change with the aim of raising awareness of sustainable and biodiverse consumption. As Brand et al. argues "*A successful participatory process is a community of practice in the making*" (Brandt et al, 2013, pp. 149). The act of creating makes the process engaging and vivid. We refer to the actions of making-telling-enacting to involve the participants in the study. It

proposes to inspire a design process through Iterations by circling through these actions.

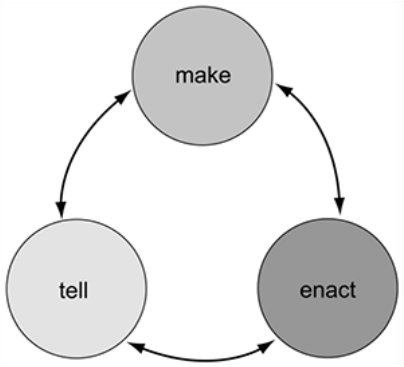

Figure 1: Tell-make-enact diagram with double-headed arrows to illustrate how the actions are connected and iterations can circle (Brandt et al, 2013).

In order to benefit from the tell-make-enact diagram, we created a kit containing ingredients from the Future 50 Foods report. The kit was delivered personally to the participants (see figure 4). After the delivery, the citizens could experience it. The concept of a kit was inspired from the usage of cultural probes developed by Gaver et al. (1999) and further described by Brandt et al. (2013) as a new way of transforming questionnaires into tools for data collection.

To engage with the participants on a deeper level we gave them tangible tools in the form of food to interact with. This afforded the possibility to experiment with ingredients, cook with them and taste them. Here we can draw similarities to the extreme citizen science study of "Soylent Diet Self-Experimentation: Design Challenges in Extreme Citizen Science Projects" in which participants are asked to self-experiment with the powdered food substitute "soylent" (Dolejšová & Kera, 2017). Our study does not go to the extremes of self-experimentation, such as 'soylent', which potentially can cause health issues. In contrast, this study seeks to raise awareness for a more sustained nutrition through eating sustainably and biodiverse. To enhance a multi-generational impact of change, we invited families with children to join the project. Our aim was to inspire and introduce the ingredients to children at an early stage to incorporate the ingredients into their cooking traditions and practices passed on from their parents. We focused on residents living in the Kolding area, Denmark, to get an overview of a local community. By doing this, we had the opportunity to meet our participants, as we personally delivered the kits to them. A final kit existing of around 25 different ingredients has been developed and was distributed to the families to experiment with and implement them in their cooking habits. Overall, it was a directed process with deliberate open elements which ensured co-design and local control at the same time (Haklay, 2013).

Throughout this study we conducted research activities including interviews, questionnaires, and focus groups. While the interviews and questionnaires were directed to the participating families in the pilot study, the focus group served the purpose of identifying which of the ingredients in the kit were already familiar to the participants and which of those they currently had in their home.

RESULTS: HOW ENGAGEMENT CAN SUPPORT CHANGE.

Salon

Being introduced to the 'Future 50 Foods' report through a salon by Wilde, 2020 created a sophisticated yet safe environment for exploring the ingredients. The format invited for discussions and imaginative thinking of the uses, as they were displayed in their raw form and unable for participants to taste. The salon formed our initial take on the project, as we during the event raised questions concerning their use and implementation in our daily cooking habits. Topics of concern were the amount of dried goods, the lack of meat and fish, substitution possibilities, globally, but not locally produced foods, and the taste. From insights of the salon we reflected upon the topics of discussion to frame which aspects within implementation of the ingredients could be interesting to develop further. Participants of the salon were self-selected yet representing diverse fields and demographics. We wanted the follow up study to reach Danish households and families, engage them in cooking with the ingredients on their own terms.

Pilot Study

A pilot study was launched with two participating households to test out the concept of co-creation research. The households were provided with a kit containing 15-21 ingredients from the Future 50 Foods report and given the task to experiment and cook with them while documenting the process by photos or videos. Though both households were given the same task they were not provided with the same kit. Household 1 was mainly provided with fresh ingredients and a few dried goods, while Household 2 mainly was given dried goods with few fresh ingredients.

Table 1: Data collecting from two households of implemented ingredients from Pilot study.

ReThinking Food - Pilot study		
	Household 1	Household 2
List of ingredients provided. Ingredients marked in green – Ingredients used in cooking.	*Fresh ingredients:* - Okra - Orange tomatoes - Alfalfa sprouts - Sprouted chickpeas - Lotus root - Ube (Purple yam) - Red sweet potato - Kale - Bok-choy - Red cabbage - Spinach - Watercress - White icicle radish - Enoki mushrooms *Dried ingredients:* - Black turtle beans - Soy beans - Mung beans	*Fresh ingredients:* - Ube (Purple yam) - Red sweet potato - Okra *Dried ingredients:* - Adzuki (red kidney) beans - Broad beans (Fava) - Cowpeas - Mung beans - Soy beans - Buckwheat - Quinoa - Wild rice - Flax seeds - Hemp seeds - Sesame seeds - Walnuts
Results of implementation:	13 out of 17 ingredients were used in cooking.	Total: 11 out of 15 ingredients were used in cooking.

We sent out a follow-up questionnaire after one week for each of the two households about their experiences to gain insight in their discoveries and challenges: "*I found it satisfying to incorporate new ingredients into the current dishes that I made… One of the challenges was the fact that some had long cooking times or required soaking.*" - Household 2. Our findings include: That cooking with new ingredients sparked curiosity, but that preparing them required timely preparations before the ingredients could be used, such as soaking dry beans overnight. Participants felt less intimidated by the ingredients after implementing them in a meal. Alongside the questionnaire, participants provided us with documentation of their cooking experiments providing both photos, videos, and description of ingredients used. We found that both nutrition and taste played a role for the outcome of the recipes: "*The idea of being able to*

substitute foods for a different taste but comparable nutritional content in order to be sustainable is an ideal situation." - Household 1

Moving forward with the findings of sparked curiosities of new ingredients, challenging cooking preparations and the importance of nutrition and taste, we formed the project frame our main study.

Main Study: Is fresh best?

Based on our findings from the pilot study we conducted our main study with an additional five families, a total of 21 participants, living in the Kolding area, Denmark. The recruitment process was conducted via a local Facebook group. Before participants were recruited for the project, they were asked to fill out a preliminary questionnaire to sum up their current cooking habits (see table 2).

Table 2: Overview of the participants, their cooking style and how often they implemented new ingredients in a meal.

Participants	People in the household	Cooking style	Implementation of ingredients per meal (average)
Family 1	6	Healthy and diverse	1
Family 2	3	Minimal intake of carbs. Eats lots of meat, vegetables and fat.	2
Family 3	4	Routine based, easy, no-waste and child-friendly.	2-3
Family 4	5	Child-friendly, one-pot meals. Don't feel like they eat enough vegetables.	2
Family 5	3	Flexitarian (vegetarian/vegan 3-4 times a week) Focus on healthy lifestyle. .	3

The results were used to compare and identify change in their cooking habits later in the project. A new iteration of the kit containing up to 21 different ingredients was deployed and personally delivered to the participants. We deemed it necessary to meet with the participants in person to introduce ourselves to the citizens and to establish a deeper connection with the participants whom we would be working with over the next two weeks. For practical reasons, the kit had to be delivered in person to preserve the freshness of the fresh ingredients in the kit. Being present at the time of delivery allowed us to perceive the participants' first reactions and impressions of the novel ingredients.

Figure 2: Participant receiving the personally delivered kits with ~21 different ingredients.

The kits consist of fresh and dry ingredients respecting allergies and food intolerances defined in the preliminary questionnaire. All participating families were divided into two groups: one received detailed information about the ingredients whereas the other groups' ingredients just had the name on it. Given information, such as cooking instructions, varied per ingredient. The unlabeled ingredients raised even greater curiosity within the participation group than the labeled ingredients did. Running the study during the lockdown of the global pandemic COVID-19 made it easier for our five participating families to take time for preparing and experiencing food together. A private Facebook group functioned as an exchange, inspiration and instruction platform for the participants, a food blogger and for us, the researchers. Participants were encouraged to share their thoughts, experiences, and insight throughout the project in form of pictures and videos with captions. Surveys and online interviews were conducted to gather data. The findings of our main study show that participants like to be challenged to cook with new ingredients: *"... [the box] seems like an exciting combination and we are looking forward to trying something new.*" - Family 3. Participants could imagine the use of the ingredients without having to look up recipes: "*It [the box] looked inviting and we are already starting to think about how we can use the different things*." - Family 5. All of the families were to some extent familiar with the ingredients: "*They [the ingredients] do not differ significantly [from their usual ingredients] ... The ingredients differ in type of beans and type of root vegetables.*" - Family 5. Two out of five of the families were willing to compromise taste and flavor for more sustainability. One of the families stated that they were willing to take additional effort to include more biodiverse foods in their daily diet. A participant suggested the following: "*The problem is probably that we do not get it enough [beans] as children… Many are intimidated when something is new and different. In addition, they should probably also be made more common in restaurants, so that people have the opportunity to try the food.*" - Family 2. This aligns with our aim of enhancing a multi-generational impact of change by introducing ingredients to children at an early stage. The findings also indicate that being confronted with sustainable and biodiverse ingredients more often increases the willingness to eat them regularly. Additionally, ingredients need to be easily accessible. On average participants implemented between one and three ingredients from the kit each meal (see table 2). Families approached the new ingredients differently. While some of them added the foods to their regular dish, others experimented trying to combine several of the kit foods at the same time: "*We used all the ingredients, but we also tried to get them incorporated every day into the meal plan*." - Family 1. We saw a pattern in the use of fresh ingredients, as they were the first to appear in recipes and pictures provided on the Facebook group: "*The ingredients must not go to waste. So, we chose the fresh ingredients first, so they did not go bad.*" - Family 2. This gave us an assumption that fresh ingredients were easier to incorporate into their cooking habits. This surprised us as we did not initially account for the freshness of an ingredient to play the biggest role of incorporation. Four out of five families completed the final questionnaire. Here they stated which ingredients they had not managed to incorporate into their meals: Family 1: Used all the ingredients, Family 2: All of the beans (due to diet restrictions), Family 3: Okra, finger millet and broad beans, and Family 5: Buckwheat, soy beans, spelt, flax seeds, broad beans and white icicle radish.

DISCUSSION: 50 FOODS FOR HEALTHIER PEOPLE AND A HEALTHIER PLANET.

Our study showed that citizens are open-minded to transform their eating behavior towards a more sustainable and biodiverse diet. We even found that they are willing to compromise on

taste and flavor for more sustainability. One question that needs to be asked, however, is whether citizens are poised to spend more time on cooking and preparing the food in the long run when experimenting with new ingredients becomes everyday life. As the target group in our study was families with children, it is especially them that have a very busy and scheduled daily life. However, their cooking styles indicate that they are targeting a very balanced, healthy diet. A challenge for many families is, however, to find (child-friendly) recipes implementing the new ingredients. The additional time requirement for cooking with the novel ingredients represents a limitation of engaging citizens. This is because many families might not be willing to spend much more time on eating more sustainably. Furthermore, the participants in the study did prefer a healthy and various diet and therefore might be more open minded for new ingredients than citizens that do not like to spend much time in the kitchen anyways. With only five families participating in the study we cannot determine any generalization of the broader 'common' households in Kolding, Denmark.

CONCLUSIONS

The households that participated in our project gave us a good starting point and provided an opportunity to bring the study further. An extension of this project will let us verify the results that we have been receiving so far.

Until now we found out that engaging and being exposed to the new ingredients inspired participants to experiment with them and their uses. We would like to suggest that being introduced to the ingredients at a very early stage of our lives has the highest probability of incorporating those ingredients in our daily diet. This is because the taste of very young children can still be shaped the most (Scaglioni et al., 2018). Within our study most participants incorporated the new ingredients to known recipes as a garnish, experimental touch, or as a side dish. In the research we found out that changing small things in a diet raises curiosity and therefore the Future 50 Foods have a great potential to gain popularity and push-start change. According to Nierenberg, "*Eaters can make big differences through small changes to their diets*" (Nierenberg, 2018) and therefore being part of a greater movement is an additional incentive for citizens to rethink their food.

The longer preparation time that comes along with most of the ingredients of the report however presents a challenge to make people cook more often with them. Besides, existing food habits are very difficult to change once they are instilled. Those challenges underlie the importance of raising awareness of a more sustainable diet in everyday life. If sustainable foods would be easily accessible and if citizens would be confronted with them more often, a greater awareness would be raised and eating behaviors could be changed.

Even if this process will take time, our research has shown that citizens are willing to include new ways of nutrition into their everyday lives to reach more sustainability and biodiversity.

ACKNOWLEDGMENTS

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REFERENCES

Brandt, E; Binder, T. & Sanders, E. (2013) Tools and techniques. Chapter 7 in: Simonsen & Robertson (Eds.). Routledge International Handbook of Participatory Design. Routledge, pp. 148-150

Dolejšová, M. & Kera D. (2017). Soylent Diet Self-Experimentation: Design Challenges in Extreme Citizen Science Projects. In Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing 2112-2123. DOI: 10.1145 /2998181.2998365, pp. 2-5

Haklay, M. (2013). Citizen science and volunteered geographic information: Overview and typology of participation. (2012th ed., pp. 105-122). Dordrecht: Springer Netherlands. DOI:10.1007/978-94-007-4587-2_7, pp. 11

Nierenberg, D., & Barilla Center for Food and Nutrition. (2018). Nourished planet: Sustainability in the global food system. Washington, DC: Island Press/Center for Resource Economics., pp. 60-64, 91

Scaglioni, S., De Cosmi, V., Ciappolino, V., Parazzini, F., Brambilla, P., & Agostoni, C. (2018). Factors influencing Children's eating behaviours. Nutrients, 10(6), 706. doi:http://dx.doi.org/10.3390/nu100607060, pp. 2

Shaver, D., & Drewnowski, A. (2019). Future 50 Foods: 50 foods for healthier people and a healthier planet. World Wildlife Federation and Knorr, pp. 3-5

Šmahel, D., Macháčková , H., Šmahelová , M., Čevelíček, M., Almenara, C. A., & Holubčíková , J. (2018). Digital technology, eating behaviors, and eating disorders. Cham: Springer International Publishing., pp. 3-4

WHAT 485 KM OF CASUAL SCROLLING TAUGHT US ABOUT THE COST OF DIGITAL LIFE

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ABSTRACT

Throughout one week, the participants of this project emitted CO2 from their smartphone equal to the amount of driving a car 485 km. The bulk of co2 was emitted through "Casual Scrolling", which describes how the citizens scroll through platforms for entertainment, pastime, and relaxation without realising the environmental cost of their digital life. Public sustainability debates often centre around dietary choices and travel, but how our digital lives are affecting the environment stays mostly unaddressed due to its technical complexity. Thus, this research's aim is to map the online behaviour of the participants and to provide an understanding of how citizens can be informed and approached. Through a multi-method Citizen Science approach, this research uncovered that the public should be informed through relatable numbers, e.g. number of washes per GB of data consumed. Furthermore, it was uncovered that, if appropriately informed, people are more willing to change unsustainable behaviour. Therefore, this research contributes to this field by providing a working concept on online behaviour and functions as a base to address this issue in an understandable way for the public debate.

KEYWORDS:

Citizen Science,
The cost of digital life,
Behavioural change,
Development goals

INTRODUCTION

In the past decades, the focus on the environment has increased due to changes in the environment. Sustainability is now being prioritised in the UNs 2030 Sustainable Development Goals, with goals such as "*take urgent action to combat climate changes and its impacts*" and "*Ensure sustainable consumption and product patterns*" among others (United Nations, u.d.). These changes in the environment have led to many people taking up a sustainable lifestyle which often focuses on dietary habits and travel and not so much on the cost of digital life (Forsberg & TV 2 Branded Content, 2019). A focus visible in science and media as well.

Throughout the years, the world has seen rapid technological development, paving the way for better smartphones and more online services. These advancements are encouraging a "Casual Scrolling" behaviour, a concept coined by a participant of this study describing how she and the participants scroll through platforms for entertainment, pastime, and relaxation - without realising the environmental cost of their digital life.

The technological advancements, in combination with this behaviour, require servers at data centres to grow in order to keep up with the increasing demand. In other words, the more we stream, share, and upload the higher the electricity consumption of these data centres are.

To understand this issue, this paper aims to map the online behaviour of the participants. Second, we aim to provide a foundation for citizens to come up with solutions to the issue and how to increase awareness on a bigger scale.

Based on Citizen Science (hereafter referred to as 'CS') methods, the paper looks to include citizens in the process of researching by collecting, analysing and interpreting the data throughout the process.

METHODOLOGY

To investigate the stated problem, a multi-mix three-stage research process was constructed based on the research of Curtis (2015). She follows a similar approach to surveys, participant observation, and semi-structured interviews. Our three-fold method will be presented in the following section. This research has citizens as the core component in order to gain first-hand data and understand the context of the citizens' perception of the cost of digital life. Through a pilot project, volunteers assisted in testing and reviewing a quiz, interviews and data tracking app. The feedback received created the foundation for optimising the research design to obtain relevant data.

Citizen Science

CS is a discipline that focuses on involving citizens in scientific work or knowledge production, on increasing data collection as well as citizens' knowledge and competencies within the area of knowledge the CS project deals with (Hecker, et al., 2018). Since the framework does not have a specific founder, many scientists have tried to concretise the theory, to improve the framework and what CS is. This means that there are different ways to use and describe CS (Riesch, 2015). To better frame our project, we decided to use Haklays (2013) 4 levels of involvement. The levels categories the different variations of CS projects and their degree of involvement. The higher level, the higher the involvement. In figure 1, the levels are defined. This project aims to reach level 3 of CS, which we have done by making a quiz to test knowledge, using an app to track online behaviour, and conducting semi-structured interviews to gain qualitative data. By combining these methods, it enables the participants to contribute to this research by analysing their data and interpreting the behaviour behind their results.

Level 4 – Extreme Citizen Science

Collaborative science – problem definition, data collection and analysis

Level 3 – Participatory Science

Participation in problem definition and data collection

Level 2 – Distributed intelligence

Citizens as basic interpreters

Level 1 - Crowdsourcing

Citizens as sensors

Figure 1: four levels of involvement by Haklays (2013)

Quiz

A quiz with two purposes was made and posted via social media. The quiz is set-up in a way that tries to relate a fact of the cost of digital life to something in people's daily life. The majority of the questions were quantitative of nature, which allows us to see trends of underestimation versus overestimation. Two voluntary open questions were added where participants give their ideas on how to make CO2 emissions related to data consumption more tangible for people and how data consumption can be reduced. The quiz has two functions to this project. Besides being a tool for data collection, the quiz also functions as a way to bring the project to the attention of potential participants for recruitment which yielded 16 participants.

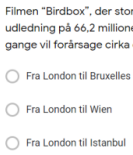

Figure 2: The questions in the quiz varied between numbers as answers and more abstract options depending on the question

Data Tracker App

Initially, the app "My Data Manager" was thought of as the tool to ensure similarity among the data collected. However, as an update hinders iPhones from working with the app, this brand's data is collected by resetting their built-In data monitor and using the data collected through here. The two versions of apps track the usage for 7 days. Following this period, the participants screenshotted their respective app and sent it to their contact person. The app for Android systems is developed by 'App Annie Basics', and it can gather information on each app's usage throughout a specified period. This allows us to present the participants with real data consumption to the interviews. 16 participants had the app installed, except for those using iPhone devices. These participants were recruited through the first quiz.

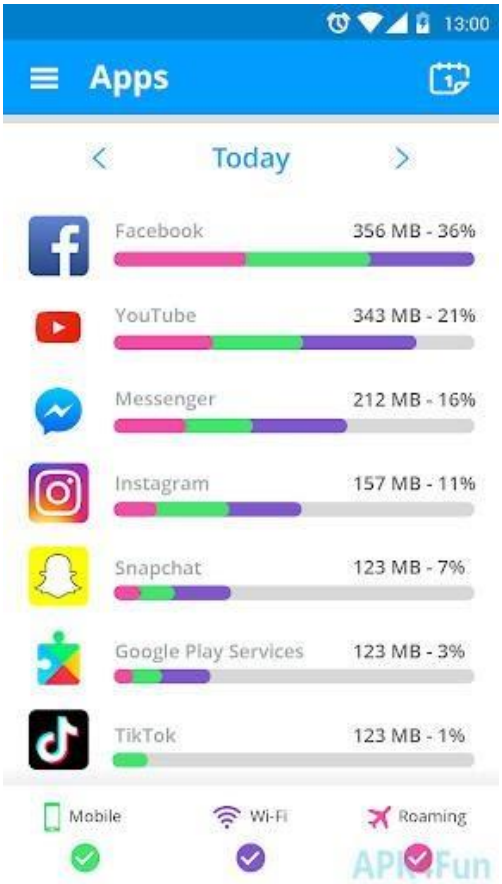

Figure 3: The questions in the quiz varied between numbers as answers and more abstract options depending on the question

Semi-structured interviews

With each participant, two interviews were conducted. The first interview took place after the quiz and before they started to track their data consumption. This interview aimed to gain information on the participant's perception of their data consumption through drawing a chart together, behaviour and thoughts on the quiz. The second interview revolved around "reality" where the citizens were presented with their perceived data consumptions vs their real data consumption. This way, this research was able to compare the results of the first and second interview and gain in-depth information on participants' reasoning. Semi-structured interviews were used to gain qualitative data to supplement the quantitative data gained through the quiz and data tracking app.

Emission calculations

To understand the environmental impact of the participant's data consumption, a conversion of the data is necessary. To demonstrate the emission in a tangible way, we decided to compare the usage to emission from driving. First, it is essential to acknowledge that there are methodological issues related to deciding these key numbers. To calculate how much CO2 per GB

used, the CO2 emission per kWh is multiplied with the amount of kWh needed to produce a single GB. This leads to the following formula:

CO2 emission per kWh x kWh to produce 1 GB = grams of CO2 per GB used

Coroama and Hilty (2014) conclude that the calculated energy intensity per GB of data transferred can range from 0.0064 kWh/GB to 136 kWh/GB due to factors such as the location of the servers. This study follows Costernaro and Duer's (2012) estimate of 5.12 kWh/GB as their study is based on an analysis of all subcomponents related to data consumption such as data servers and device specifications.

The participants of this study are based in Denmark, meaning that the Danish CO2 emissions per kWh is applied, which is 135 grams of CO2/kWh (Energinet, 2020). This leads to the equation:

135g CO2/kWh x 5,12kWh/GB = 691,2 CO2/GB

Participant i is, as calculated above, responsible for the emission of 7554,8 grams of CO2 throughout the data tracking period of one week.

10,93 GB used x 691,2 grams of CO2/GB = 7554,8 g/CO2

In 2019 the emission per km by car was 122,4 (European Commission, n.d.), which is used to demonstrate how many kilometres can be driven for the same amount of CO2 emission. This results in 61,72 km.

7554,8 g/CO2 / 122,4 g CO2/km = 61,7 km

Ethical considerations

The nature of this research is very privacy-sensitive for the participants as it involves them giving insight into their online behaviour. Based on the pilot project, the decision is made to only track phones and not computers as well, as the participants mentioned that it would infringe too much on their privacy. Before participating, a consent-form is signed, where the participants are informed about the research, how the data is used, and that they have the freedom to withdraw at any moment. Permission to record the interviews for transcribing is asked before the interviews commenced, and their data is used anonymously.

RESULTS

Knowledge & insights

The quiz has 76 responses after one month, where the average of correct answers is 2,5 out of 7 possible. Two of the questions (see figure 4, for question 1 and 2), share the highest amount of correct answers, namely 40 - equal to 52,6%. On the other side, scoring only 10,5% correct answers is question number 3 (see figure 4). Participant E interprets the response pattern:

"*I could imagine that people answer incorrectly because you have the other questions where you are being completely surprised and think this must be a high number as well. [...] And then because you do not have any knowledge, so I have for example just guessed*" (translated from Danish).

The quote shows that some of the participants' own interpretations point to an essential element, stating that there is a knowledge gap in society. This is visible as the participant is influenced by the high numbers of the previous questions, and the numbers are intangible, causing some participants to guess their way through the quiz.

In relation to their own data plan, the majority of participants currently have no insights into how much they have available. Some have their contract through a company or family deal and therefore, do not have to worry about the bill, others are simply not aware of the amount of GB they have available each month.

To the question "Do you have a general overview of your mobile data plan?", participant C answers

"*Yes and no […], It means that my parents pay. Then it just works, and it is all fine, but yes, then I know I have enough*" (translated from Danish).

This quote illustrates that data is to some just always there, meaning that they do not have to worry about having enough data at hand, as it has become an easily accessible resource, which works at all times. Several of the participants did not seem to distinguish clearly between GB and MB. This can be a result of a general unawareness on how to calculate once's consumption.

Question 1

"The movie 'Birdbox', which was a hit on Netflix in 2018, got over 80 million views. This equals to the emission of 66,2 million kg of co2. To drive a car back and forth between which two cities 38,879 times would cause approximately the same emissions?"

Question 2

"The news magazine 'Ingeniørens' research on internet usage, shows that under normal circumstances, it is impossible to use more than this number of Megabytes per second on the internet at home?"

Question 3

"How much data do you use per hour during a high quality 1:1 Zoom meeting?"

Figure 4: three questions of the quiz

Data Plan

More than half of the participants are unaware of their current mobile data plan. Where some have their mobile through a company or family deal and do not have to worry about the bill, others are simply not aware of the amount of GB they have available each month. To the question "Do you have a general overview of your mobile data plan?", participant C answers:

"*Yes and no […], It means that my parents pay. Then it just works, and it is all fine, but yes, then I know I have enough*" (translated from Danish).

This quote illustrates that data is to some just always there, meaning that they do not have to worry about having enough data at hand, as it has become an easily accessible resource, which works at all times. Furthermore, several of the participants do not know the difference between GB and MB, which exemplifies a lack of knowledge within the technical part of the field.

Participant's sustainable behaviour

When asked if sustainability or other environmental When asked if sustainability or other environmental thoughts play a role in the participants' daily life, a majority points toward sorting of waste. Some participants limit their interest in sustainability to what is required, whereas others want to do more. Tendencies when shopping repeatedly occurred such as 'shopping with my own reusable bag', 'buying food with a short expiration date to avoid it being thrown out', 'choosing local or Danish products rather than international' or 'avoiding products with too much plastic packaging'. Avoiding single-use items, in general, is also brought forth as a way to limit the use of plastic.

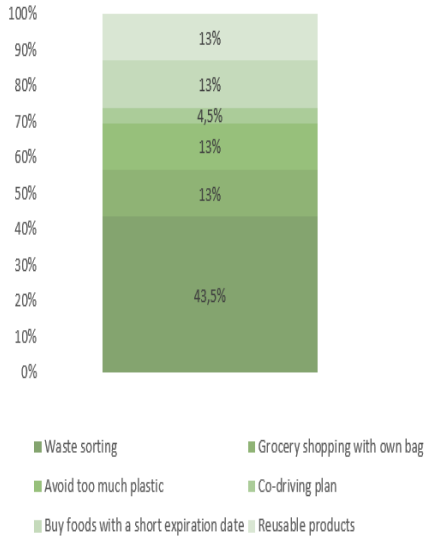

Figure 5: The distribution of sustainability actions in the participants' daily life

Participant's data consumption

The previous section shows that, based on the quiz, the majority of people were unaware of the emissions related to data consumption. When asking the participants how they did on the quiz, some of the participants answered that they found it challenging to answer because the emissions related to data usage are not concrete or tangible. Participant J claims that:
"*It is because people are uneducated. I mean, people are not informed about it. (...) It is just a part of our daily life just like everything else. It is just something we don't seek information about*" (translated from Danish).

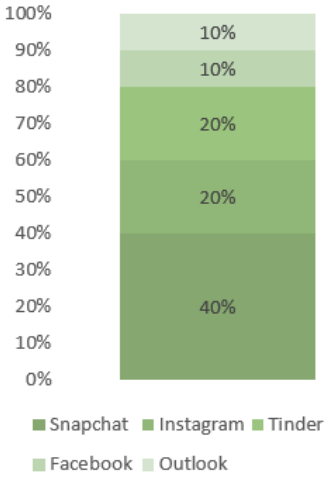

Figure 6: the expected distribution of data usage between participant J's top 5 apps; Snapchat (1), Instagram (2), Tinder (3), Facebook (4), Outlook (5).

For one participant, the question about the emissions related to thank you emails made data usage related emissions more tangible. For six other participants, this question was the one that stuck the most to them when asked if they were surprised by any facts they learned from the quiz.
Due to the intangible aspect of this topic, the participants are asked to estimate their top five apps (in relative percentages) they use in a week and the number of round trips they could drive on the emissions they emit via consuming data. The majority of participants are surprised about their data consumption when shown their real consumption compared to their estimation. Especially the amount of data consumed by social media in relation to their overall consumption.
"*I think it is shocking that I use Instagram so much when I self-thought 20%, and then I use 66%*", participant J (translated from Danish).

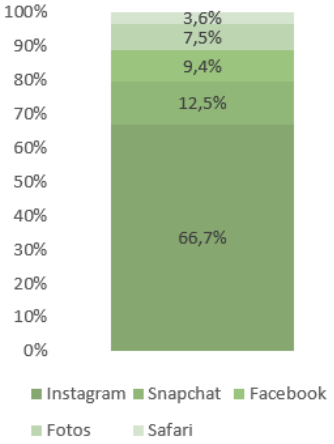

Figure 7: the actual distribution of data usage between participant J's top 5 apps; Instagram (1), Snapchat (2), Facebook (3), Photos (4), Safari (5).

As illustrated below, none of the participants guessed the correct order of all 5 apps. In addition, 5 participants did not guess any apps correct in the ranking. All 16 participants were correct in at least one app being in their top 5.

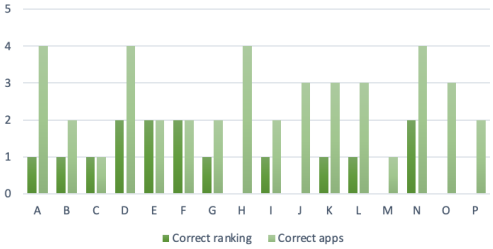

Figure 8: an overview of the participants' correct top 5 apps and ranking.

In terms of the numbers of roundtrips they had to guess, all the participants overestimated the number of roundtrips they can travel. Mostly due to a common misconception of the amount of CO2 emissions related to car travel and data consumption. Similarly, to the quote of participant J regarding people being "uneducated".
"With some of the first questions I thought, 'wow is it that high?' So, then you automatically think that the others have to be like that too" Participant E (translated from Danish)

In total, the participants used 85,92 GB of data on their phone during their data collecting period. This data consumption equals 59.388 KG of CO2 emitted, which is equal to the CO2 emission from driving 485 km (calculated from the average emission of new cars registered between 2015-2019 in EU).

Making emissions tangible

Through the project, it has become clear that the effect of data on the environment is challenging to comprehend. Therefore, the participants are asked to give their perspective on how to visualise data consumption effects on the environment.

Figure 9: Participant K's interpretation of how the visualisation could look.

A majority independently states that it needs to be visualised by comparing it to everyday things, such as washing clothes and driving to make it easier for citizens to process. Furthermore, some of the participants suggest that platforms like YouTube and Netflix should make people more aware of how much their streaming is polluting, by, for example, informing the users before starting the video, or lowering the quality by default. The following figure shows how participant K imagines it can be visualised, where a 'Data News' app can provide information about data usage, as well as comparing to other users and provide challenges between friends.

Casual Scrolling

One of the aims of this research is to map the online behaviour of the participants. So far, this research has identified tendencies and reasoning of the participants in how they grasp the cost of digital life. However, how are the participants using their phones and for what? For most participants, their phones, or the internet in general, is a tool mainly for leisure, but also work and school. In terms of leisure, social media stuck out as the primary answer, together with streaming. Social media is often named as a way to stay in contact with friends, stay updated about friends and the world in general, but also as a pastime, or more specific to kill time through "*Casual Scrolling*", person B (translated from Danish). When showcasing their real data consumption vs what the participants in reality used, six participants forgot to mention background apps such as Spotify and podcast apps.

"I can see it is very different (the chart). I did not think Spotify would be one, because it just always in the background", Person O, (translated from Danish)

Many of the participants were surprised about their data consumption, their app use, or in general about the facts presented in the quiz. Despite this, many of the participants mentioned that they would not change their behaviour. Some mentioned that they feel they do not use that much data compared to others, and some claims it is too ingrained in their behaviour or do not know how to change.

"I have actually been thinking about it since I started participating in this project. I think about how much you use your phone. Somehow, I think about it but I just grab my phone by instinct I don't think about it I grab my phone and then I think fuck and put it away and do it again later.", Participant I

Despite the majority of participants not changing their behaviour, some participants claimed they would change both personal habits as well as in the workplace, coming with their own ideas. Participants M and N both send less "thank you emails" at work. Participant M proposes that writing "thank you in advance", deleting the email signature, and have more physical invitations and thank-yous might reduce the number of emails sent or data per email. On the question "do you have an idea on how you can cut down on your internet usage", participants tend to suggest personal habits to be the best way to cut down on internet usage, such as cutting the streaming quality or spending more time in nature. Others suggested activities with others to cut down, watching movies more together rather than alone. While others suggest more technical tips like turn off background data or using flight mode at night.

Overall, the participants are willing to talk to people about the cost of digital life if it occurred naturally in a conversation. The participants not telling about this issue mainly address their limited knowledge on the topic as a reason not to talk about it.

DISCUSSION

Widdicks et. al., (2019) argue that the most internet-demanding activity in the house is streaming (video-streaming is estimated at around 50% of all peak data traffic), which shows another side of the data usage than this paper presents. However, it can be argued that data usage standards follow a cornucopian paradigm of the resources not being rationalised, resulting in a growth in internet infrastructure caused by an increase in streaming (Widdicks, et. Al., 2019). Furthermore, this paper is also limited to collecting quantitative data by tracking smartphones, causing an unreported number of data being utilised through computers, tablets, consoles etc. This limitation is directly connected to the ethical considerations, where participants of the pilot all claimed that tracking their computer or other units would be infringing too much in their private lives. As pointed out by several participants throughout the project, many find the data hard to comprehend due to a lack of knowledge in the field. As a result, many of the participants will not change their online behaviour. This is a trend that is seen in other sustainability topics as well, such as wasting food. People underestimate the amount of wasted food, and consequently, the personal impact they have on the environment leading to

less motivation to reduce their food waste (Geffen, Herpen, & Trijp, 2019). On the other hand, the participants are very keen on sorting their waste, which often is promoted and enhanced by municipalities through extensive information campaigns. This underlines the need for this research as it shows that lack of problem awareness reduces the success rate of SDG 13, climate action which can be solved by informing citizens with information understandable to them.

Previous behavioural designs suggest nudging the streaming-consumers in the right direction by e.g. addressing binge-watching tendencies by removing video 'auto-play' and using fixed-access networks to pre- downloading video for mobile consumption (Widdicks, et. al., 2019). These suggestions were raised by some of the participants as well. One participant specifically mentioned that he listens to music on YouTube, however, that there is no option to just listen. Instead, a video is running in the background leading to unnecessary data usage. Another quiz participant suggested that streaming services should give the option to watch series and films offline for users to reduce their internet consumption.

(Widdicks, et. al., 2019)

A tendency occurring when undertaking the second round of interviews is the participants being surprised about their top 5 data consuming apps, often annoyed that they forgot a music or streaming app which usually runs in the background. In line with Widdicks et. al., (2019)'s argument that our community designs for more engagement, which often leads to an increase in data demand. Whereas this paper shifts the focus from what companies or organisations can do to address the problem to how the average consumer can be educated on the topic. It is important to underline that the responsibility is neither on only the organisations or the citizens, however, both may be expected to take responsibility according to the un SDGs.

Working towards level 3 of Hacklay's theory on CS, this project does not succeed in engaging the citizens in the problem formulating process. As stated earlier, the lack of knowledge creates a barrier as citizens may not see their digital behaviour, such as Casual Scrolling, as a damaging habit. It can be argued that the problem would not be suggested due to the citizens' unawareness of the problem, meaning the project not being able to reach level 3 of CS. However, as Hackley argues there "*shouldn't be a strong value judgement on the position that a specific project takes*", meaning that a project should not be frowned upon if not suggested by citizens or if not, full citizen engagement is achieved (Haklay, 2018). On the other hand, it can be argued that a project following this may see this paper as a pilot, and follow up on the citizens' suggestions, making them participate in the problem formulating process in the next project.

CONCLUSIONS

The aim of this research was to map the online behaviour of the participants and to create an understanding of how citizens should be approached when addressing this issue. Based on the project, it can be concluded that understanding the cost of digital life can be intangible. Therefore, there is a knowledge gap in this field which is hindering citizens in both comprehending the information but also in seeking more information. In order to change this, the project has made it clear, based on the participants' perspective, that the cost of digital life should be visualised, where it is compared with the emission of everyday activities. Thereby it makes it more understandable for citizens. By doing so, it can be assumed that an introduction of the information via visualisation, to children early at school or educating adults through campaigns or exhibitions, may bring benefits with them and motivate them to change behaviour. However, several participants reject a direct behaviour change based on an idea that others have a bigger consumption and more polluting online habits. This creates the foundation for an argument stating that 'I am not as bad as others. Despite this argument, some of the participants have made a change in both personal habits as well as in the workplace. It can be concluded that a change in behaviour is obtainable if the right information is presented as well as the citizen is in the right state of mind at that moment. To increase the possibility of a deep-rooted behavioural change at larger scale, it is recommended to incorporate tangible visualisations. Furthermore, through the concept of "Casual Scrolling", coined by participant B, the online behaviour of the participants was better understood, which allows future research to investigate this phenomenon more specifically.

To make a CS project reach level 4 of Hacklay's theory, the problem definition must be defined by the participants. Due to how intangible the cost of digital life is, it is found hard to obtain this. By using CS, it enables the project to reveal the participants' needs, and thereby making a behavioural change more realistic.

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REFERENCES

Coroama, V., & Hilty, L. (2014, February). Assessing Internet energy intensity: A review of methods and results. *Environmental Impact Assessment Review*, pp. 63-68.

Costenaro, D., & Duer, A. (2012). The Megawatts behind Your Megabytes: Going from Data-Center to Desktop. *ACEEE Summer Study on Energy Efficiency in Buildings*, pp. 65-76.

Curtis, V. (2015). Motivation to Participate in an Online Citizen Science Game: A Study of Foldit. *Science Communication*, pp. 723–746.

Energinet. (2020, June 15). *Miljørapport 2020*. Retrieved from Energinet: https://energinet.dk/Om-publikationer/Publikationer/Miljoerapport-2020

European Commission. (n.d.). *Reducing CO2 emissions from passenger cars - before 2020*. Retrieved August 2020, from European Commission: https://ec.europa.eu/clima/policies/transport/vehicles/cars_en?fbclid=IwAR3uGMGzAjdF9xXTxKJeGBDd1_UeZHqReU3BGzlOQ236zV2FTA0Cg-UXeMo#:~:text=Following%20a%20phase%20in%20from,l%2F100%20km%20of%20diesel

Forsberg, C., & TV 2 Branded Content. (2019, December 7). *Familie lever bæredygtigt: - Vi har sjældent behov for nyt*. Retrieved from TV2: https://livsstil.tv2.dk/bolig/2019-12-07-familie-lever-baeredygtigt-vi-har-sjaeldent-behov-for-nyt

Geffen, L., Herpen, E., & Trijp, H. (2019, September 4).

Household Food Waste—How to Avoid It? An Integrative Review. *Food Waste Management*, pp. 27-55.

Haklay, M. (2013). Citizen Science and Volunteered Geographic Information: Overview and Typology of Participation. In D. Sui, S. Elwood, & M. Goodchild, *Crowdsourcing Geographic Knowledge. Volunteered Geographic Information (VGI) in Theory and Practice* (pp. 105-122). Dordrecht: Spring.

Haklay, M. (2018). Participatory citizen science. In S. Hecker, M. Haklay, A. Bowser, Z. Makuch, J. Vogel, & A. Bonn, *Citizen Science. Innovation in Open Science, Society and Policy* (pp. 52-62). London: UCL Press.

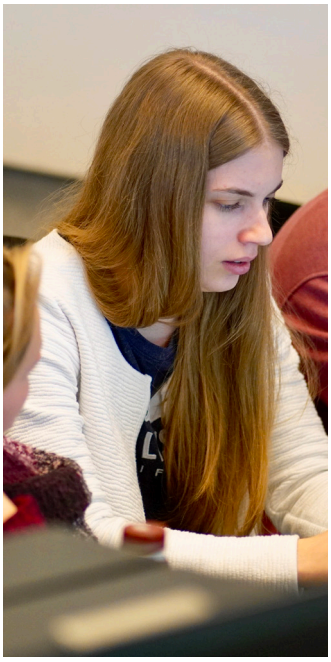
Hecker, S., Haklay, M., Bowser, A., Makuch, Z., Vogel, J., & Bonn, A. (2018). Innovation in open science, society and policy – setting the agenda for citizen science. In S. Hecker, M. Haklay, A. Bowser, Z. Makuch, J. Vogel, & A. Bonn, *Citizen Science. Innovation in Open Science, Society and Policy* (pp. 1-23). London: UCL Press.

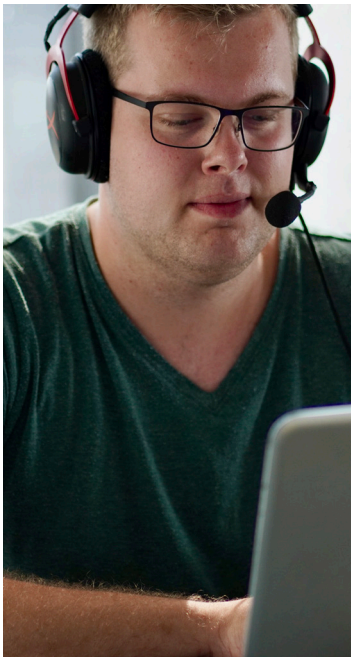
Riesch, H. (2015). Citizen Science. In J. D. Wright, *International Encyclopedia of the Social & Behavioral Sciences* (pp. 631-636). London: Elsevier.

Robinson, L., Cawthray, J., West, S., Bonn, A., & Ansine, J. (2018). Ten principles of citizen science. In S. Hecker, M. Haklay, A. Bowser, Z. Makuch, J. Vogel, & A. Bonn, *Citizen Science: Innovation in Open Science, Society and Policy* (pp. 27-40). London: UCL Press.

United Nations. (n.d.). *History*. Retrieved August 2020, from Department of Economic and Social Affairs Sustainable Development: https://sdgs.un.org/goals

Widdicks, K., Hazas, M., Bates, O., & Friday, A. (2019, May). Streaming, Multi-Screens and YouTube: The New (Unsustainable) Ways of Watching in the Home. *Association for Computing Machinery*, pp. 1-25.





IDENTIFYING POWER CONSUMPTION AND FACTORS OF SUSTAINABILITY - A CITIZEN SCIENCE PROJECT

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ABSTRACT

The following paper investigates the energy consumption patterns of German and Danish households and the potential risk of a re-bound effect in the use of LEDs. The research, thereby, combines both qualitative and quantitative data from a total of 21 participants, following the approach of citizen involvement. It is found out, that a great majority of citizens highly values energy-efficiency and is motivated by economic, environmental, and psychological factors as well as by convenience. However, citizens using LEDs tend to be keep their lights switched on for slightly longer, indicating a possible re-bound effect of this new technology. The paper is an important contribution to the rather young discipline of citizen science, as it shows how environmental and societal change can be brought forward through the involvement of citizens. For future research it is, therefore, suggested to include a higher number of participants in the scientific process.

KEYWORDS:

Mapping power consumption, Citizen Science, Factors for sustainability, Rebound effect

INTRODUCTION

With the ongoing development of climate change and its consequences, such as global warming and rising sea-levels, our society is facing one of the greatest challenges in human history (EEA, 2020). Today, there is no doubt that climate change is human-induced and especially triggered by the production of greenhouse gas emissions (UNFCC, 1997). There is a widely accepted consensus among scientists that one of the most important sources of greenhouse gas emissions is the creation of power and electricity, which count for about 25% of the total emissions (EPA, 2020).

Statistics show, that in almost all Western societies, the consumption of electricity has been increasing over the past years. Looking at Denmark as a case study, it becomes further apparent, that while the electricity price has stayed on a rather stable level since 2015, the costs for lighting equipment have continuously been going up since then (Danmark Statistik, 2020).

Yet, a further investigation of various light sources is needed, to highlight the differences in both price and energy efficiency. An analysis of the most common light bulbs (Incandescent, Fluorescent, Halogen, and LED) reveals that LEDs are the most power-efficient and environmentally friendly ones. Hence, not only energy but also money can be saved with the installation of LEDs, despite a relatively higher investment cost compared to Fluorescents (Greater CEA, 2020).

Nevertheless, from previous studies it is known, that new technologies often cause a so-called “rebound effect”, which is a decrease in expected benefits from new technologies that originally raise resource efficiency, due to behavioural changes (Hertwich, 2005). An example of this could be the way, in which advancements in fuel efficiency have made driving cheaper, leading to citizens driving more and having bigger chars. Currently, the role of different factors influencing the energy consumption patterns of Danish and German citizens and a possible “rebound effect” connected to LEDs is still a rather underdeveloped topic. Hence, our study focuses on the following questions:

1. What are the factors, that are influencing the energy consumption of Danish and German citizens?
2. Is there a rebound effect visible, when looking at the electricity consumption and use of LEDs of Danish and German citizens?

METHODS

The following research is built on a citizen science approach, in which citizens have been included at different stages throughout the projects’ processes. Repeated participation was desired, as it strengthens the “sense of ownership” of the citizens and contributes by focusing on local knowledge and expertise (Hecker et al., 2018).

The first dialog

We established the first dialogue with six citizens through individual, unstructured interviews (Flick et al., 2007) in which the citizens could share their insights and their thoughts on power consumption and electricity. The citizens were part of the personal network of the researchers and were selected based on their nationality (German or Danish) and their interest in the topic. It was aimed to conduct all interviews in person, however, due to current restrictions, parts of them needed to take place online. The focus of the dialogue was to find out about what the citizens used their electricity on, what motivated or would motivate them to be more power-efficient as well as what information they were curious on getting collected in the project. Hence, the creation of new knowledge and learning outcomes for both citizens and scientists was followed as a

guiding principle (Hecker et al., 2018). This qualitative data was then used for the formation of the questionnaire (see below).

The Warm-up exercise

One part of the citizen's interaction with the project has been a warm-up exercise, in which the citizens moved around their house and collected data on how many light bulbs they had, and what kind of light bulb it was (LED, halogen, fluorescent, CFL or incandescent). The goal of the warm-up exercise was to engage and motivate citizens to fill out the main questionnaire and collect quantitative data on citizens collection of lightbulbs and its diversity through a small questionnaire (Simonsen & Robertson, 2012).

The Questionnaire

Based on the insights collected from the six interviews, a questionnaire was created through the approach of participatory design. Hence, the citizens and the researchers worked together through several feedback-rounds and evaluations of different ideas (Simonsen & Robertson, 2012). The questionnaire was anonymous with an option to fill in personal contact information to be part of a follow-up dialogue (see below). The questionnaire was based on 21 qualitative and quantitative questions, which can be split up in the four categories demographic, living situation, pattern in power consumption, and opinion on power efficiency. The questionnaire has been shared on social media, such as Facebook, through Facebook groups with similar interest to the project, and through the author's social network. This approach resulted in 21 citizens filling out questionnaires. For sample see table 1.

Table 1: Democratic distribution of citizens participating in the questionnaire

	Participant	Nationality	Gender	Age group
2	A	Danish	Male	20-29
3	B	Danish	Male	20-29
4	C	Danish	Male	20-29
5	D	German	Female	20-29
6	E	German	Male	20-29
7	F	German	Female	20-29
8	G	Italian	Male	20-29
9	H	Dutch	Female	20-29
10	I	Danish	Female	20-29
11	J	South Africa	Female	20-29
12	K	Danish	Male	50-59
13	L	Hungarian/R	Female	20-29
14	M	Danish	/	40-49
15	N	Danish	Male	> 19
16	O	Danish	Male	20-29
17	P	Danish	Male	20-29
18	Q	Danish	Male	20-29
19	R	Danish	Male	20-29
20	S	Danish	Male	20-29
21	T	German	Male	20-29
22	U	Geman	Male	20-29

The second dialogue

To get a clearer insight into the data from the questionnaire, the second round of semi-structured interviews was launched, in which two of the participants from the first dialogue participated (Flick et al., 2007). The interviews focused on sharing the findings of the questionnaire as well as collecting qualitative data on how the citizens identified with the data and the citizens' insights on the reasoning behind the choices on the questionnaire. Hereby, a two-way feedback loop between the researchers and the citizens was established not only to discuss the scientific outcomes in more detail but also to strengthen their personal relationship (Hecker et al., 2018).

Likert Scale

To measure attitudes, opinions and perceptions in the questionnaire of the citizens, we used a rating system, defined as Likert Scale (2020). By converting qualitative data into quantitative values, the data can be used for statistical analysis (Norman, 2010).

DATA ANALYSIS AND RESULTS

Light bulbs overview and reason why

Energy efficiency is important to 90,5% of the citizens. This attitude is confirmed by the preference of buying LED light bulbs. As shown in Figure 1, 53% of the citizens caring about energy efficiency prefer LED light bulbs and 5% Halogen.

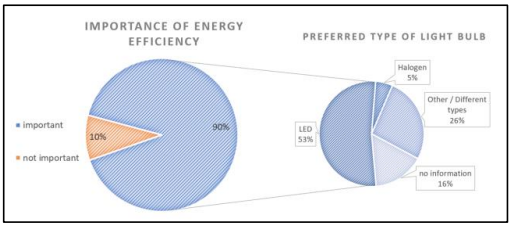


Figure 1: Importance of Energy efficiency and preferred type of light bulb

The factors for buying a specific type of lightbulbs can be clustered into six groups: efficiency (38%), lifetime (19%), light quality / aesthetic (19%), cost (10%), smartness (10%) and availability (10%), whereas multiple answers have been considered.

In addition to that, the highlighted preference of energy-efficient light bulbs is also represented in the used lightbulbs by the citizens. In total, the citizens most commonly use LED and Halogen light bulbs for their homes. For the analysis, two participants were disregarded (P14 & P16), due to inadequate data, resulting in 18 citizens counted for the exercise in total. From all lamps counted 47% are LED and 31% are Halogen light bulbs. Compared to that Incandescent (7%), Fluorescent (8%) and CFL (3%) lightbulbs are outnumbered. An overview of the counted light bulbs and percentages of the different types used are represented in Table 2.

Fehler! Verweisquelle konnte nicht gefunden werden.

Legend:	
	highest percentage (TOTAL)
	number of light bulbs not identified
	>75% of one type
	>50% not identified

Table 2: Overview of counted light bulbs from the warmup exercise

On the right sight, highlighted in light grey, not identified light bulbs are calculated. In total, most of the light bulbs could be identified by the citizens. However, if citizens had problems with the identification, the amount accounts for a great part of the total number of lightbulbs used. For example, participant 12 (P12) was not able to identify 89% of the light bulbs used at home.

Life expectancy

Besides that, the preference of branded or unbranded light bulbs is analysed. 73% of the citizens responsible for buying light bulbs for their homes stated that they don't follow a specific pattern. The rest of the citizens is equally separated between buying branded or unbranded ones. Price, convenience and quality are here the main factors.
Contrary to that, the perception of the lifetime of lightbulbs differs among the citizens. In total, 38% perceive lightbulbs to last between one and three years, followed by 29% between three and five years. 14% perceive light bulbs to last more than five years. Only 5% perceive their light bulbs to last less than one year.
Looking at the perceived lifetime in relation to the preference of branded or unbranded lightbulbs, there is no direct connection visible according to Table 3.

Table 3: Correlation of preferred type of light bulbs and perceived lifetime

Preferred lightbulbs	Perceived lifetime	Reasons
known brands	3-5y	Reliability
known brands	<1y	Credibility
known brands	>5	better quality
ø known	~3years	
unknown brands	1-3y	Convenience
unknown brands	3-5y	cheaper
ø unknown	~3years	

Sustainable actions

To analyze the scale measurements of the questionnaire, the qualitative data was translated into numbers using the method of the so-called Likert scale. The scale values have been rated from 1 to 4. Invalid answers have been considered with 0. For each measure the sum of all responses was calculated and converted into a percentage using Equation 1.

$$\frac{Sum\ per\ efficiency\ measure}{Total\ number\ of\ participants * Max.possible\ value}$$

Equation 1: Calculating scale measures based on the Likert Scale

For the importance of energy-efficiency measures the minimal value 1 corresponds to the answer 'not at all important' and the maximum value 4 to 'very important'. An example of the mentioned percentual calculation is shown below in Equation 2.

$$\frac{\sum_{P21}^{P1} Higher\ energy\ prices}{(21 * 4)} = \frac{60}{84} = 71\%$$

Equation 2: Example of calculating scale measures with higher energy prices

The overall distribution of the importance of energy efficiency measures is shown in Figure 2.

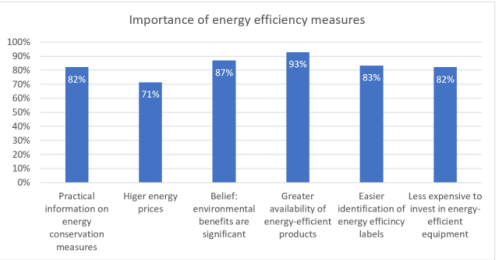


Figure 2: Importance of energy efficiency measures

Likewise, the performance of daily activities to reduce energy consumption is rated from 1 for never to 4 corresponding to always. The percentual distribution of the performance measures are shown in Figure 3.

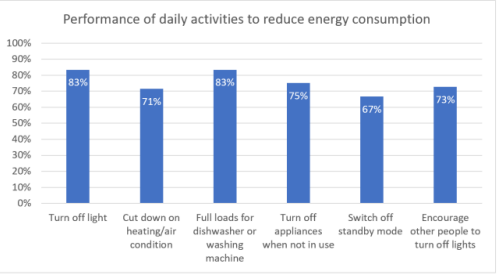


Figure 3: Performance of daily activities to reduce energy consumption

Rebound effect

As a potential measure for the rebound effect based on Schleich et. al. (2014) the different patterns of switching of the lights when leaving a room are analyzed based on the preferred type of light bulbs. However, there is no significant difference as shown in Figure 4.

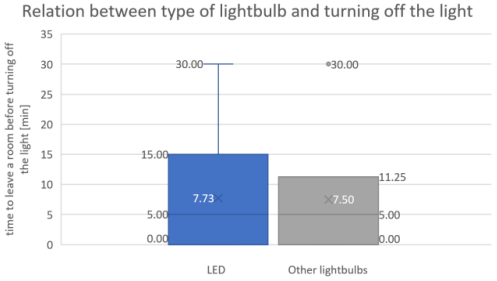


Figure 4: Statistical analysis of the relation between preferred type of lightbulb and time to leave a room before turning of the light

A small tendency of citizens who prefer LEDs are more wasteful with energy is indicated- having to leave the room for a longer time before turning off the lights (LED: >7.73min / Other: >7.50min). The motivational factors for turning off the lights can be clustered into 3 categories: saving energy/reducing consumption, cost and mindset. For the mindset different answers were clustered together, e.g. *"There is no reason to have lights on in rooms that aren't in use"* or *"it feels stupid and wasteful"*.

In addition to that, external measures for the rebound effect are shown in one of the second dialogues: e.g. spending the money saved by using energy-efficient lightbulbs for other assets.

DISCUSSION

Light bulb diversity

The data of table 2 indicates, that 47% of all lightbulbs, which have been counted by our participants, are LEDs. The reasoning for this result can be explained by figure 1. Figure 1 indicates that 90% of the citizens identify with the statement, that it is important for them to be power-efficient. Based on the second dialogue, this number would be even higher, if the citizens had a larger income, as the reason, why some citizens claimed that they did not agree with the statement, was based on the fact, that they did not feel that they had the resources to make a change as well as that their change would not have an effect on a larger scale. Furthermore, the high percentage of LEDs can be explained by the data, which indicates, that six factors are influencing the consumers' decision on lightbulbs, where the three major factors (efficiency, burn time, light quality/aesthetics) make up 70% of the decision matches with the qualities LEDs offer.

Correlation between branded lightbulb & perceived burn time

When citizens were asked about, if they follow a specific pattern of buying branded or not branded lightbulbs, the majority answered, that they did not follow a specific pattern. Yet, when participants were asked about the reason behind their choice, the same six factors mentioned in the section above emerged again as well as two new factors: credibility and convenience. Prior research indicates, that branded lightbulbs have a longer burn time, yet, the data collected in table 3, indicates that the participants, who bought the branded ones, had the perception that the light bulbs had a shorter lifespan compared to what other citizens, who bought unbranded lightbulbs. This indicates that there is no correlation between citizens' perception of branded and not-branded lightbulbs regarding their burn time.
Four Factors for being power efficient have been identified: *economic*, *environmental* and *a mental state of mind that its bad to be wasteful* and *convenience.* The *economic* factors' influence can be seen in the data as indicating the electricity price but also the expense of buying more power-efficient tools (figure 2). This can be supported by the six influential factors when buying lightbulbs. Prior studies, such as Schleich et. al. (2014) indicate that the biggest barrier created when switching to a more power-efficient technology, such as going from Incandescent light bulbs to LEDs is the economic expense. The e*nvironmental* factor indicates that citizens are aware of their effect on the climate. The importance of this factor can be seen in figure 1 as well as figure 2, where 87% of the citizens agreed with the statement that knowing that the environmental benefits are significant was important for being power-efficient. *The state of mind; that it is bad to be wasteful* is noticeable in the qualitative dataset. In the questionnaire, this factor can also be supported by the qualitative data collected in the second dialog where a citizen stated - "*It annoys me If I get home and I notice that I forgot to turn off the light. It's just waste then, I could have used the energy on something else."* Based on the actions evaluated in figure 3 and the importance of the evaluation in figure 2, a pattern of c*onvenience* emerges. An example of this could be that activities that do not require extra work, such as only using the dishwasher when it has a full load, seem more appealing compared to having activities, which require extra work compared to the alternative. An example could be turning off the TV on the outlet and not on the remote/standby function, which is more tedious. This c*onvenience* factor also emerged when citizens are making choices on buying lightbulbs; they buy the lightbulbs that the shops have in stock because of convenience.
The evidence of the rebound effect cannot be proven through our study. As the main measure, the relation between the preferred lightbulb type and the behavior in turning off the light was investigated. The results show a minimal difference, indicating that citizens preferring energy-efficient lightbulbs are more wasteful. Based on that, there Is a tendency of an existing rebound effect in this study. However, the difference Is not significant. A larger study would be beneficial to prove this tendency either correct or wrong.
Furthermore, a direct link between the warm-up exercise and the questionnaire could have helped to identify and proof the rebound effect. This connection would allow additional measures of the rebound effect. For example, the number of light bulbs per square meter could be used to identify If citizens with more energy-efficient lightbulbs have proportionally more lightbulbs. Furthermore, the identified motivational factors for turning off the lights could indicate measures for or impacts on the rebound effect and could be elaborated further in a larger study.

Limitations of the study

Our study revealed important, new insights into the energy consumption patterns of Danish and German citizens and their use and perception of LEDs. Nevertheless, the practice of citizen science is – like any other scientific discipline – not free from biases (Heckert et al., 2018). Hence, these findings need to be seen in light of some limitations.

Sample size: Our sample consists of only 17 citizens. Therefore, it is hard to derive general patterns from the data we collected, and findings are only limited representative. Our initial goal was to reach a number of 50-100 participants; however, this was not possible because of the low response rate of the citizens. For future research, we suggest including a bigger sample of >100 to generate data, that is more representative.

Sample profile: Our sample profile is skewed both towards male participants as well as to young participants (in the age range of 20-29). Hence, it does not represent a real picture of the Danish or German society. However, for a follow-up study, it is suggested to include a more diverse sample.

Language proficiency: Next to the sample, also the language proficiency of both us, the researchers, as well as the participating citizens can be seen as a limiting factor. Hence, no party is an English native speaker and, therefore, there is the potential risk of a language barrier. For future research, it is recommended to conduct the study in the native language of both parties.

Citizen Science Approach: According to Haklays model on citizen science, our project reached the third level of citizen involvement – 'participatory science' (Heckert et al., 2018). Thus, we have not only included citizens in the problem definition through our first round of dialogues, in which participants were offered to share their ideas and interest on what the research should focus on and which habits they wanted to change but the data was also collected together with

the citizens. In general, the approach of citizen science was successful, however, we struggled with involving a greater number of participants. Only 21 citizens participated in the study and the majority of the participants were students in the age group 20-29. Not having more participants in other age groups has limited the data collection in regard to mapping power consumption as well as identifying what motivates citizens to be more power-efficient. This is, because the values and priorities differ from generation to generation as well as what state in life the citizens are In.

Nevertheless, the method of participatory science enabled us to have a proof of concept by the citizens, starting from the first draft of the questionnaire through the entire study up until the analysis of the results.

Additionally, by doing citizen science, we have the chance to bring forward environmental and societal changes, since the approach to be more energy-efficient originates from the citizens themselves rather than from us. The approach of citizens science has made it possible to teach citizens about power consumption and energy efficiency, which strengthens the chance of having an impact social and environmental factors but does also affect the research as by teaching we affect the participant which from a traditional research viewpoint can be seen as negative but from a citizen science viewpoint can be seen as a positive outcome. This idea is called "science literacy" and refers to the concept of "learning by doing". With regard to our project it implies that we are educating citizens by doing the questionnaire and the warm-up exercise, because they have to reflect on their behavior, opinions, and patterns (Snow & Dibner, 2016).

We expect that in future research with more participants and open data, citizens would also be more likely to accept the results and their consequences. This approach makes use of intrinsic motivational factors, which might enable the fourth level of citizen involvement according to Haklay in the following larger study. Nevertheless, through the cooperative analysis of the results with the citizens has made it possible to get an interpretation of the data by the citizens rather than just drawing conclusions. Overall, the study and results build a profound basis to engage citizens in research on sustainability as it highlights the value of this kind of participatory science. In future research, an approach that could be used to support the research by giving the participants smart lightbulbs which would promote interaction and thereby bring awareness to the citizens' power consumption as well as being a more convenient way on measuring power consumption as well as offer more data, which would make it possible to research the correlation between time and use of lightbulbs.

CONCLUSIONS

With the ongoing development of global climate change, it becomes increasingly important to live and consume more sustainably. In cooperation with 21 citizens from Denmark and Germany, energy consumption patterns of private households and the potential risk of a rebound effect with the use of LEDs has been researched. Thus, the study has led to four main findings: Firstly, nine out of ten citizens regard it as important to be energy-efficient and - going along with that - a majority (47%) of detected light sources in private households are LEDs. Secondly, it has been found out that the most influential motivations for being energy-efficient are economic, environmental and psychological reasons as well as convenience. Thirdly, there is no obvious correlation between the perceived life span of light bulbs and the factor, if they are branded or not. Hence, a great majority of citizens does not follow a specific consumption pattern. Finally, it has been detected that participants, who use LEDs in contrast to traditional lightbulbs have the tendency of leaving the light on for longer, indicating a possible rebound effect of the technology. Thus, this project is a successful example of how sustainable motivation and societal change can be brought forward by the involvement of citizens in scientific research, as their contributions build the core of this study. For future research it is suggested to include a higher number of citizens not only to generate more representative data but also to magnify the positive impact of the project for society and the environment.

REFERENCES

Danmark Statistik (2020), Link: http://www.dst.dk/forbrug, last accessed: 11.08.2020

European Environmental Agency (2020), Link: https://www.eea.europa.eu/themes/climate/climate-change-is-one-of, last accessed: 11.08.2020

Flick, U., Kvale, S., Angrosino, M. V., Barbour, R. S., Banks, M., Gibbs, G., & Rapley, T. (2007). *Doing interviews*.

Greater Cincinnati Energy Alliance (2020), Link: https://greatercea.org/lightbulb-efficiency-comparison-chart/, last accessed: 11.08.2020

Hecker, S., Haklay, M., Bowser, A., Makuch, Z., Vogel, J., & Bonn, A. (2018). *Innovation in open science, society and policy–setting the agenda for citizen science. Citizen science: innovation in open science, society and policy*. UCL Press, London, UK, 1-23.

Hertwich, E. G. (2005). *Consumption and the rebound effect: An industrial ecology perspective*. Journal of industrial ecology, 9(1-2), p.85-98.

Likert scale. (2020). In Encyclopædia Britannica. Retrieved from https://academic-eb-com.proxy1-bib.sdu.dk/levels/collegiate/article/Likert-scale/605393

Norman, G. (2010). *Likert scales, levels of measurement and the "laws" of statistics. Advances in health sciences education: theory and practice*, 15, p.625-632.

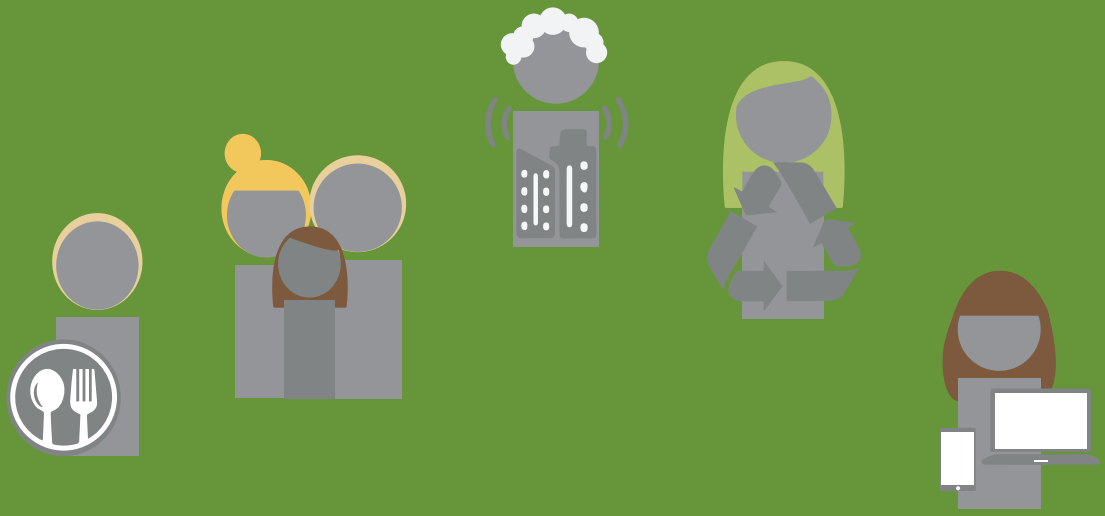
Schleich, J. Bradford, M. Dütschke, D. (2014). *A brighter future? Quantifying the rebound effect in energy efficient lighting*.

Simonsen, J., & Robertson, T. (Eds.). (2012). *Routledge international handbook of participatory design*. Routledge.

Snow, C. E., Dibner, K. A., National Academies of Sciences, Engineering, and Medicine, Education, Division of Behavioral and Social Sciences and, Education, B. o. S., Science, Committee on Science Literacy and Public Perception of, ... National Academies, National Academy of Medicine. (2016). *Science literacy: Concepts, contexts, and consequences.* Washington, D.C: National Academies Press. p.47-105

UNFCCC (1997). *Kyoto Protocol to the United Nations Framework Convention on Climate Change adopted at COP3 in Kyoto, Japan, on 11 December 1997.*


HUMAN
SUPER



EXPLORING CITIZEN SCIENCE - NINE TALENT STUDENT PROJECTS

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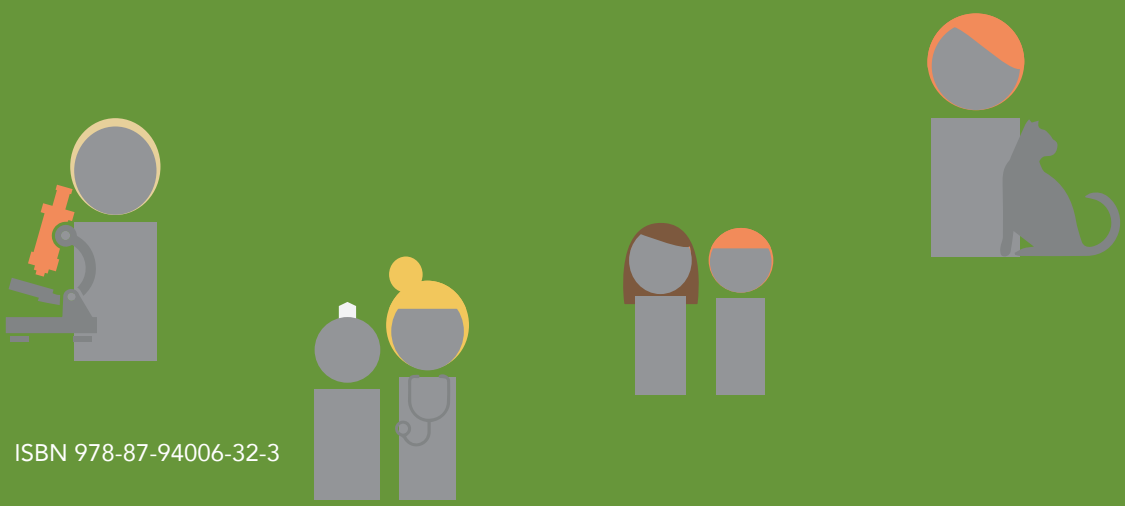

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