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Affordances and tensions in recording bird observations: how coordinators and volunteers perceive and experience citizen science in birding

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Abstract

Digital citizen science projects differ greatly in their goals and design. Tensions arise when coordinators' design choices and conceptions of citizen science conflict with users' motivations and expectations. In this paper, we use a combination of qualitative methods to gain new insights into the ways citizen science is understood and implemented digitally. This includes a study into the affordances of two citizen science portals for bird observations, and qualitative interviews with users and coordinators of the portals. This reveals tensions related to data sharing, community hierarchies, and communicated expectations. Awareness of these tensions can benefit the future design of online citizen science projects.

Keywords Citizen science; Public engagement with science and technology

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Introduction

1.1 Theoretical framework

Citizen science is increasingly practiced online. Thanks to technological developments, the public has the opportunity to share knowledge with each other and science through websites and mobile applications. These technologies have been embraced especially within biodiversity recording projects. Through websites and mobile applications such as eBird, iNaturalist or iSpot, thousands of citizens contribute nature observations for scientific use, utilizing the sensory abilities of these technologies, such as GPS and high-resolution cameras [Preece, 2016; Sharma et al., 2019; Skarlatidou et al., 2019].

Such media differ greatly in their design and the options that they offer users. This is in line with the wide variety of citizen science projects in general. As evident from categorizations of citizen science projects [Haklay, 2013; Shirk et al., 2012], projects vary greatly depending on the goals of the project, the moment of citizen

involvement or the level of engagement with users and the scientific community. Although such categorizations illustrate the diversity of citizen science projects, little attention has been paid to the way in which the design of digital portals reflect these differences reflect these differences and how the tools provided to citizens influence their participation and engagement. Designers of these media often focus on technical practicalities. However, these choices are not neutral but influence how users make use of the portals and their understanding of citizen science. For example, the design of a citizen science project guides citizen scientists into certain types of data collection [Brown and Williams, 2018; Houghton et al., 2019]. Within digital media studies it is widely studied how design choices guide users into certain actions. The concept of 'affordances' is especially relevant here. First conceptualized by Gibson [1997], affordances are defined as that which is 'afforded' to you by your environment. In his development of the concept, Gibson gives examples from our physical environment like water, fire, or places of shelter. We are given opportunities by these affordances, but we are also limited by the affordances available to us. Within digital media studies, these affordances have been thought of as functionalities and design choices. This can include submission fields, search options, menus or supportive texts. The concept helps to investigate how the design of a digital portal offers users certain opportunities but also limits how users use these media [Hutchby, 2001]. For example, mandatory fields force the user to provide relevant information, whereas users cannot share information for which no fields are provided. These choices are normative, as they reflect the purposes the designers behind the portal had in mind: "a site's design makes a normative claim about its purpose and appropriate use that both demonstrates an understanding of users and builds a set of possibilities into the object" [Stanfill, 2014, p. 1060]. Reminiscent of Foucault, Stanfill notes that in this sense affordances are also political. Power is provided to those in charge of design, deciding what practices are fostered or disallowed.

The concept of affordances helps to understand how users of citizen science portals are guided by the options provided to them. This is not only relevant from an academic perspective but will also make coordinators of citizen science portals aware how the portals' design can lead to tensions between the projects' goals and the use of the portal. As Dieter et al. [2019] note: "enquiries into interfaces can tell us not only about [digital media] but also about the expectations that those interfaces have of users and how certain ideas about users are designed into those [digital media]" [p. 4]. Previous studies into the design of citizen science portals have suggested that design choices are highly dependent on the intended data use [August et al., 2015; Houghton et al., 2019]. Affordances that stimulate data quality are often implemented, with little attention to how these implementations affect the users' understanding of citizen science. On the other hand, some design choices are made to increase engagement and retention of citizen scientists [Reeves et al., 2017; Tinati et al., 2015]. A design might then be based on knowledge about the motivations or behaviour of citizen scientists, leading to the integration of affordances such as discussion forums, rewards or rankings.

So far, studies into the design of citizen science portals have focused on the design of the portal itself, and have not thoroughly integrated the experience of users or the intentions of project coordinators into these studies [August et al., 2015; Gouveia et al., 2004; Reeves et al., 2017]. Studies into the experiences of citizen science projects have mostly focused on the motivations of and benefits for citizen

scientists [Ganzevoort, van den Born et al., 2017; Haywood, 2016; Wright et al., 2015]. Similarly, studies have focused on the role of project coordinators or designers [Tinati et al., 2015]. These previous studies have thus lacked a broader approach, where an analysis of the design of digital citizen science portals is combined with the perspectives of user and coordinators, with only limited studies attempting to take a wider perspective [Wiggins, 2013]. In this explorative study, an analysis of a portal's affordances is combined with the perspectives of users and coordinators. By taking this broader approach, this article aims to answer the following question: How do affordances available on online portals for bird observations help to understand how citizen science is perceived by portal coordinators and users? This question is divided into three sub-questions, as described in the methodological section of this article.

1.2 Case studies

In this qualitative study of citizen science portals, we will focus on the context of Dutch citizen science for bird observations. There is a long history of citizen science in the field of ornithology with many projects initiated and conducted by the public throughout the years [Greenwood, 2007]. Two portals have been chosen as case studies from the variety of birding portals available in the Netherlands. To be sensitive towards the aforementioned wide range of approaches to citizen science, two portals were chosen that are diverse in their origin and type of citizen science project. On the one hand a top-down portal was chosen: Avimap, the portal for the Breeding Bird Monitoring Project (BMP). This portal was founded by Sovon, the Dutch Centre for Field Ornithology. Sovon is a non-profit organisation that monitors, registers and studies the presence and development of wild bird populations in the Netherlands. BMP aims to monitor bird populations with the help of volunteers through the systematic mapping of breeding birds throughout the Netherlands. Avimap will be compared to bottom-up portal Waarneming.nl, founded in 2003 and managed by members of the birding community. Today, the portal is run by a small team of paid professionals and a large team of volunteers. The portal allows users to upload observations of birds as well as other nature observations. Most users register casual observations, which are openly accessible and made available for research or conservation efforts. In contrast to Sovon, Waarneming.nl profiles itself more as a service provided to individuals and organisations to register and share biodiversity observations.

These two portals take different places in citizen science categorisations such as those of Haklay [2013] and Shirk et al. [2012]. In Haklay's [2013] categorisation, BMP would be considered 'Distributed Intelligence', as volunteers collect data for a research question that is set by Sovon, rather than merely collecting data (crowdsourcing) or contributing to problem definition (participatory science) and/or analysis (extreme). However, Waarneming.nl cannot easily be categorised following Haklay [2013]. On the one hand it could be argued that Waarneming.nl does not meet the criteria of crowdsourcing as there is an emphasis on unsystematic collection of casual observations. On the other hand, the portal might exceed Haklay's levels as the portal was entirely initiated by the public who at times even contribute to analyses.[1] This level is more in line with Shirk et al.'s

[1] It is not uncommon for users of Waarneming.nl to conduct analyses of Waarneming.nl data and publish data in community driven publications or even (semi)scientific journals.

[2012] categorisation, in which Waarneming.nl would be considered a 'Collegial Project' where the public initiated the project and can advance scientific knowledge. BMP would rather be considered as a 'Contributory Project' as it was designed by scientists and the public contributes. In both these categorisations it is notable that BMP and Waarneming.nl can be placed on different levels, making them especially interesting for comparison.

Methods

This explorative study is grounded in digital media studies and the social sciences. Especially the combination of methods from digital media studies and ethnographic interviewing makes this an interdisciplinary project. To combine the results from these different methods, triangulation was used [Gray, 2014]. The study was divided into four phases that were conducted sequentially.

2.1 Phase 1: application of walkthrough method

The walkthrough method was developed by Light, Burgess and Duguay [2016] to study mobile applications and their affordances. The method focuses on specific themes grounded in Science and Technology Studies and Cultural Studies. In line with the aim of these fields, the themes in the walkthrough mostly focus on identifying power relations within technological products to identify what opportunities the technology provides to users and by whom. During this phase, a walkthrough of Waarneming.nl and Avimap took place. Although the walkthrough method was specifically designed for mobile applications, in this study it was also used to analyse the portals' webpages, as both the mobile applications and webpages of the given portals function in similar ways. The method was thus applied to Waarneming.nl and their Android application ObsMapp, and BMP's online portal Avimap and their Android application with the same name.[2] By applying this method to these portals, the first sub-question could be answered: what affordances are present on Dutch birding portals Avimap and Waarneming.nl?

The walkthrough consists of three steps that each include the analysis of texts, forms, menus and other affordances. First, the 'environment of expected use' is identified, which includes an analysis of the activities that the portals aim to provide, support and enable. Following this, the 'technical walkthrough' allows identification of characteristics that guide the users in their everyday use of the portal. In this study, everyday use was defined as the registering of observations, as this is the main function of both portals. Finally, 'discontinuation of use' is analysed, considering log-out procedures and removing user data.

2.2 Phase 2: interviews with users

Interviews with users were set up to answer the second sub-question: how do users make use of and perceive these affordances? Characteristics were identified

[2]The iOS versions of the mobile applications were not included in the analysis, as the iOS version of Avimap was not yet available at the start of this project. Additionally, the walkthrough was limited to the current version of Waarneming.nl. A significant number of observations are still uploaded through an older version of the site (accessible through old.waarneming.nl). However, as the main research question focuses on the way portals provide tools for citizen science, the new version is a better representation of the current aims and goals of Waarneming.nl.

that would allow for the sampling of a wide variety of users active on both portals. Previous literature has suggested the importance of emphasizing the heterogeneous use of digital portals, for example in terms of activity, demography or motivation [Dieter et al., 2019]. Additionally, previous studies on citizen science projects and birding also differentiated heterogeneous participants [Aristeidou, Scanlon and Sharples, 2017; Boakes et al., 2016; Cole and Scott, 1999; Hvenegaard, 2002; Parrish et al., 2019; Ponciano and Brasileiro, 2014; Seymour and Haklay, 2017]. A variety of characteristics could be derived from reviewing this literature, such as online activity ratio, travel distance or taxonomic preferences. However, most of these characteristics are either based on online citizen science tasks (e.g. games or identification tasks), or only focused on offline birding activity. To further specify these characteristics, experts on digital portals for bird observations were consulted. Experts were asked what they found to be key factors on which users who register bird observations differed and were presented with the characteristics found during the literature review. After consulting four experts, their responses were found to be sufficiently saturated, resulting in three main characteristics on which users could be differentiated: activity in the field (measured in number of observations), knowledge of species (self-reported) and experience with the portal (measured in years since creating an account). Additionally, experts described a fourth characteristic which differentiated users, namely a focus on photography.

Sampling included finding interviewees that sufficiently differed on these four characteristics, through recommendations from our network(s). The interviews included questions to help determine if the characteristics on which the interviewee was recommended actually matched with the interviewees' own experience. Users were asked how long they had been active on the portal, how often they registered observations and how they would rank their knowledge of species in comparison to other users. The answers to these questions did not always match with the recommendation, however this method did provide a wide enough variety of users to proceed. Of the nine interviewed users, two interviewees were users of Avimap, two interviewees were users of both Avimap and Waarneming.nl, and five interviewees were only active on Waarneming.nl. We initially sampled a roughly equal number of Avimap (4) and Waarneming.nl (5) users, however, users of Avimap tended to also make use of Waarneming.nl, resulting in more Waarneming.nl users in the sample.

The interviewees participated in semi-structured interviews. Questions were determined in line with the themes addressed in the walkthrough and included use of the site, motivations, and thoughts on data collection. During the interviews, users were offered the chance to support their answers by navigating the web portals or applications together with the interviewer, to elicit new and more in-depth responses [Kaufmann, 2018].

2.3 Phase 3: interviews with coordinators

In addition to interviews with users, the coordinators of both portals also took part in semi-structured interviews. One interview was attended by both coordinators of Waarneming.nl, the second interview was held with the coordinator of the BMP project. Questions followed the themes addressed in the walkthrough and included questions on the goals behind the portals and their affordances, as well as their

views on citizen science. The results from these interviews helped to contextualize and deepen the walkthrough and user interviews, providing an answer to sub-question three: how do the affordances, and how users perceive these, relate to the perceptions of the portal coordinators?

2.4 Phase 4: analysis

All interviews were recorded and transcribed using InqScribe software. Following this, the transcripts were coded in Atlas.ti by the first author. The codes were initially selected by the first author, based on recurring themes in the interviews. Following this initial coding, the other two authors provided feedback on the selected codes based on two of the interview transcripts, after which the codes were refined, and coding was continued by the first author.

All interview audio files and transcripts were processed anonymously. All users and project coordinators gave informed consent to use their citations in this publication without being named and were sent the report of this study in advance of this publication. This is in line with the institutional ethics proceedings; considering the design and target population no formal ethical approval was required.

Results

3.1 Goals and motivations

On their website, Sovon describes their aim as: "organizing national bird counts and performing research for conservation, policy and science" [Sovon, n.d.]. BMP's coordinator described a similar goal: "*determining trends for many breeding birds at national, regional and provincial level, as well as the trends for Natura 2000 areas*". On their website, Waarneming.nl describe their goal as "enable[ing] everyone to save and share nature observations on the internet, to capture the richness of nature for now and the future". They also specifically note they "do not interpret this data. This is a task for other organizations" [Waarneming.nl, n.d.(a)]. Additionally, they state that "it is crucial [for science] to have access to these observations (so-called Citizen Science) and use this for research" [Waarneming.nl, n.d.(b)]. Both portals thus express it as their goal to contribute data for policy and/or science, although for BMP this is more pronounced than for Waarneming.nl, who specifically note they merely collect data and make it available. However, during the interviews, the coordinators of Waarneming.nl noted data use was only of secondary concern to them. Their main goal is "*to enthuse a lot of users to keep using your portal and to attract new users*". They described the use of data not as an aim in itself, but more as a "*pleasant consequence*". The emphasis is put on providing a service to users that is "*fun to use*". It is assumed that this enjoyment will then lead to more active users, who provide more usable data. The goal to enthuse users is also motivated by competition with (international) portals: "*[we] strive to become the best of them*".

When asked about the goal of the portals, users linked this to **expectations** about data use. Users of both Avimap and Waarneming.nl mostly expected data to be used for nature protection and policy, population trends and/or academic research, and also noted this as the goal of the portals. Users indicated that they not only expect data to be used for said purposes but that they were also **motivated** by the

idea that data would be used as such: "*Apart from the fact that I greatly enjoy this, which is partly why I do it, I do hope that it is used for something*" (U1). Some users even addressed the use of the portal to provide data for these purposes as a **justification** for their hobby: "*a kind of justification to yourself that you are not doing it for nothing*" (U6).

The coordinators of both portals also indicated the pivotal role their audiences have played in the developments of the portals. BMP's coordinator noted that the development of the project was thanks to the enthusiasm of "*people who enjoy studying bird populations in a specific area (. . .) In the early eighties there were so many, that we figured it should be possible to start a real monitoring project on Dutch breeding birds. That turned into BMP*". The coordinators of Waarneming.nl noted that they created the portal for "*people like us, who were interested in nature but did not necessarily know all that much*", and integrated functions in response to users' wishes: "*If people on the forum wrote 'this [function] would be great', I liked to create that*". Coordinators of both portals also noted that they put great emphasis on making the use of the portals enjoyable, as this would lead to more users, who would contribute more and higher quality data.

3.2 *Affordances*

3.2.1 Visibility

During the walkthrough, it became clear that the portals take different approaches to the visibility of registered observations. On Avimap, users can only view their own observations. The observations of others are not publicly available. In the privacy options, users can either grant Sovon permission to share their data with projects and organizations Sovon trusts or users can opt to be contacted when data are requested and grant permission for each case specifically. During the interview, BMP's coordinator noted that these options were chosen "*as a substantial number of users do not appreciate it when their data are available to everyone on a detailed level*". However, during the interviews with users, most indicated they had not actively considered these privacy settings, expressing sentiments like: "*It doesn't really interest me much*" (U1), or "*I don't have anything to hide*" (U3).

On Waarneming.nl, the question of data visibility is more complex. In principle all observations are publicly visible, for users and non-users. However, data can be protected in a variety of ways. Firstly, users can choose to hide the time of their observations in their account settings. Secondly, when uploading an observation, they can choose to obscure an observation or put it under embargo. During the interviews, users related these options to nature protection, obscuring an observation "*when I think there is a nest (. . .) For example, a Harrier with a twig. Then they might be building a nest, so then I will always obscure [the observation]. Or when it is a species that a lot of people could come to see, which would lead to disturbance*" (U8). The coordinators of Waarneming.nl also mentioned these functions but noted they prefer observations to be publicly available: "*If three-quarters is obscured, it's useless to me (. . .) There are examples of plants and animals whose habitats are gone now because they were kept secret*". Some users indicated similar sentiments: "*Especially when it is something unusual, what better way to protect it than to make it findable?*" (U2). Other users related it to enjoyment of the portal: "*If you . . . no longer show anything, obscure*

everything, then it won't take long before no one enjoys it anymore" (U4). Finally, Waarneming.nl also offers privacy options that determine with whom data are shared. As also expressed by BMP's coordinator, the coordinators of Waarneming.nl described this as a response to users' wishes: "*There were people who said 'I don't want you to just give data away', and others who said 'Yes, I want to share them with science, but not with project developers or commercial organisations'* ".

During the interviews, users linked the privacy options to their **trust** in the portals. A user of Avimap expressed: "*I have chosen to share everything and trust Sovon. If they think the data should be shared with someone, that is fine*" (U5), another user similarly noted to "*blindly trust*" Sovon to use the data "*for something good*" (U2). For Waarneming.nl some users expressed "*complete trust*" (U7) that data would be shared with organizations for nature protection. However, other users indicated they actively made use of the option in the privacy settings to share data with the Dutch National Database for Flora and Fauna, so the data don't "*end up in the Twilight Zone*" (U6). When data are shared with this external database, it can be used for research, "*so that there's a point to my obsession*" (U2).

3.2.2 Data quality checks

During the walkthrough, it became clear that some of the affordances on the portal are specifically targeted towards **checking** data quality. On Waarneming.nl this is specifically done by appointing specific users as 'administrators' who can validate observations. The coordinators noted: "*At the start, we had 90 users, who all knew each other, so you could keep an eye on each other. But at some point, we grew so much that you didn't know everyone anymore. At that point, we thought: 'maybe we should check if it's all correct'* ". Additionally, an algorithm validates observations based on statistics, when sufficient information is available. The validation status of the observation is indicated by icons next to the observation. One of the coordinators noted: "*If you register an observation with proof you can get a green checkmark. Some people really like that, as your observation is then validated at the highest level*".

For BMP, it is not publicly communicated on the Avimap portal how data quality is checked, however during the interview with BMP's coordinator it became clear that counts are validated by Sovon employees manually, checking if the count was performed in line with regulations, such as the number of counts and the time of the day. Additionally, data are checked for unexpected observations, such as unusual numbers of individuals or unusual species: "*When for a certain species twenty pairs have been observed for years, and now only one pair was counted, . . . we will send an email [to the observer] saying 'Hey, we've established this and this, can you explain why that is?'* ". Users of Avimap expressed that they were not aware of the way data checks took place: "*Actually, I don't know how they handle that*" (U1).

For both portals, the **submission fields** for observations include triggers to improve data quality. This includes mandatory fields for time, date, location and species. On Avimap the breeding code[3] is also mandatory. Additionally, users receive a warning when registering an unexpected combination of fields or rare

[3]Coding to indicate behavior of an observed bird that can provide information on its breeding status (e.g. foraging, nesting material).

species on Waarneming.nl. When using Avimap, data quality is also stimulated by providing suggested breeding codes that are likely for the registered species.

The link between submission fields and data quality was also addressed by users during the interviews. Users of Waarneming.nl often linked quality to the number of completed fields, as more information leads to easier validation. Especially the photo field was addressed as important: "*If you attach photographs they know for sure that it is the right observation, because not everyone knows equally well what animals they observe*" (U9), and fields indicating bird activity (e.g. flying over, nest building) were mentioned.

The interviewed users also linked the quality of the observations to the **knowledge** of the users. For BMP it was highlighted that there is a basic level of knowledge needed to participate, "*otherwise you're just messing around (. . .) Of course you don't have to [know everything] but you can't let everyone do this. I don't think that's wise*" (U1). However, Waarneming.nl is open to everyone: "*Waarneming.nl is system for people who are interested in nature, and it should stay that way. The quality should be integrated through a strong foundation and the admins*" (U4). Another user also stated that quality assurance is not the task of the portal, it being merely a place where data are collected.

Even though a wide variety of users were interviewed, they all ranked their own knowledge above 5 on a scale from 1 to 10. They noted that they were confident about their observations but that they did deal with **uncertainties** sometimes. Some users specified the need to express when you are uncertain about what species was observed, so this could be accounted for during the data checks: "*When you register an observation you either have to be certain about it, or you have to indicate your doubt and describe what you saw*" (U8). On Waarneming.nl this can be done by labelling you observation as uncertain, after which the observation is labelled with an '?' icon. This can trigger an administrator to help the user with the correct identification and is a reminder to other users that the observation is not certain. Both on Waarneming.nl and Sovon uncertainties can also be added in the 'note' field. "*[A high quality observation] does not necessarily mean that someone knows everything perfectly, but that when you are in doubt you say so (. . .) You have to be honest about the data you register. For me, that is a high quality count*" (U3).

3.2.3 Learning processes

Affordances that were addressed in the interviews with users were often related to learning. During the walkthrough it already became clear that both portals offer affordances that aim to teach users about nature and species. BMP mostly achieves this by providing online and offline courses. In the case of Waarneming.nl more affordances related to learning are available. This includes affordances that stimulated communication between users, such as comments from admins, or the forum. Secondly, the portal includes the ObsIdentify tool, where users can upload a photo, and the tool will use artificial intelligence to indicate the most likely species on the photograph.

Users of both BMP and Waarneming.nl mentioned learning was a motivation to use the portals. One of the ways in which they learn is by **interacting** with other users,

either online in comments and the forum, or offline through excursions, trainings, or information trips with other birders. In the case of BMP, the coordinator noted that Sovon matches new observers with experienced ones to train their skills in the field. The same was expressed by one of the users: "*I went along with experienced observers for tips and tricks . . . if you don't recognize a sound, do this or that, record it, look for the bird, take notes. They just have the experience, and it is great to at least get a basis from the experience that they share*" (U3). Alternatively, users express interacting with others through the Waarneming.nl forum: "*There are a lot of nice people on there who really reply to you (. . .) Like, if I have an observation and I'm wondering what it is, I will post it on the forum and then they will help you, give you a hint*" (U4).

Users of Waarneming.nl also mentioned that they learn by using the **ObsIdentify** tool. One of them notes that they find it "*incredibly useful, because otherwise I would have no idea what I saw*" (U7). The coordinators of Waarneming.nl also noted that this tool makes the portal more accessible to users with little knowledge: "*If you take nice photographs, you will have good knowledge of nature in no time*".

Another source of learning is the **validation** of observations. The coordinators of Waarneming.nl noted that admins give "*constructive criticism (. . .) It's like learning how to read or write*". Users expressed similar experiences: "*Sometimes they tutor me. If I saw something incorrectly, they will correct me*" (U9). The BMP project coordinator similarly noted that when counters submit counts that seem unlikely "*of course we try to give tips on how to improve. On our website you can find a few online courses to improve your knowledge*". The founders of Waarneming.nl also note the learning curve of users: "*The people who validate observations today are our own people who started here 10 years ago by searching through books and helping each other on the forum*".

3.2.4 Hobbyism

Two affordances that were also addressed specifically related to Waarneming.nl were the **icons that indicate the rarity** of species and the possibility to **keep and compare lists**. These affordances connect to existing characteristics of the birding community, where there is generally much emphasis on recording lists of observations, especially of rarer species. During the walkthrough, it was observed that Waarneming.nl uses icons to indicate the rarity of species, and that rare species are given a prominent place on the portal, for example by featuring rare observations on the homepage. The portal also allows users to keep lists of all observed species, per day or year. Additionally, users are ranked by the number of observed species.

During the interviews, some users indicated they make use of such lists: "*I always do like to have a list of the past year, to see how many I have seen*" (U4). On the other hand, users also indicated the negative effects of such affordances: "*That list is nice, but it's an extra. I do feel that it takes over sometimes, making you think 'Oh, I should make a quick stop there'. But I try not to do that*" (U2).

Users also noted a focus on rare species: "*You get a sort of bias towards rarer species, iconic species. Like a Kestrel, everyone always registers Kestrels, but no one registers all Gray Geese next to the road*" (U6). Apart from rare species, users also noted that they mostly upload uncommon observations, which do not only include rare species but

also observations of unusual behaviour: "*It's nice to have a singing Blackbird [in February] . . . those are nice unusual things*" (U6), or "*when [an observation] is quite unusual at this location*" (U8).

This focus on rare species and keeping lists was also linked to 'twitching'.[4] Users responded relatively negatively to the use of Waarneming.nl for this purpose: "*In the past, I used to twitch, and I still do it sometimes. But [not] if it is too far away, and I always wait a few days because I hate those flocks of birders (. . .) They ruthlessly stomp through everything*" (U4).

Discussion & conclusion

The aim of this article is to formulate an answer to the question: *How can affordances available on online portals for bird observations help to understand how citizen science is perceived by portal coordinators and users?* Based on the results from the walkthrough and interviews, new insights on the implementation and understanding of citizen science were brought forward. Specifically, it became clear that tensions exist on the level of data sharing, community hierarchies, and expectations. These three tensions best encompass the variety of themes addressed in the interviews. Furthermore, these tensions are most likely not limited to the two portals under analysis here. As reference to previous studies will show, these are wider existing tensions on portals for (biodiversity) citizen science.

4.1 Data sharing

As noted in the introduction, the use of collected data is often one of the main goals of (biodiversity) citizen science projects [e.g. August et al., 2015]. One key topic addressed in these previous studies is how data are shared with others [Ganzevoort, van den Born et al., 2017]. The importance of data sharing is also reflected in our results. Previous studies have mostly focused on the effects of data sharing on the privacy of users, or the use of this data from the perspective of scientific organizations [Brown and Williams, 2018; Gouveia et al., 2004; Houghton et al., 2019]. On the investigated portals, multiple privacy and security options were offered to users, which were decided upon in response to users' wishes. Although we only interviewed a relatively small number of users, it was notable that most of them expressed little concern about their personal privacy. Rather, they expressed concern for a topic that received significantly less attention in previous studies, namely the effect of data visibility on the observed flora and fauna. On the one hand, the idea was proposed that flora and fauna are best protected by hiding data from the public, to avoid possible disturbances. This fits with Avimap's design, where data are only available for users themselves and Sovon, and with Waarneming.nl's obscure options. On the other hand, some users and the coordinators of Waarneming.nl expressed an opposite sentiment, namely that flora and fauna would be best protected when data are openly available. It was argued that open access to observations benefits conservation efforts, as this informs people what needs to be protected where.

Limited previous research has addressed these differing approaches to data visibility. Commenting on the public communication of tracking data, van der Wal,

[4] Activity of a sub-group of bird watchers who aim to see as many different species as possible.

Zeng et al. [2015] also noted resistance to share potentially sensitive locative data on species in contrast to the benefits of wide information dissemination. Verma, van der Wal and Fischer [2016] noted that when information about vulnerable and endangered species is made public through technology, this can conflict with conservation efforts. By making specific locations of species visible, the species can be surveilled. On the one hand, this surveillance is arguably needed to identify population decline and trigger nature conservation efforts. However, these data could also (unintentionally) lead to disturbance or hunting. As Pearce-Higgins et al. [2018] argue, open data sharing can then come into conflict with the goals of citizen science projects: "Open access to data about rare and threatened species can put conservation objectives as risk, and may lead volunteers to withhold data from schemes that contribute to public archives" [p. 2547]. In this quote, it also becomes evident that this mostly applies to rare and threatened species. Other species might avoid surveillance by being less popular to provide information about [Rose and van Dooren, 2011].

Here the tension between birding as a hobby and a form of citizen science is of great relevance. Users of the studied portals have to go back and forth between their hobby and the goals of the portals. On the one hand, users want to enjoy their nature observations and share these with others. On the other hand, the use of these portals also asks of these users to consider the use of this data for nature conservation and policy. Lawrence and Turnhout [2010] similarly found love for nature and a sense of achievement in observation to coexist with a desire to share the data for the sake of nature conservation, and (like our interviewees) highlighted the importance of trust in the data handler. This tension between hobbyism and scientific contributions is especially notable for special observations, for example of rare species or large numbers of individuals. Such observations are often considered impressive [Ganzevoort and van den Born, 2019], and interviewed users expressed they mostly share such special observations. However, these special observations are often the very observations that are deemed special enough to deserve protection (e.g. because they are rare, endangered and/or likely to be disturbed).

4.2 Community hierarchies

While data sharing is an important topic in research on citizen science portals, the relationships within the community collecting these data are often overlooked. Hierarchies are in place on the investigated portals, where some actors involved have more or less power to design, change or use specific affordances [Stanfill, 2014]. On Avimap, there is a clear hierarchy where the researchers at Sovon design and manage the portal and the users of Avimap collect the data, in line with Shirk et al.'s [2012] contributory model. Even though BMP was initiated by volunteers and even though some volunteers still have some coordinating roles,[5] there is thus a clear professional-amateur divide on the portal [Dowthwaite and Sprinks, 2019].

In the case of Waarneming.nl, this hierarchy is more complicated. Although the coordinators designed the portal, they noted that it is not unusual for affordances to be built in after requests from the user community. Most strikingly, specific users

[5] For example, one of the interviewed Avimap users coordinates the BMP counts in his region by assigning areas to specific counters.

of the portal are labelled as 'administrator'. These users have more power over the affordances on the portal, as they are allowed to validate, obscure, change or even remove observations when deemed necessary. This creates a hierarchy among users, which is more often the case in digital collaborative knowledge projects such as Wikipedia [Niederer and van Dijck, 2010]. Arguably, hierarchies are also created through other types of status symbols, such as users with many green validation icons or higher positions in the ranking list based on the number of observations of a user.

When addressing the roles of specific users and the hierarchies embedded in them, it is important to reflect on who are in- and excluded from the user community [Preece, 2016]. A tension between offering learning opportunities while improving data quality can be observed, as both education and data collection are understood as goals of citizen science projects [Brown and Williams, 2018; Reeves et al., 2017]. Similarly to previous findings, most interviewed users also indicated learning as a motivation [Ganzevoort, van den Born et al., 2017; Ryan, Kaplan and Grese, 2001]. Waarneming.nl emphasizes such learning possibilities by providing affordances such as validation icons or ObsIdentify. They also specifically express the aim to involve 'everyone'. However, by lowering this threshold of participation, data quality might go down initially as users with only little knowledge are able to add observations. Only after using the portal for a while, and making use of the learning options, the data quality increases again [van der Wal, Sharma et al., 2016]. As BMP is more selective in who can participate, the learning curve might be shallower, but data quality can be more optimal from the start. This also means that there is little possibility to climb in the hierarchy, unless a user becomes a Sovon employee. On Waarneming.nl learning can result in a higher position in the hierarchy, as advanced users with much knowledge on a species group can be asked to be admins.

4.3 Expectations

Finally, it became clear that there are tensions between the goals communicated on the portals, and the perceptions of users and coordinators. The chosen affordances on a citizen science portal are strongly linked to the portal's goal and the intended data use [August et al., 2015; Skarlatidou et al., 2019; Reeves et al., 2017]. As became evident during the walkthrough, BMP asks for more structured data collection as data are used in biodiversity trend estimations. Avimap thus makes use of mandatory fields and stricter rules are communicated about data collection methods. Waarneming.nl also communicates to users that they aim to contribute to policy and research. However, the interviewed coordinators rather emphasised their goal to enthuse users. It was assumed that users who enjoyed the use of the portal would also contribute more (usable) data. The use of this data is regarded as consequence, rather than a direct goal in itself. This might explain why users are provided with more freedom in submission fields and less regulations compared to Avimap. Some users of Waarneming.nl seemed aware of the fact that Waarneming.nl did not actively aim for data use, adjusting their privacy settings to make sure data would be shared with external parties. However, other users expressed the expectation that data would be used for said purposes, with some even noting this as their main motivation. For Waarneming.nl there thus seems to be a variety of expectations among users and coordinators.

The differing motivations of users should also be considered here. As mentioned in the previous section, users can be motivated by different elements at the same time, such as contributing data to science or general nature experience. Targeting users with a wide variety of motivations is not problematic in itself; the literature on environmental volunteering has also demonstrated how 'helping the environment' is often a key motivation for participants, but often alongside others, including learning, connection to nature and social bonding [Bruyere and Rappe, 2007; Ganzevoort and van den Born, 2020; Sloane and Pröbstl-Haider, 2019]. However, for user retention it is important to provide transparency on what is expected of users and what they can expect from the portal [Reeves et al., 2017].

As data use is relevant for both portals, it is to be expected that validation of data quality takes place in response to scepticism from the scientific community on the quality of citizen science data [Skarlatidou et al., 2019; Wiggins, 2013; Preece, 2016]. Waarneming.nl indeed has a thorough validation procedure with a variety of affordances in place to stimulate data quality (e.g. admin users and validation icons). However, even though BMP puts more explicit emphasis on data use than Waarneming.nl, there are no affordances related to validation in place on Avimap. Notably, data validation might not only be relevant for purposes of data use but also for community strength. As literature on online community shows [Hajli et al., 2014; Preece, 2001], credibility of shared information is of great importance for community strength. This seems to be in line with the expressed reason for integrating data validation on Waarneming.nl.

4.4 Conclusion

This explorative study aimed to illustrate how a combination of methods can give new insights into the understanding and implementation of citizen science. Even though a relatively small number of interviews were conducted these still provided us with new and valuable insights to inspire future research. Increasing the number of interviews and considering more case studies would lead to more in-depth insights in the future. Additionally, it would be of interest to add additional supportive data sources to the triangulation, such as user statistics (e.g. activity patterns), as already applied in other studies [Boakes et al., 2016]. Although this study included a wide variety of users, future research could also benefit from comparing different types of users, to see how their experiences might differ.

This study has used a combination of sources from both interviews with users and coordinators of digital citizen science portals, as well as analysis of the design of the portals to come to conclusions about the understanding and implementation of citizen science. In doing so, this study has contributed a new approach to studying digital citizen science projects, combining an analysis of the portal design with the perspectives of users and coordinators. Furthermore, this study has provided insights into tensions that exist around the understanding and implementation of citizen science. Firstly, different ideas exist about the visibility of data, especially in relation to biodiversity conservation efforts. Secondly, differing social hierarchies within the community of citizen scientists are created through the design of portals. Finally, the communicated goals of the portals might not always align with expectations of users and coordinators.

In the end, this study has shown that citizen science is differently perceived by users and coordinators, and that applications vary greatly between portals. Furthermore, the communication throughout the portal and the affordances provided do not always match with the perceptions of either users or coordinators. Transparency and coherence in communication would be the most important answer to this. By providing more explicit information on the goal of the portal, how data will be used, and who plays a role on the portal, projects will be more effective in aligning the experiences of users with expectations of the coordinators.

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