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Participation in Citizen Science: Motivational and Contextual Factors

Hazal Baytok

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Participation in Citizen Science: Motivational and Contextual Factors

*Participation à la science citoyenne : Facteurs motivationnels et
contextuels*

Thèse de doctorat de l'université Paris-Saclay

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Graduate School : Economie - Management. Référent : Université d'Évry Val d'Essonne

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Titre : Participation à la science citoyenne : Facteurs motivationnels et contextuels

Mots clés : science citoyenne, motivations, biens communs de la connaissance, plateformes numériques, participation du public à la recherche scientifique, réseaux de connaissances en ligne

Résumé : La science citoyenne est la participation de personnes qui ne sont pas des scientifiques à des processus de recherche tels que la collecte et l'analyse de données. La science citoyenne offre de nombreux avantages, tels qu'une collecte de données plus rapide et plus facile, l'étude des défis environnementaux, de la biodiversité au changement climatique, ainsi que la contribution à la recherche en astronomie et la collaboration entre les scientifiques et le public.

La réalisation des avantages potentiels de la science citoyenne dépend de la compréhension des perspectives des participants. Dans cette étude, j'examine les différents modes de participation à la science citoyenne et la manière dont les motivations des participants, la conception des plateformes et d'autres facteurs sont associés à ces modes de participation. La thèse contribue à notre compréhension des ingrédients clés dans la conception des programmes de science citoyenne afin d'accroître l'engagement du public.

Dans la première partie, j'ai réalisé une étude bibliographique par le biais d'une analyse bibliométrique. Cette partie se concentre sur les défis, les facteurs de succès et les motivations de la science citoyenne. Le reste de la thèse est composé d'une étude qualitative et d'une étude quantitative portant sur trois plateformes de science citoyenne activement utilisées dans le domaine de l'ornithologie dans deux pays, la Turquie et la France, à savoir Faune-France en France, Trakuş et eKuşbank (eBird Turkey) en Turquie.

Dans la partie qualitative, au moyen d'entretiens semi-structurés approfondis, j'examine les acteurs, les différents modes de participation, les motivations et les externalités négatives qui peuvent survenir en utilisant la littérature sur les plateformes multilatérales et les biens communs de la connaissance.

Les résultats de cette partie nous ont permis d'identifier quatre rôles dans les plateformes : l'ornithologue, le photographe d'oiseaux, le scientifique et le chasseur, qui interagissent les uns avec les autres et créent des externalités.

J'ai également constaté deux types de participation : active et passive. En ce qui concerne les motivations, nos résultats suggèrent des similitudes avec les études précédentes. Toutefois, à la différence des travaux précédents, nous avons souligné la nécessité de distinguer les motivations pour l'engagement dans la plateforme, d'une part, et les motivations pour le sujet (les oiseaux), d'autre part.

Dans la deuxième partie, en menant une enquête à grande échelle auprès des participants des trois plateformes et une analyse économétrique, j'ai examiné comment les motivations sont associées à la participation, ainsi que les externalités négatives et les valeurs créées par la plateforme. Dans cette partie, je m'appuie sur la théorie de l'autodétermination, les plateformes multilatérales et le concept d'externalités négatives de la littérature sur les biens communs.

Les résultats de la deuxième partie suggèrent que les deux types de motivations identifiés dans la première partie (motivation pour le sujet et motivation pour l'engagement sur la plateforme) sont positivement associés à la participation active et passive. En outre, les valeurs offertes par la plateforme et les moyens mis en œuvre par les plateformes pour remédier aux externalités négatives ont des effets différents sur la participation active et passive en fonction du contexte. Ainsi, l'importance perçue des concours par les participants a un effet positif sur leur participation active en France, alors qu'elle n'a pas d'impact significatif en Turquie. De même, l'importance perçue par les participants de la protection des données sensibles par la plateforme est associée négativement à la participation passive en France, alors qu'elle l'est positivement en Turquie. Ces résultats sont importants pour comprendre les participants et mieux concevoir des plateformes de science citoyenne efficaces.

Title: Participation in Citizen Science: Motivational and Contextual Factors

Keywords: citizen science, motivations, knowledge commons, digital platforms, public participation in scientific research, online knowledge networks

Abstract: Citizen science is the participation of people who are not scientists in research processes such as data collection and analysis. Citizen science provides various benefits like faster and easier data collection, investigation of environmental challenges from biodiversity to climate change, as well as contributing to astronomy research and leading to collaboration between the scientists and the public.

Realising the potential benefits of citizen science depends on understanding the perspectives of participants. In this study, I examine different ways of participation in citizen science and how the motivations of participants, the design of the platforms, and other factors are associated with these. The thesis contributes to our understanding of the key ingredients in designing citizen science programs so as to increase the engagement of the public.

In the first part, I carried out a literature survey by bibliometric analysis. This part focuses on challenges, success factors, and motivations in citizen science. The rest of the thesis is composed of one qualitative and another quantitative study by focusing on three citizen science platforms that are actively used in the field of ornithology in two countries, Turkey and France, which are Faune-France from France, Trakuş and eKuşbank (eBird Turkey) from Turkey.

In the qualitative part, through semi-structured in-depth interviews, I examine the actors, different ways of participation, motivations, and negative externalities that may arise using the Multi-Sided Platforms (MSPs) and knowledge commons literature.

The results of this part helped us identify four roles in the platforms: birdwatcher, bird photographer, scientist, and hunter, interacting with each other and creating externalities.

I also found two types of participation: active and passive. Regarding motivations, the findings suggested similarities in the previous studies. However, as different from previous work, I highlighted the need to distinguish motivations for engagement in the platform on the one hand and motivations for the subject matter (birds in our case) on the other.

In the second part, by conducting a large-scale survey targeted at the participants of the three platforms and an econometric analysis, I examined how motivations are associated with participation, as well as the negative externalities and values created by the platform. In this part, I draw upon the Self-Determination Theory (SDT), Multi-Sided Platforms (MSPs), and negative externalities concept from the commons literature.

The findings in the second part suggest that the two types of motivations identified in the first part (motivation for the subject and motivation for platform engagement) are positively associated with active and passive participation. Also, values offered by the platform and platforms' ways of addressing negative externalities have different impacts on active and passive participation based on the context, such as the participants' perceived importance of competitions positively affecting their active participation in France, whereas not having a significant impact in Turkey. Similarly, participants' perceived importance of the protection of sensitive data by the platform has a negative association with passive participation in France while being positively associated with it in Turkey. These results are important to understand the participants and to better design successful citizen science platforms.



Participation in Citizen Science: Motivational and Contextual Factors

Hazal BAYTOK

**Thesis Supervisor, Professor Müge ÖZMAN, IMT-BS/LITEM,
Thesis Co-Supervisor, Professor Nicolas JULLIEN, IMT-
Atlantique/LEGO**

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My PhD journey included moving to a new country, going through the pandemic of the century in that new country, making friends from all over the world, learning a new language and actually speaking it, rediscovering my passion and curiosity about how people, animals, and everything else works, appreciating the beauty of birds and nature, seeing my strength and willpower in the face of the brutal bureaucracy as an immigrant, learning -a lot-, and many more...

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LIST OF ABBREVIATIONS

API	Application Programming Interface
BOINC	Berkeley Open Infrastructure for Network Computing
BRICs	Brazil, Russia, India, China, and South Africa
CFA	Confirmatory Factor Analysis
CFI	Comparative Fit Index
CWOP	Citizen Science Weather Observer Program
EBBA2	Second European Breeding Bird Atlas
ECSA	European Citizen Science Association
EU	European Union
GIS	Geographic Information System
IAD	Institutional Analysis and Development
IBAs	Important Bird Areas
ICT	Information Communication Technology
IT	Information Technology
LPO	Ligue pour la Protection des Oiseaux (League for the Protection of Birds)
LR	Likelihood Ratio
METU	Middle East Technical University
MSPs	Multi-Sided Platforms
MVC	Massive Virtual Collaborations
MVS	Motivation to Volunteer Scale
NGO	Non-Governmental Organisation
NSF	US National Science Foundation
OECD	Organisation for Economic Cooperation and Development
PPSR	Public Participation in Scientific Research
RMSEA	Root Mean Square of Approximation
RRR	Relative Risk Ratio
RSPB	Royal Society for the Protection of Birds
SABAP2	Second Southern African Bird Atlas Project
SDGs	Sustainable Development Goals
SDT	Self Determination Theory
SEM	Structural Equation Modelling
SHOC	Suivi Hivernal des Oiseaux Communs (Winter Monitoring of Common Birds)
SRMR	Standardised Root Mean Squared Residual
SRQ-A	Academic Self-Regulation Questionnaire

SRQ-E	Exercise Self-Regulation Questionnaire
SRQ-F	Friendship Self-Regulation Questionnaire
STOC	Suivi Temporel des Oiseaux Communs (Temporal Monitoring of Common Birds)
TPB	Theory of Planned Behaviour
TLI	Tucker Lewis Index
UN	United Nations
UNEP	United Nations Environment Programme
US	United States
VIF	Variance Inflation Factor
VFI	Volunteer Functions Inventory
VGI	Volunteered Geographic Information

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1 INTRODUCTION

1.1 A BRIEF INTRODUCTION TO CITIZEN SCIENCE

In this dissertation, I investigate the participation dynamics in citizen science by focusing on the motivational and contextual factors that influence participation. I approach the motivational factors by examining the motivations of participants by identifying the drivers of platform engagement in a detailed manner and grouping them in a novel way. I analyse the contextual factors by considering the platform features of the three platforms that I include in the study and examine their impact on the platform engagement of participants.

Citizen science is briefly defined as the participation of the public in scientific processes by “gathering, submitting, or analysing large quantities of data” (Bonney et al., 2016, p. 3). With citizen science, collecting, submitting, or analysing large quantities of data in very short time becomes possible, beyond what individual scientists and/or small scientific teams can do (Adler et al., 2020; Dickinson et al., 2010; Larson et al., 2016). This data is used for scientific publications, as well as for non-scientific publications such as books, non-scientific journals, or other informative publications targeted at general public. Citizen science also has further implications and benefits beyond the contributions in science in terms of data collection and analysis. For example, by using the data obtained through various citizen science projects and platforms, major environmental and societal challenges such as, pollution, climate change, extinction of species, and ways of biodiversity conservation are investigated (Deguines et al., 2020; Dickinson & Bonney, 2012). Furthermore, it contributes to the society through creating learning opportunities in different fields (Adler et al., 2020; Straub, 2020); and to society and science in general by creating collaboration opportunities between the public and scientists, as well as among scientists globally (Adler et al., 2020; Dickinson & Bonney, 2012). I delve into further detail about its benefits below.

The term citizen science dates back to around the end of the 1980s (Haklay, Dörler, et al., 2021) and the beginning of the 1990s (Hecker et al., 2018; Pelacho et al., 2021), and it is becoming increasingly widespread with the rise of the internet and the developments in Information and Communication Technologies (ICT) (Dickinson & Bonney, 2012; Gharesifard & Wehn, 2016; Miller-Rushing et al., 2012; Silvertown, 2009), more specifically through the advancements in web applications using Geographic Information System (GIS) and the use of smartphones (Dickinson et al., 2010, 2012; UN Environment, 2019). Research shows that participation in citizen science is higher when data entry is through digital tools compared to data entry through offline tools (Arts

et al., 2020). Similarly, researchers found that participation and data submission increased with the use of the mobile application, for instance, in the case of the Southern African Bird Atlas Project (SABAP2) (A. T. K. Lee & Nel, 2020).

Research on the history of citizen science shows that initially, science was progressing through amateurs, and only after the professionalisation of science, starting from the end of the 19th Century, did it become a paid profession (Dickinson & Bonney, 2012; Irwin, 2018; Miller-Rushing et al., 2012; Silvertown, 2009). For example, Silvertown (2009) highlights that citizen science was not a paid profession in the late 19th Century, and, for example, Charles Darwin was not seen as a professional naturalist back then (Silvertown, 2009). Miller-Rushing et al. (2012) state that before the professionalisation of science towards the end of the 19th Century, scientific research was in the hands of amateurs, and with the professionalisation of science in the last 150 years, these amateurs became marginalised (Miller-Rushing et al., 2012). Similarly, Dickinson and Bonney (2010) mention that the pioneering scientists in North America were autonomous as they lived before formal science emerged (Dickinson & Bonney, 2012). Irwin (2018) traces the origins of citizen science back to ancient China, where people helped track outbreaks caused by migrating locusts for 2.000 years (Irwin, 2018). Based on these examples, citizen science seems to be at the origins of *science* as we refer to it today.

Two fields led citizen science at the end of the 19th Century, astronomy and ornithology, by having the largest group of amateur experts and the longest history of their engagement in scientific research (Dickinson et al., 2010). Some researchers refer to one of the first citizen science projects as the Christmas Bird Count, organised by the National Audubon Society in the USA since 1900 (Dickinson et al., 2010; Dickinson & Bonney, 2012; Silvertown, 2009). Dickinson et al. (2010) highlight the "Transit of Venus" project, which aimed at measuring the distance between Earth and the Sun in 1874, funded by the British government, which attracted support for data collection all over the world, as another initial citizen science project (Dickinson et al., 2010; Ratcliff, 2016). Bird monitoring efforts in Finland starting in 1749 are also among the pioneers of citizen science (Dickinson et al., 2010; Greenwood, 2007). The U.S. Geological Survey (USGS) in 1880, which started to engage the public in bird monitoring and became the Breeding Bird Survey (BBS) in 1966, is another pioneering citizen science activity (Dickinson et al., 2010). Dickinson & Bonney (2012) mention the starting of the Astronomical Society of the Pacific in 1889 by amateur astronomers, as well as the National Weather Service Cooperative Observer Program, which began in 1890 among the citizen science examples from the 19th Century (Dickinson & Bonney, 2012).

Despite the historical roots of astronomy and ornithology in leading citizen science, today, citizen science is active in a variety of research fields with diverse projects, led by data collection, submission, or analysis efforts in variety of scientific fields. Table 1 shows research fields and some example projects.

Table 1. Different Fields and Examples of Citizen Science Projects

Field	Citizen Science Project/Platform
Environmental monitoring and conservation	Penguin Watch, the Cricket Wing, Killer Whale Count, Frog Find, Notes from Nature - Big Bee Bonanza by Zooniverse, eBird, Trakuş, Trakel, Tramem, NestCams, Yellowhammer Dialects, My Naturesound, Summer Garden Birding Gallery, Dawn Chorus, observation.org, the Butterfly Migration Project, Turtle Watch
Marine monitoring	Phenomer (Project on harmful Algal Blooms), California Collaborative Fisheries Research Program (CCFRP), Is it Alien to you? Share it!!!, SEACleaner, Whale mAPP, Redmap Australia
Astronomy, Space	Cloud Spotting on Mars, Solar Jet Hunter, Galaxy Zoo, and Planet Patrol projects by Zooniverse. Jovian Vortex Hunter, Rosetta Zoo, New Particle Search at CERN, Stardust@Home, SETI@home
Light pollution	Globe at Night
Weather & Meteorology	Weather Rescue at Sea, Nasa Globe Cloud Gaze by Zooniverse
Climate change	Achieving a New European Energy Awareness (AURORA) Project
Water quality	BACKDROP Project (Dublin Liffey River), Freshwater Watch
History	Criminal Characters, People's Contest Digital Archive, Star Notes, Every Name Counts projects by Zooniverse.
Sustainable Development Goals (SDGs)	OSDG Community Platform
Health, DNA, Genome	Genome Detectives, Synaptic Protein Zoo, Node Code Breakers, Dental Disease Detection by Zooniverse, Foldit, Step Change: Non-alcoholic fatty liver disease, Folding@home
Language	Maturity of Baby Sounds Project, Are you talking to me? Project by Zooniverse
Energy	Step Change - Energy Communities/Tenant electricity
Earthquake monitoring, seismic platforms	Raspberry Shake, MyShake
Radiation monitoring	OpenRadiation

Volunteered geographic information (VGI)	BikeMaps.org
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To better understand the research fields covered by citizen science projects, I conducted a bibliometric analysis as a part of the literature review¹. The results show that there are three main clusters, as Figure 1 presents.

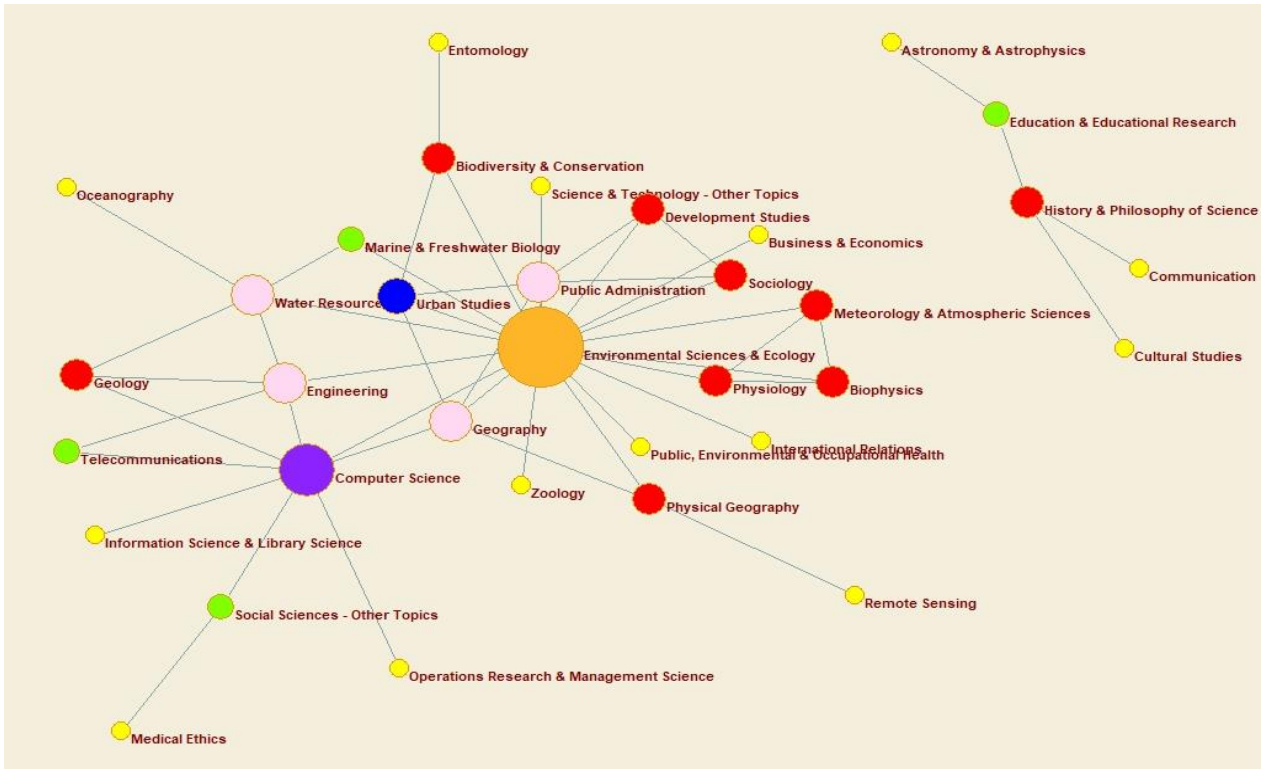


Figure 1. Research Fields in Citizen Science Motivation and Participation Research Literature

The most prominent research field appears to be Environmental Sciences and Ecology, meaning that most of the papers in the dataset are published in the field of environmental sciences and ecology. This is in line with the findings of Pelacho et al. (2021), who highlighted that half of the studies in their dataset were in Ecology and Environmental Sciences and Biodiversity Conservation. They further emphasised that these two categories include five times more papers than those published in Astronomy and Astrophysics (Pelacho et al., 2021). In another study, Kullenberg and Kasperowski (2016) found that research on biology, conservation, and ecology are the main fields

¹ The details of this work are presented in Chapter 2.

that use citizen science for collecting and classifying data (Kullenberg & Kasperowski, 2016).

Even though the fields of astronomy and ornithology constitute the foundation of citizen science as we know it today, the Astronomy and Astrophysics cluster is disconnected from the Environmental Sciences and Ecology cluster in this analysis. Also, the Environmental Sciences and Ecology studies appear to be represented by a larger number of studies in our dataset than the papers in Astronomy and Astrophysics. The place and the potential of citizen science in different research areas are visible in these examples.

Citizen science is considered as the foundation of science as we know it today, (Dickinson & Bonney, 2012; Irwin, 2018; Miller-Rushing et al., 2012; Silvertown, 2009) which is also evident in the historical examples mentioned above, and offers various benefits for different parties involved. The benefits of citizen science stretch out to science, environment, society and individuals, and collaboration between different stakeholders.

Many fields of science benefit from effective data collection or analysis through citizen science at a scale that small research teams cannot cover (Devictor et al., 2010; Jarvis et al., 2015). The advantages include dispersed data collection on a scale that single researchers would not be able to achieve (Adler et al., 2020; Dickinson et al., 2010) and/or increasing the capacity for data collection (Larson et al., 2016). The United Nations emphasize the reduced workload of scientists, lowered costs, and wider spatial and temporal coverage in data collection with citizen science (UN Environment, 2019). To give a more concrete example, eBird platform which operates under the Cornell Lab of Ornithology, and also a part of this study through its Turkey platform -eKuşbank (eBird Turkey)-, highlights that more than 930 scientific publications use the data collected through citizen science via eBird platform (*Publications - eBird Science, 2024*). Another major citizen science platform, Zooniverse, which hosts many different citizen science projects ranging from Galaxy Zoo -one of the biggest citizen science projects globally-, to projects in other fields such as social science, medicine, language, nature, humanities, climate, physics, and space, underline that there are currently over 480 scientific publications which use the data analysed through the Zooniverse platform (*Publications - Zooniverse, 2024*).

Citizen science provides important benefits for the environment as well. For example, citizen science creates opportunities to investigate the effects of environmental pollution, climate change, land use and gathering information about the ecosystem, including information about the distribution and extinction of species (Dickinson & Bonney, 2012). Thus, citizen science creates ecological knowledge (Dickinson et al., 2012) and improves marine policy (Earp & Liconti, 2020).

Citizen science acts as a tool for environmental monitoring (UN Environment, 2019), long-term monitoring (Adler et al., 2020), biodiversity conservation (Deguines et al., 2020), and wildlife conservation (Larson et al., 2016) as well. Taking part in nature-based citizen science initiatives encourages good behaviour for biodiversity (Deguines et al., 2020) and increases environmental stewardship (Earp & Liconti, 2020; UN Environment, 2019).

As far as the society and individual-related benefits of citizen science are concerned, it contributes to local empowerment (Larson et al., 2016) and the empowerment of marginalised groups (Phenrat, 2020). Citizen science creates various learning opportunities (Dickinson et al., 2012), such as learning about science and scientific methods (Adler et al., 2020), as well as the nature of science (Straub, 2020). It helps in "learning observational and analytical skills and gaining a better understanding of the natural world" (UN Environment, 2019, p. 266) and improves social learning (Phenrat, 2020). Other benefits of citizen science for society and individuals are creating opportunities to carry out experiences in nature (Dickinson et al., 2012) and helping in community building (Adler et al., 2020).

Collaboration-related benefits of citizen science include its potential to create opportunities for collaboration between scientists and the public (Dickinson & Bonney, 2012) and to allow scientists to build connections with the communities (UN Environment, 2019). Furthermore, citizen science facilitates international research collaborations, which are crucial considering that species are naturally not contained within country borders (Adler et al., 2020). Finally, it ameliorates the communication and interaction between local groups, academic institutions, and other stakeholders (Lavariega et al., 2020).

Given the above potential benefits of citizen science, understanding the factors that influence participation in citizen science is an important concern to ensure more and high quality data collection, and I address this issue in this thesis. I examine the interactions of actors and participants' motivations and shed light on alternative governance and management approaches concerning citizen science projects and platforms so that the potential benefits of citizen science, underlined above, can be realised.

In this introductory chapter, I present an introduction to citizen science by referring to its history, the fields in which citizen science is used, and the benefits it provides. I also provide a comprehensive picture of its background, present the debate on the terminology, and provide definitions and framing of citizen science and the classification of citizen science projects. This chapter concludes by presenting the motivations behind this thesis, its aims and contributions, as

well as the presentation of the chapters.

1.1.1 DEFINING CITIZEN SCIENCE

Researchers proposed various definitions and different terms to explain citizen science. The definition of citizen science that I consider in this thesis is the one by Bonney et al. (2016), which is, public participation in scientific research by collecting, submitting, or analysing data. Even though this definition summarises citizen science, there are other discussions that take place regarding its definition. I find it valuable to briefly present the discussion about how to define citizen science, because it gives insights about the non-limiting nature of citizen science in general.

For instance, Bonney et al. (2009) suggested using the term Public Participation in Scientific Research (PPSR) (Bonney et al., 2009), Shirk et al. (2012) supported the use of the term PPSR highlighting that it encompassed different terms and diverse fields (Shirk et al., 2012). Haklay et al. (2021) underlined that even though the US National Science Foundation (NSF) suggested the use of the term PPSR, aiming to be more inclusive beyond only legal citizens, it did not gain wide acceptance, and they warned against the risk of introducing an unused term instead of an encompassing one (Haklay, Fraisl, et al., 2021). By considering this ambiguity, Pelacho et al. (2021) made an extensive investigation of the different terms used for citizen science, aiming to reveal the articles in which the term citizen science has not been openly used (Pelacho et al., 2021). This was a significant step in bringing together the related terms and highlighting the commonly used ones. They concluded that citizen science is the most commonly used term in publications in their dataset (Pelacho et al., 2021). The list they developed is a valuable collection of the related terminology concerning citizen science. (Table 2)

Table 2. Commonly Used Terms in the Context of Citizen Science

Source: (Pelacho et al., 2021, p. 229)

1	Public participation in scientific research (PPSR)	(Haklay, 2015; Shirk et al., 2012; Theobald et al., 2015) and https://scistarter.org/citizen-science
2	Civic science	(Dillon et al., 2016; Haklay, 2015; Hand, 2010)
3	Participatory science	(Clarke, 2003; Haklay, 2015)
4	Amateur science	(Alberti, 2001; Gura, 2013; Haklay, 2015; Mims, 1999) and https://scistarter.org/citizen-science
5	Crowd-sourced science	(Franzoni & Sauermann, 2014; Haklay, 2015; Hand, 2010) Hand (2010) and https://scistarter.org/citizen-science
6	Crowdsourcing science	(Wiggins, 2010)

7	Crowdsourcing research	(Zhao & Zhu, 2014)
8	Crowd science	(Franzoni & Sauermann, 2014; Hand, 2010; Scheliga et al., 2018)
9	Collaborative science	Socientize Project (2013), (Chan et al., 2015; Hess & Ostrom, 2007)
10	Community science	(Carr, 2004; Haklay, 2015; Theobald et al., 2015)
11	Volunteer monitoring	https://scistarter.org/citizen-science and (Haklay, 2015)
12	Volunteer-based monitoring	(Maas et al., 1991)
13	Volunteer thinking	Socientize Project (2013), (Grey, 2009; Haklay, 2015; Yadav et al., 2018)
14	Volunteer computing	(Anderson et al., 2005; Haklay, 2015; Sarmenta, 2001; Yadav et al., 2018)
15	Participatory sensing	(Goldman et al., 2009; Haklay, 2015)
16	Crowdfunding science	(Ikkatai et al., 2018)
17	Contributory science	Considering the classifications of Bonney et al. (2009) and Shirk et al. (2012), in which they proposed the category contributory projects, as later Haklay (2013, 2015)

Additionally, Haklay et al. (2021) mentioned the digital volunteerism-related terms that are used in relation to citizen science like “People-Powered Science, Participatory Mapping, Volunteered Geographic Information (VGI), Community Remote Sensing, Citizen Observatories, Crisis Mapping and Citizen Generated Data” (Haklay, Fraisl, et al., 2021, p. 3).

Haklay et al. (2021) also investigated the different definitions of citizen science used by different institutions and countries across Europe. They highlighted the ambiguity of the term, which they considered as a strength in the sense of its non-limiting nature for broad coverage of citizen science activities, but as a problem concerning funding and policy making. They argue that different definitions also create confusion regarding what is considered citizen science and what is not and that there have been various efforts to set criteria for it. They concluded that different definitions complement each other, and this diversity serves the developing field of citizen science without putting limitations on it (Haklay, Dörler, et al., 2021).

In another study, Haklay et al. (2021) inquired into the common characteristics that practitioners consider in citizen science, and they argued that looking into what is not citizen science would address some ambiguities. To do so, they developed a vignette study where they prepared 50

vignettes with example cases and asked respondents who are familiar with citizen science to make selections based on their perception of whether the example is citizen science or not. They concluded that there are ambiguous points that cause doubt about different activities to be considered citizen science (Haklay, Fraisl, et al., 2021). However, these ambiguities show that citizen science should be considered context-specific, open, and fluid (Haklay, Fraisl, et al., 2021).

Along with these attempts to better frame and define citizen science, the European Citizen Science Association (ECSA) highlighted ten principles of citizen science (Table 3), which gives insights into the essence of citizen science.

Table 3. European Citizen Science Association (ECSA) 10 Principles of Citizen Science
Source: (ECSA (European Citizen Science Association), 2015)

1	Citizen science projects actively involve citizens in a scientific endeavour that generates new knowledge or understanding. Citizens may act as contributors, collaborators, or project leaders and have a meaningful role in the project.
2	Citizen science projects have a genuine science outcome.
3	Both professional scientists and citizen scientists benefit from taking part.
4	Citizen scientists may, if they wish, participate in multiple stages of the scientific process.
5	Citizen scientists receive feedback from the project.
6	Citizen science is considered a research approach like any other, with limitations and biases that should be considered and controlled for.
7	Citizen science project data and meta-data are made publicly available and where possible, results are published in an open-access format.
8	Citizen scientists are acknowledged in project results and publications.
9	Citizen science programs are evaluated for their scientific output, data quality, participant experience, and wider societal or policy impact.
10	The leaders of citizen science projects take into consideration legal and ethical issues surrounding copyright, intellectual property, data-sharing agreements, confidentiality, attribution, and the environmental impact of any activities.

The discussions around the definition and boundaries of citizen science that are presented in this section show that, citizen science is flexible, as Haklay et al. (2021) highlight. This flexibility is also a strength of citizen science, especially combined with the ECSA Principles of Citizen Science, not limiting it to certain definitions and boundaries and providing space for further application areas and further development. Next, I investigate the different classifications proposed regarding citizen science. The richness that is observed in terminology and definitions of citizen science is

also seen in different ways of classifying citizen science projects.

1.1.2 CLASSIFYING CITIZEN SCIENCE PROJECTS

The diversity of definitions of citizen science is reflected in how these projects are classified as well. Overall, citizen science projects are classified by considering the project's focus or the degree of participant involvement in the project (MacPhail & Colla, 2020).

a) Classifications According to the Focus of the Project/Platform

Nichols and Williams (2006) highlight targeted monitoring projects in which “the design and implementation of the monitoring are based on “a priori hypothesis” and surveillance monitoring which is not carried on by a priori hypothesis (Nichols & Williams, 2006, p. 668). Dickinson et al. (2010) emphasise this distinction in question-driven experimental projects that are experimental projects based on specific questions and “long-term data collecting and data monitoring” projects (Dickinson et al., 2010, p. 151). Silvertown (2009) embraces a parallel approach by identifying three categories: hypothesis-driven, volunteer mapping or monitoring, and tools, guidance, and resource provider projects. The first two categories are similar to the two categories identified by Nichols and Williams (2006) and Dickinson et al. (2010); the third category refers to projects that provide tools and resources for citizen science (Silvertown, 2009).

Wiggins and Crowston (2011) widened the categories according to the objective of the projects and highlighted five categories: action projects, conservation projects, investigation projects, virtual projects, and education projects. They refer to action projects as bottom-up projects initiated by volunteers with long-term goals regarding local environmental issues. Conservation projects aim at natural resource management, and data collection is the main focus together with educational goals. Investigation projects focus on data collection for scientific research in which educational goals are secondary. They state that these projects can become international and have a high number of participants. Virtual projects have fully ICT-oriented activities without physical participation, such as going to the field, which marks their difference from investigation projects. Education projects are the ones with the main objective of education and reaching wide audiences (Wiggins & Crowston, 2011).

Bonney et al. (2016) emphasise a broader categorisation as data collection projects, data processing projects, curriculum-based projects, and community science projects. They highlight that data collection and processing projects focus on data collection or processing, similar to the categorisations of other researchers, as mentioned above. Curriculum-based projects are usually

developed for younger audiences from primary school to high school; supervised by adults, they collect and submit data under a comprehensive citizen science project. Community science projects are data collection projects with the aim of having an impact on policy or decision-making processes in fields of public health or conservation. These are usually developed by the public and communicated to the scientists by reaching out to them (Bonney et al., 2016), similar to what Wiggins and Crowston (2011) suggest regarding the bottom-up nature of action projects.

b) Classifications According to the Degree of Participant Involvement

Citizen science projects are also categorised considering the degree of involvement of the participants. Bonney et al. (2009) distinguish contributory projects, collaborative projects, and co-created projects. They underline that in contributory projects, scientists design the project, and the public contributes by collecting data. Collaborative projects are the ones that are also designed by scientists in which the public can contribute by collecting data, as well as by contributing to project design processes, data analysis, or the dissemination of findings (Bonney et al., 2009). Co-created projects are designed together by scientists and the public, where participants take part in each step of the scientific process (Bonney et al., 2009).

Shirk et al. (2012) make a similar categorisation by suggesting five categories: contractual projects, contributory projects, collaborative projects, co-created projects, and collegial contributions. Contractual projects and collegial contributions are different categorisations than the previous identification made by Bonney et al. (2009). In contractual projects, the public reaches out to scientists to conduct specific scientific research, and collegial contributions refer to the research conducted by people without credentials to conduct research, and the degree of recognition of these projects varies (Shirk et al., 2012).

Haklay (2013) developed a participation framework that analysed the levels of engagement of participants with the project, such as crowdsourcing, in which citizens act as sensors; distributed intelligence, in which citizens act as interpreters; participatory science, which included defining the problem and data collection; and collaborative science, through defining the problem, collecting data, and analysing data (Haklay, 2013).

Pocock et al. (2017) adopt a simplified approach and highlight two categories for citizen science projects: mass participation, when participation is easy and by anyone, from anywhere, and systematic monitoring, which refers to the participation of trained volunteers (Pocock et al., 2017).

As shown, there are different ways of classifying citizen science projects. Overall, they are classified

according to the focus of the project and participant involvement in the project (MacPhail & Colla, 2020). In the next section, I present the aim, contribution and structure of the thesis.

1.2 AIM, CONTRIBUTION AND STRUCTURE OF THE THESIS

Having provided an introduction to citizen science, this thesis is concerned with the motivations of people to engage with online citizen science platforms. This is important because of several reasons. Citizen science provides various benefits such as: 1) data collection, submission, and/or analysis at scales that individual scientists or small scientific teams cannot do (Adler et al., 2020; Devictor et al., 2010; Jarvis et al., 2015); 2) investigation of the environmental and societal challenges such as effects of pollution, climate change, extinction of species, and ways of biodiversity and wildlife conservation (Deguines et al., 2020; Dickinson & Bonney, 2012; Larson et al., 2020); 3) creating learning opportunities for the public (Adler et al., 2020; Dickinson et al., 2012); 4) contributing to local empowerment (Larson et al., 2016; Phenrat, 2020); and 5) leading to collaboration among scientists and between scientists and public (Adler et al., 2020; Lavariega et al., 2020), as also highlighted above.

To specifically exemplify the role of citizen science in different scientific fields further, through the data obtained via eBird citizen science platform, over 930 scientific publications mainly in the field of ornithology and biodiversity conservation were published (*Publications - eBird Science, 2024*). Similarly, the projects under the Zooniverse citizen science platform which include space studies, language studies, social sciences, medicine, physics, climate studies, humanities, and ecology, led to over 480 scientific publications that utilise the data obtained through these projects (*Publications - Zooniverse, 2024*). Another example is from the citizen science projects under NASA (National Aeronautics and Space Administration); in refereed scientific publications, over 410 citizen scientists were named as co-authors and helped make thousands of scientific discoveries (*NASA - Citizen Science, 2024*). I investigate the motivational basis and behavioural dynamics in citizen science platforms to contribute to achieving these various benefits which span from science fields to the society. Because better understanding the participants means designing more efficient citizen science platforms in terms of addressing the needs and expectations of their users.

To encourage participation, one of the prerequisites is understanding what energises people to participate, including their needs and motivations (Raddick et al., 2013; Rotman et al., 2012; Shirk et al., 2012; Sullivan et al., 2014). Understanding the motivating factors for citizen scientists will result in designing more efficient citizen science projects and platforms in terms of the volume

and sustainability of participation (Rotman et al., 2012; Shirk et al., 2012), which in turn act as a tool in the creation of scientific knowledge and democratisation of science by inclusion of public in the scientific processes (Giardullo et al., 2023).

To do so, the research questions in this dissertation are as follows:

1. What different roles exist in online citizen science platforms?
2. What are the different motivations of participants in online citizen science platforms?
3. What types of participation can be distinguished in online citizen science platforms?
4. What are the negative externalities² arising from the relationship between the participants and the platforms, and how do platforms address these negative externalities?
5. Can we explain differences in users' active and passive participation by their motivations for birdwatching and engagement in a digital platform?
6. Regarding active and passive participation, is there an interaction effect between users' motivations for birdwatching and platform engagement?
7. Can we explain differences in users' active and passive participation by their perception of the importance of mechanisms that platforms use to address negative externalities?
8. Can we explain differences in users' active and passive participation by the values offered by the platform?

This thesis has several implications for citizen science platform/project managers, researchers, and policymakers. Identification of roles, motivations, participation types, and negative externalities leads to a better understanding of the structure and internal workings of these platforms, including the interaction patterns in the platform and the features of the platform. This understanding is important in developing, designing, and managing citizen science platforms and gives insights for future applications.

More specifically, examining different roles is the first step to analyse the motivations of these different roles, as well as to reveal the complex interactions between each role and their implications on participation. After the identification of roles, distinguishing motivations related to the subject of the platform and motivations for engaging with the platform make it possible to

² Externalities are the indirect effects of the actions of one stakeholder on other stakeholders (Laffont, 2008). Externalities are positive when others receive benefits and negative when others bear costs (Kreitmair & Bower-Bir, 2021). We will get into details of externalities in the following chapters.

target the necessary motivation category, as well as become aware of the interactions of different motivation types with each other in their influence on different ways of participation: active and passive participation³. Approaching participation in citizen science as active and passive allows for developing corresponding targeting strategies for participants. And lastly, identifying the negative externality situations gives insights into the related factors and how to solve them for the well-being of the platform, as well as for the knowledge created through the platform and for the participants.

In this thesis, I use a combination of qualitative and quantitative methods. Semi-structured in-depth interviews are used to obtain detailed information and insights about the experiences, thoughts, and motivations of participants regarding citizen science and the platforms. These interviews provided novel information and insights and led us to the development of the survey to test the prominent points that I identified. With regression analysis, I investigated the associations of different motivation types and platform characteristics with participation. This combination of qualitative and quantitative methods was important for this study in citizen science, first, to have a detailed picture, then to quantitatively test the hypotheses developed following the detailed analysis of the qualitative study.

I included platforms from two countries in this study: Turkey and France. Even though these two countries are similar in terms of the population using the internet (81% in Turkey and 86% in France) (World Bank, 2021), they are different in income levels, considering that Turkey is an upper-middle-income country and France is a high-income country (World Bank, 2023). Examination of the platforms from these two countries show similarities and differences in citizen science platform participation in different contextual settings.

As environmental sciences and ecology are among the significant areas in citizen science, and ornithology is one of the most rooted fields regarding the history of citizen science, I decided to select the platforms I examine in this project by considering these aspects. Thus, the context of the project for both qualitative and quantitative studies conducted under it, consists of the three platforms that are active in the field of ornithology, even if not limited by it. These platforms are

³ In this thesis, I refer to active participation as sharing data in the platform; passive participation as engaging with the platform through other ways such as following others' observations, reading information about birds, following statistics, reading publications, or following news sections. I provide further detail about participation types in Chapter 4.

Faune-France in France, eKuşbank (eBird Turkey), and Trakuş in Turkey.

When it comes to defining citizen science, I agree with Haklay et al. (2021) in terms of the strength that comes from the ambiguity of the term, which allows a non-limiting approach to it (Haklay, Dörler, et al., 2021). I also think the definition made by Bonney et al. (2016) to be a precise and comprehensive one: public participation in scientific research by data collection, submission, and/or analysis. I use this definition throughout the thesis. I argue that the engagement of people who are not scientists in scientific research in any way can be considered citizen science. This engagement can be in different forms, such as collecting data, analysing data, and/or submitting data, and other potential ways of engagement that are not limited to these, such as co-authoring scientific publications, or designing citizen science projects. The different classifications proposed in the context of citizen science, as mentioned above, explain different ways of engaging with the projects/platforms, for instance.

Chapter 2 presents a comprehensive literature review of the challenges, success factors, and motivation and participation studies in citizen science, as well as the theoretical background of the thesis. In Chapter 2, I show that even though motivations and participation occupy a significant place in citizen science literature, the need for further studies to shed light on the nature of motivations and participation is necessary. To do so, as the general framework throughout the thesis, I use the Institutional Analysis and Development (IAD) framework. This framework is commonly used in the literature of commons as a tool to understand their structure (Hess & Ostrom, 2007). The theoretical background also includes other theories and approaches that are used together with the IAD framework. These are, the commons theory, more specifically, knowledge commons theory; Multi-Sided Platforms (MSPs) approach; and Self-Determination Theory (SDT) to analyse the motivations.

Chapter 3 presents three platforms I examined in this study: Faune-France from France, eKuşbank (eBird Turkey) and Trakuş from Turkey. I used the guiding questions of the IAD framework for the analysis and presentation of the platforms in this chapter.

In Chapter 4, I present an empirical qualitative study to understand the nature of motivations and participation in citizen science in the platforms in Turkey and France. This analysis aims to examine the different roles participants play in citizen science platforms/projects and the consequences of the interactions among these roles and platforms. I focus on the value deals between various actors and negative externalities that may arise from the interactions between different roles and different participation types. I did so through in-depth, semi-structured interviews of the

participants of the three platforms investigated in this thesis. The theoretical framework of this chapter includes the motivation and participation literature in citizen science, the Multi-Sided Platforms (MSPs) approach to analyse the roles, value deals, and negative externalities, and knowledge commons literature to further shed light on the negative externalities arising from interactions. This chapter provides a unique point of view by incorporating the MSPs approach to citizen science platforms.

In Chapter 5, I present an empirical quantitative study with the objective of analysing the relationship between participation, motivations, value deals, and response mechanisms of platforms to negative externalities, which are identified among the results of the study presented in Chapter 4. To examine these relationships, I conducted a large-scale survey on the participants of the three platforms investigated in this study. The theoretical framework to analyse motivations is the Self-Determination Theory (Deci & Ryan, 2015; Ryan & Deci, 2000b). I investigated platforms' value deals with different parties and the solutions they provide to negative externalities using the MSPs approach. The data analysis started with confirmatory factor analysis to determine motivation variables, followed by multinomial logistic regression analysis to reveal the relationships between the variables on which I based the research questions and hypotheses.

Chapter 6 concludes the thesis by providing a general summary, presenting the examination of the three platforms using the IAD framework following the detailed analysis through the qualitative and quantitative studies, providing managerial implications, and discussing the potential limitations and future work.

2 REVIEW OF THE LITERATURE AND THE THEORETICAL BACKGROUND OF THE THESIS

2.1 INTRODUCTION

This chapter aims to explore the challenges that citizen science faces, the factors leading to success in citizen science, and the role of participant motivations; as well as presenting the theoretical background of the thesis. A preliminary literature survey revealed that one of the most important challenges in citizen science projects is related to the various aspects of citizen participation, which is also intuitive considering that participants are at the core of citizen science. By taking motivations to participate in citizen science as the main axis of research, I conducted a bibliometric analysis of motivations and participation in citizen science. Participation is referred to as initiating and sustaining the involvement of employees in volunteering activities in the context of corporate volunteering (Peterson, 2004). I consider participation as the involvement of participants in citizen science platforms by different means, such as sharing, reading, and interacting with the platform/project and its community.

When it comes to the challenges faced by citizen science, researchers previously identified factors like data quality and validity issues (Adler et al., 2020), increasing participation and learning, engaging new participants, retention of participants (Bonney et al., 2016; Killion et al., 2018), participant motivations (Bonney et al., 2016; Earp & Liconti, 2020), project design issues (Killion et al., 2018), privacy concerns (Anhalt-Depies et al., 2019; Fox et al., 2019), inclusiveness, digital divide, technology savviness (Fiske et al., 2019), and collaboration between scientists and laypeople (Cheung & Feldman, 2019).

Most of the above challenges are directly related to citizen scientists. For instance, many studies evaluated the accuracy of the data collected and identified by citizen scientists, underlining that it is accurate under appropriate conditions (Gibson et al., 2019; Safford & Peters, 2018). Increasing participation and retaining participants are also directly related to the citizen scientists. Sullivan et al. (2014) highlight that understanding the participants' needs will increase participation (Sullivan et al., 2014). Design of the citizen science projects is another challenge which is related to citizen scientists. For example, specifying learning outcomes (Shirk et al., 2012) and taking into consideration the motivating factors of participants during the design process (Rotman et al., 2012) are crucial for sustainable participation. Furthermore, participant motivations are also among the previously identified challenges. Understanding the perspectives of participants (Raddick et al.,

2013) and taking into consideration their needs (Shirk et al., 2012) and motivations (Rotman et al., 2012) are important factors for designing successful citizen science projects.

To contribute this line of research, I use the Institutional Analysis and Development (IAD) framework in this thesis, together with two theories, knowledge commons and Self-Determination Theory (SDT), and Multi Sided Platforms (MSPs) approach. The IAD framework is a tool used in examination of the commons (Hess & Ostrom, 2007), and in our case, knowledge commons because I consider these citizen science platforms to be knowledge commons. Commons is defined as a resource that a group of people share (Hess & Ostrom, 2007), which requires “a form of community management or governance” (Strandburg et al., 2017, p. 10). Citizen science platforms also act as hosting a resource shared by a group of people and they require community management practices, which I cover in the review of the literature through data-related, design-related, and user-related issues. Along with being knowledge commons, they are also *platforms*. Therefore, incorporating the platform point of view by using Multi-Sided Platforms (MSPs) approach will be useful in better understanding the motivations and participation dynamics. I also use Self-Determination Theory (SDT) from the psychology literature to analyse the motivations in Chapter 5, in which I will delve into further detail of SDT. Therefore, these three approaches complement each other in the case of citizen science. IAD framework is helpful because it provides an umbrella framework for the examination of these platforms. Knowledge commons is useful in terms of giving insights about the governance structures, and MSPs provides the platform point of view for the analysis. SDT is important as it focuses on the participant motivations.

Citizen science is a vast field, applicable in diverse areas such as the classification of data in astronomy, collection of data in environmental monitoring, or classification of historical reports. Previously, literature reviews concerning citizen science research focused on specific areas, such as citizen science in water quality monitoring (Quinlivan et al., 2020a), agricultural research participation (van de Gevel et al., 2020), best practices in citizen science, success factors in water quality monitoring citizen science (San Llorente Capdevila et al., 2020), citizen science in K12 science education (Tsivitanidou & Ioannou, 2020), citizen science in hydrological monitoring (Njue et al., 2019), outcomes for participants in biodiversity citizen science (Peter et al., 2019), and Volunteered Geographic Information (VGI) and citizen science (Mooney & Morgan, 2015), among others.

Considering the important role of citizen scientists in the success of citizen science projects and the vastness of the field, I decided to focus on an important research area under citizen science.

Thus, I conducted a bibliographic coupling analysis of citizen science research by focusing on the motivations and participation in citizen science so as to identify common themes that emerged in previous research. This analysis provided further insights regarding success factors in citizen science platforms, confirming the motivations of participants as an important success factor behind citizen science projects. I expanded the review beyond the data obtained for bibliometric analysis and conducted further research based on the identified themes for a more comprehensive analysis.

I further scanned the previous bibliometric studies on citizen science. I saw that researchers used different bibliometric tools to understand different aspects of citizen science research, such as collaboration and co-authorship networks (Pelacho et al., 2021), methodologies and research questions (Hajibayova et al., 2021), theories and methodologies (Hajibayova, 2020), different fields that use citizen science (Kullenberg & Kasperowski, 2016), and common subjects in citizen science (Follett & Strezov, 2015). Considering the previous areas of research conducted using bibliometric tools, this study contributes to this field by focusing on motivations and participation in citizen science.

In this chapter, challenges and success factors of citizen science, including the data quality, validity, and verification issues, project/platform design approaches in citizen science, and their connection with participation motivations in citizen science projects/platforms, are discussed. This review is followed by the presentation of the theoretical background of the thesis. Conclusions follow.

2.2 DATA AND METHOD

The term “bibliometrics” was coined by Alan Pritchard in the late 1960s (De Bellis, 2009). Bibliometrics is a “set of quantitative methods used to measure, track, and analyse print-based scholarly articles” (Borchardt & Chin Roemer, 2015, p. 28).

Citation analysis is an area of bibliometrics that examines the citations to and from documents. Researchers have carried out citation analysis so as to investigate the history of science, explaining the relations between the past and present research (Garfield, 1979/1983), “identifying and mapping research fronts, defining disciplines and emerging specialties, analysing the interdisciplinary and multidisciplinary characters of the fields, examining the impact of research projects” (Garfield, 1983, p. 136), and “information retrieval, scientometric evaluation, and outlining the topical structure of different fields” (Marshakova, 1981, p. 13).

There are two ways of conducting citation analysis: bibliographic coupling analysis and co-citation analysis. In bibliographic coupling, “two papers are related because they cite other common papers; and in co-citation analysis, two papers are related because they are both cited by the same papers” (Garfield, 1988, p. 162). Figure 2 illustrates the bibliographic coupling and co-citation analyses.

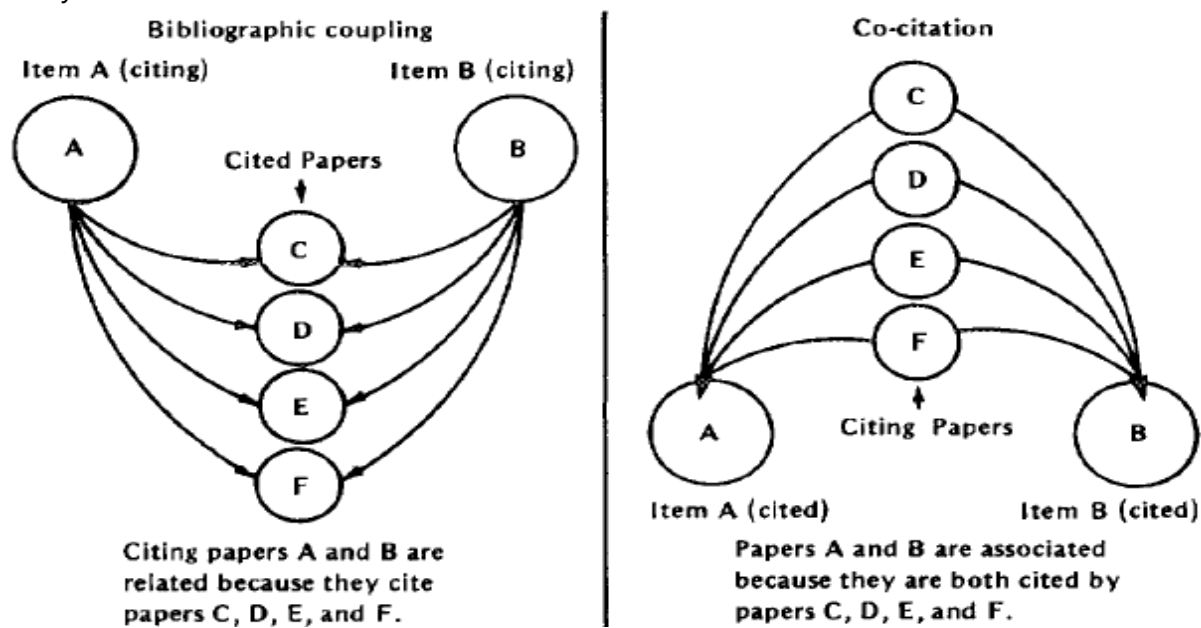


Figure 2. Bibliographic Coupling and Co-Citation Analysis

Source: (Garfield, 1988, p. 162)

So as to explore the evolution of research on citizen science and participation motivations in citizen science, I carried out a bibliographic coupling analysis. This clustering analysis helped to identify the main knowledge domains and the gaps that need to be addressed. I used bibliographic coupling analysis, considering that the analysis of core documents gives insights into the popular research topics and is used for science mapping (Glänzel & Czerwon, 1996; Jarneving, 2007). Moreover, bibliographic coupling analysis stands out as more advantageous than co-citation analysis, especially in better capturing the early stages of the evolution of a research field (Glänzel & Czerwon, 1996; Jarneving, 2007). Being aware of possible limitations of bibliographic coupling, such as the lack of evaluative research to use it for science mapping (Jarneving, 2007) or the possibility of missing more recent papers in the review, I employed further Web of Science and Google Scholar searches throughout the research. To summarise, the research was conducted in three stages. First, data collection and analysis using content analysis; second, a clustering analysis to identify the core cluster and the main themes; and third, complementary literature collection.

In the first stage, I conducted a Web of Science search on participation motivations in citizen science. The search aimed to retrieve articles related to participation and motivations in citizen science so as to conduct a bibliometric analysis. I retrieved the articles on December 11, 2020, from the Web of Science core collection. I did not apply a time filter. A total of 878 articles were included in this dataset⁴.

The search query was < "citizen science" and (motivation or participation) >. There are other terms being used in the literature which correspond to citizen science, as mentioned in the previous chapter. However, *citizen science* remains to be the most widely used term; therefore, I expected to obtain reliable results for the identification of the common themes by using this term, in the first step of the literature review. To exemplify, in their bibliometric study, Pelacho et al. (2021) also discuss the debate around the terms used to refer to citizen science, and they further conduct an analysis to see if the term *citizen science* is "unequivocal enough to be used as a generic term that includes a wide range of activities" (Pelacho et al., 2021, p. 228). They conclude that it is indeed enough to use the term *citizen science*. They highlight that the term citizen science is clearly the dominant term among the 17 other terms⁵, and by reducing their search term to citizen science, network analysis is expected to be robust in case of small changes (Pelacho et al., 2021). Similarly, Follett and Strezov (2015), in their bibliometric analysis, used the term *citizen science* only, and they further had to remove the references which did not correspond to the definition of citizen science in the Green paper of citizen science (Follett & Strezov, 2015). These studies show that even though there are discussions around the terminology in citizen science, the most widely used term is *citizen science*.

Therefore, I used the term citizen science in the search performed on Web of Science (WoS), to obtain the dataset which I use for the identification of the main themes of research in citizen science; and I further expanded the research beyond the term of *citizen science* after the identification of common themes to include other articles that possibly use other terms, in the examination of these common themes. As also Pelacho et al. (2021) underline in their bibliometric

⁴ The original dataset included 882 articles, but the references of 5 articles were missing, so I did not include them in the final dataset.

⁵ More specifically, they searched the terms citizen science, public participation in scientific research, civic science, participatory science, amateur science, crowdsourced science, crowdsourcing science, crowdsourcing research, crowd science, contributory science, collaborative science, community science, volunteer monitoring, volunteer-based monitoring, volunteer thinking, volunteer computing, participatory sensing, and crowdfunding science.

study, I didn't expect the overall results for the identification of the common themes to differ. But I included those other terms in the further examination of the common themes that I identified.

For the analysis of the data, first, common themes were examined through a content analysis of the abstracts of 878 articles. Content analysis is "a research method that provides a systematic and objective means to make valid inferences from verbal, visual, or written data to describe and quantify specific phenomena" (Downe-Wamboldt, 1992, p. 314). Therefore, I used content analysis as the appropriate tool to delve into the common themes found in the papers in the dataset.

Second, I used network analysis to carry out bibliographic coupling of articles in the dataset. On the network, nodes represent articles; lines connecting the two nodes (edges) represent common citations between the articles. I used Pajek software (Batagelj & Mrvar, 2004) for the network analysis. In this way, I identified the core set of articles, which consisted of 29 articles, using network analysis. I also examined the articles in the core set in terms of their subjects and themes.

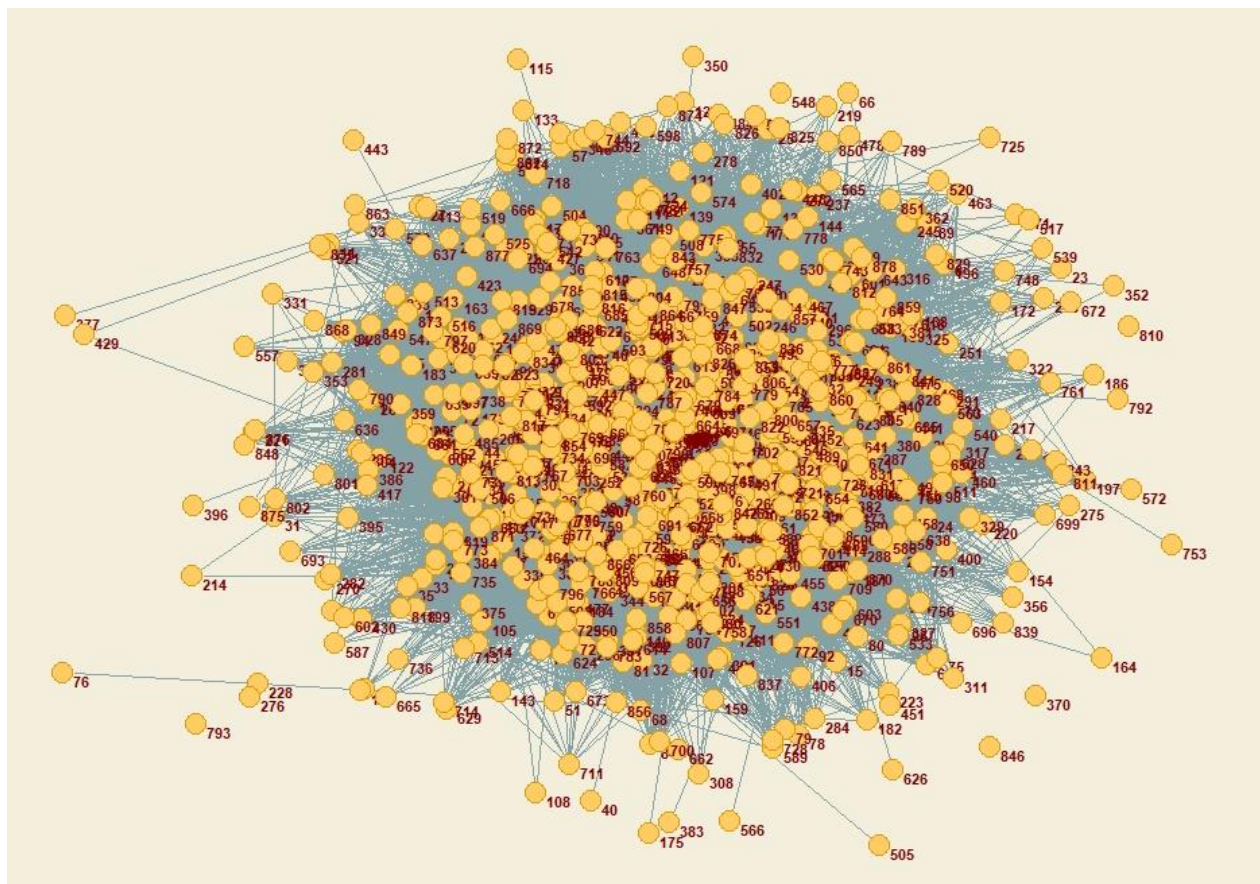


Figure 3. Full Network of 878 Articles

The process of extracting the core set of articles started with the visualisation of the full network

(Figure 3). Considering that the full network does not provide insights as it is, to reach the core of the network, I made different trials by changing the number of common citations that the articles in the network have. I saw that the network gets smaller as the number of common citations between the articles increased, eventually leading to a core cluster which consists of articles that share more than 20 citations. In other words, the core set consists of articles with more than 20 common citations. When the number of common citations was increased above 25, the network became disconnected. Because of that, I considered the 29-article cluster as the core cluster or core set (Figure 5).

As mentioned before, the research included in this review is not limited to the initial dataset retrieved from the Web of Science used for bibliometric analysis. Based on the findings from bibliometric analysis, I identified the common themes, then I further searched related studies not included in the initial dataset to make sure that research not included in bibliometric analysis is not missed out. In the next section, I present the common themes that I found. These themes correspond to challenges and success factors in citizen science.

2.3 COMMON THEMES: CHALLENGES AND SUCCESS FACTORS IN CITIZEN SCIENCE

Figure 4 shows the number of articles published per year. Papers in the data set start from the year 2000, even though I did not apply a time filter. This might be because citizen science is a relatively new term, dating back to the late 80s (Haklay, Dörler, et al., 2021) and early 90s (Hecker et al., 2018; Pelacho et al., 2021). According to the articles in the data set, motivation or participation research concerning citizen science appears to have started around the 2000s.

There is an increasing trend in the number of articles published each year. There is a slight decrease in 2020. This decrease might be due to the COVID-19 pandemic or the delay in publications. The increase in publications concerning citizen science is in line with the findings of previous studies (Bautista-Puig et al., 2019; Follett & Strezov, 2015; Kullenberg & Kasperowski, 2016; Pelacho et al., 2021).

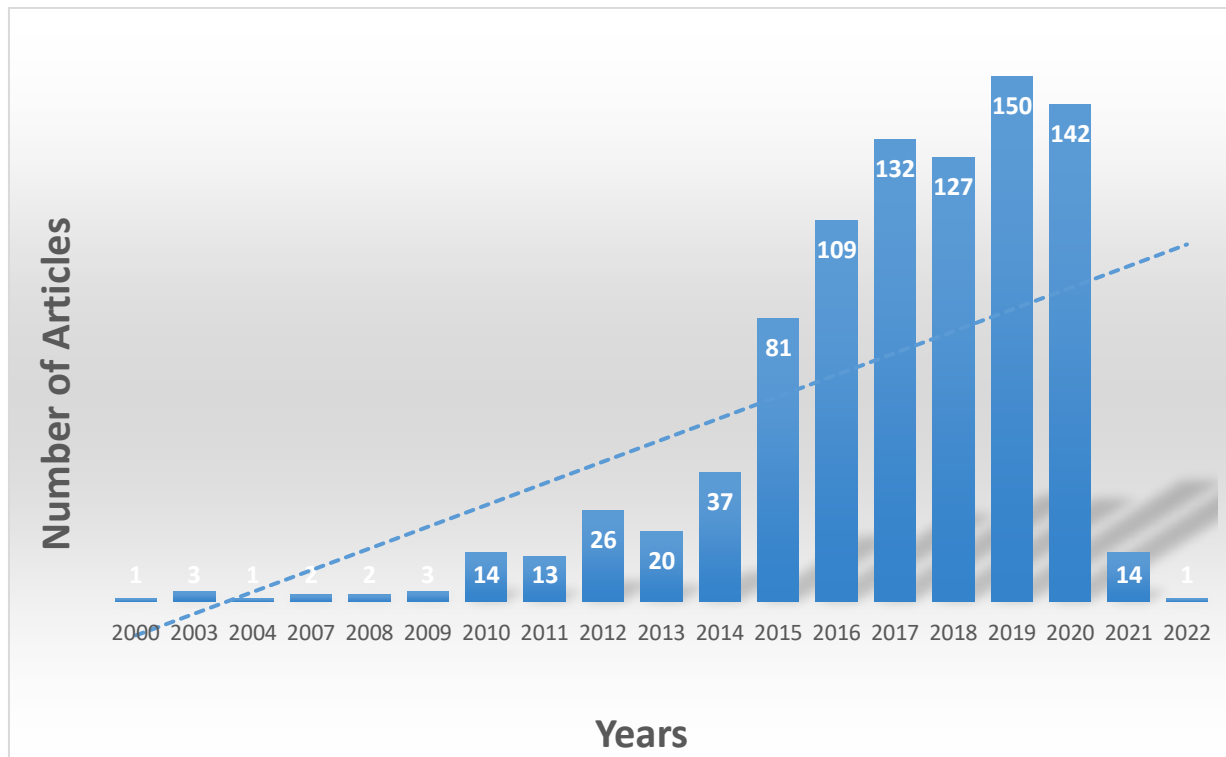


Figure 4. The Articles Published per Year

I first identified common themes of the articles in the dataset by examining the abstract sections of all articles in the dataset. By common themes, I refer to the subjects of the articles that I analyse. I aimed to find the widely researched subjects in the articles in the dataset. As a result, I identified the most common subjects of research. Through this categorisation of themes, I identified the common areas of past research related to the motivations for participation in citizen science. I identified the following research themes:

- Citizen science project/platform design (207 papers)
- Motivation for participation in citizen science (129 papers)
- Behaviour, change of behaviour, and participation in citizen science (112 papers)
- Data quality, validity, verification, and accuracy in citizen science (104 papers)
- Policy (63 papers)
- Students and education (48 papers)
- UN Sustainable Development Goals (SDGs) (13 papers)

Some papers share more than one theme; for instance, design and motivations can appear together in one paper. Some themes that I identified correspond to the challenges mentioned in previous studies, such as data quality, validity, and consistency (Adler et al., 2020; Bonney et al.,

2016; Earp & Liconti, 2020; Rotman et al., 2012), increasing participation and enhancing learning (Adler et al., 2020; Bonney et al., 2016), motivations of participants (Earp & Liconti, 2020), design of citizen science projects (Killion et al., 2018). Therefore, we can say that the research regarding citizen science and motivation evolved by addressing the previously highlighted challenges in citizen science.

Following the examination of the articles in the whole dataset and identifying these common themes, I conducted bibliographic coupling analysis in the second step. Figure 5 illustrates the 29-node core cluster after reducing the number of common citations among the articles.

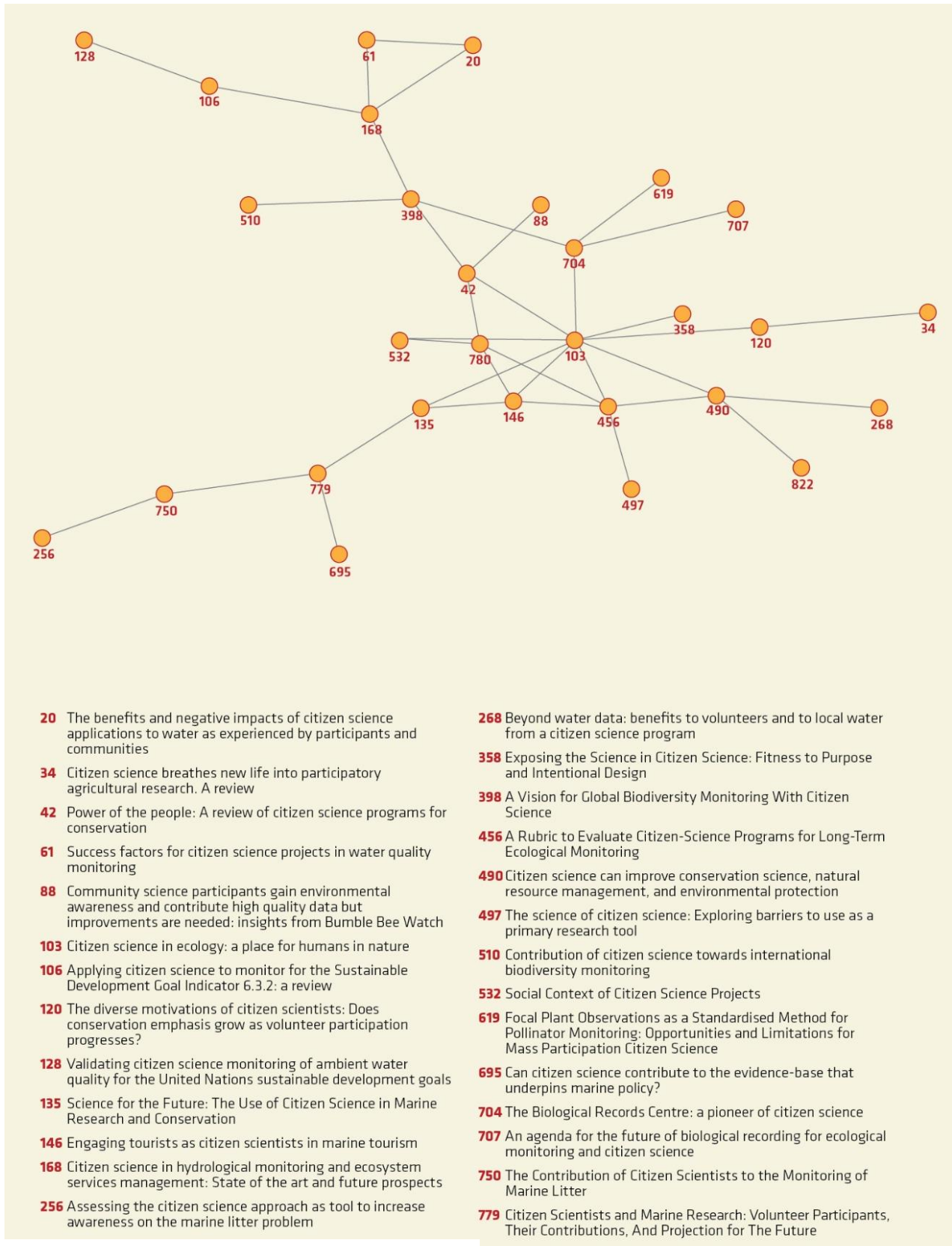


Figure 5. Core Cluster of 29 Articles

I examined the themes and subjects of the articles in the core cluster, as shown in Table 4. They largely correspond with the main themes identified by examining the whole dataset. Table 4 shows the 29 articles in the core cluster with their matching themes, authors, and publication years.

These first two steps in literature review were helpful to derive the common themes. The brief explanation of common themes are provided below. In the next section, I delve into their details by conducting further research beyond the initial dataset by including other terminology used related to citizen science.

Table 4. 29 Core Cluster Articles with Themes

Title	Authors & Publication Year	Theme
The benefits and negative impacts of citizen science applications to water as experienced by participants and communities	(Walker et al., 2021)	Organisational issues
Citizen science breathes new life into participatory agricultural research. A review	(van de Gevel et al., 2020)	Review, benefits
Power of the people: A review of citizen science programs for conservation	(MacPhail & Colla, 2020)	Organisational and user-related issues
Success factors for citizen science projects in water quality monitoring	(San Llorente Capdevila et al., 2020)	Organisational issues
Community science participants gain environmental awareness and contribute high quality data but improvements are needed: insights from Bumble Bee Watch	(MacPhail et al., 2020)	User-related issues
Citizen science in ecology: a place for humans in nature	(Adler et al., 2020)	User and data-related issues
Applying citizen science to monitor for the Sustainable Development Goal Indicator 6.3.2: a review	(Quinlivan et al., 2020a)	SDGs and Organisational issues
The diverse motivations of citizen scientists: Does conservation emphasis grow as volunteer participation progresses?	(Larson et al., 2020)	User-related issues
Validating citizen science monitoring of ambient water quality for the United Nations sustainable development goals	(Quinlivan et al., 2020b)	SDGs and Data-related issues
Science for the Future: The Use of Citizen Science in Marine Research and Conservation	(Earp & Liconti, 2020)	User and data-related issues
Engaging tourists as citizen scientists in marine tourism	(Schaffer & Tham, 2019)	Organisational issues

Citizen science in hydrological monitoring and ecosystem services management: State of the art and future prospects	(Njue et al., 2019)	Organisational issues
Assessing the citizen science approach as tool to increase awareness on the marine litter problem	(Locritani et al., 2019)	User-related issues
Beyond water data: benefits to volunteers and to local water from a citizen science program	(Church et al., 2019)	User-related issues
Exposing the Science in Citizen Science: Fitness to Purpose and Intentional Design	(Parrish et al., 2018)	Organisational issues
A Vision for Global Biodiversity Monitoring With Citizen Science	(Pocock et al., 2018)	SDGs and policy-related issues
A Rubric to Evaluate Citizen-Science Programs for Long-Term Ecological Monitoring	(Tredick et al., 2017)	Data-related and organisational issues
Citizen science can improve conservation science, natural resource management, and environmental protection	(McKinley et al., 2017)	Policy-related and organisational issues
The science of citizen science: Exploring barriers to use as a primary research tool	(Burgess et al., 2017)	Data-related issues
Contribution of citizen science towards international biodiversity monitoring	(Chandler et al., 2017)	Organisational issues
Social Context of Citizen Science Projects	(Tiago, 2017)	History, user-related and organisational issues
Focal Plant Observations as a Standardised Method for Pollinator Monitoring: Opportunities and Limitations for Mass Participation Citizen Science	(Roy et al., 2016)	Organisational and data-related issues
Can citizen science contribute to the evidence-base that underpins marine policy?	(Hyder et al., 2015)	Policy-related issues
The Biological Records Centre: a pioneer of citizen science	(Pocock et al., 2015)	Data-related issues
An agenda for the future of biological recording for ecological monitoring and citizen science	(Sutherland et al., 2015)	Policy and organisational issues
The Contribution of Citizen Scientists to the Monitoring of Marine Litter	(Hidalgo-Ruz & Thiel, 2015)	Data-related issues
Citizen Scientists and Marine Research: Volunteer Participants, Their Contributions, And Projection for The Future	(Thiel et al., 2014)	User-related issues
Citizen Science: A Tool for Integrating Studies of Human and Natural Systems	(Crain et al., 2014)	Organisational issues
When peer-reviewed publications are not enough! Delivering science for natural resource management	(McKinley et al., 2012)	Policy-related issues

I grouped these themes under three headings: data-related factors, organisational factors, and

user-related factors. These are in line with the challenges that citizen science face, highlighted in the literature (Adler et al., 2020; Bonney et al., 2016; Killion et al., 2018). I also found some additional themes which were not previously mentioned among challenges in the literature. These are, students and education, policy-related issues, and the UN Sustainable Development Goals (SDGs).

Common themes about challenges and success factors in citizen science:

- Data-related factors:
 - Data quality, validity, verification, and consistency issues (Acorn, 2017; Adler et al., 2020; Bonney et al., 2016; Earp & Liconti, 2020; Ekman & Weilenmann, 2021; European Commission, 2020; Hecht & Spicer Rice, 2015; Riesch & Potter, 2014; Rotman et al., 2012; UN Environment, 2019; Wiggins & He, 2016)
 - Privacy concerns (Anhalt-Depies et al., 2019; Fox et al., 2019; UN Environment, 2019)
- Organisational factors:
 - Design and organisational issues (Chesser et al., 2020; European Commission, 2020; Killion et al., 2018; Rotman et al., 2012)
 - Inclusiveness, digital divide, technology savviness (Fiske et al., 2019; Walker et al., 2021)
- User-related factors:
 - Increasing participation, engaging new participants, retention of participants, and participation behaviour (Adler et al., 2020; Bonney et al., 2016; Killion et al., 2018)
 - Motivations (Bonney et al., 2016; Earp & Liconti, 2020; Ellis, 2020; He et al., 2019; Hennig, 2020; Larson et al., 2020; Martin & Greig, 2019; UN Environment, 2019; Wehn & Almomani, 2019)

Additional themes that I have identified are briefly presented below:

- Students and education:

Previous research discussed the role of students in citizen science and the potential of citizen science in education (Aivelo & Huovelin, 2020; Kocman et al., 2020; Schneiderhan-Opel & Bogner, 2020). Even though education-related articles were not among the core articles, when I analysed the whole dataset of 878 articles, 43 articles appeared to share the theme of citizen science in education and the role of students in citizen science.

- Policy implications:

Recommendations for integrating citizen science in policy making (Pita et al., 2020) and discussing the policy implications of citizen science (Wamsler et al., 2020) are among the recurring themes,

with 63 studies identified in the dataset. Even though not mentioned among the challenges of citizen science, other studies highlighted policy implications as well (Haklay, 2015; Nascimento et al., 2018).

- The United Nations Sustainable Development Goals (SDGs):

The UN SDGs appear to become prominent after the United Nations began to refer to citizen science in its reports, such as the United Nations Environment Programme (UNEP) report “A Snapshot of the World’s Water Quality: Towards a global assessment” (UNEP, 2016) or UN-Water report “Sustainable Development Goal 6: synthesis report 2018 on water and sanitation” (UN Water, 2018). The impact of an institution such as the UN mentioning citizen science as a way to support policy goals is visible in scientific publications. The first mention of SDGs in the abstract of an article in the dataset dates back to 2018, aimed at investigating citizens’ role in changing biodiversity monitoring (Pocock et al., 2018). Several articles discussed the ways for citizen science to contribute to SDGs (Fraisl et al., 2020; Quinlivan et al., 2020b; Schleicher & Schmidt, 2020; Shulla et al., 2020; Wuebben et al., 2020). Shulla et al. (2020) reviewed 127 citizen science projects in Germany, and they highlighted that many projects coincide with SDG 4 (Shulla et al., 2020), “Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” (United Nations, 2015). Also, there are three articles (Fraisl et al., 2020; Quinlivan et al., 2020b, 2020a) that focus on SDG 6, “Ensure availability and sustainable management of water and sanitation for all” (United Nations, 2015); they investigated citizen science in water monitoring. In total, there were references to nine SDGs in several articles in the dataset. These are SDGs 2, 3, 4, 6, 7, 11, 12, 15, and 17, indicating their existing and potential utilisation of citizen science to contribute to the Goals. Three articles (Cappa et al., 2020; Pocock et al., 2018; Quinlivan et al., 2020b) mentioning SDGs in abstracts were among the 29-article core cluster. This was one of the reasons that I decided to refer to SDGs among the common themes.

Having presented the common themes that were identified, below, I examine how previous research in citizen science approached these themes. As mentioned before, this part of the study was not limited to the initial dataset and thus included information obtained from further search.

2.3.1 DATA-RELATED FACTORS: VALIDITY, QUALITY, VERIFICATION, PRIVACY OF DATA, AND INCLUSIVENESS

Ensuring that data shared by citizen scientists is of high quality, valid, and verified stands out as one of the main issues in citizen science (Kosmala et al., 2016; Wiggins & He, 2016). One of the

biggest concerns of scientists in a citizen science project is the quality of data coming from the citizen scientists (Rotman et al., 2012; Wiggins & Crowston, 2015). Therefore, previous research explored the validity and the accuracy of data collected by citizen scientists (Gibson et al., 2019; Safford & Peters, 2018) and identified the conditions to ensure valid and high-quality data (Kosmala et al., 2016; Parrish et al., 2018). Understanding the motivations of participants when they share data stands out as one of the factors in having more accurate and higher-quality data.

a) Validity and Accuracy of Citizen Science Data

The validity and accuracy of data collected by citizen scientists stand out as one of the data-related challenges citizen science faces. The accuracy of the data depends on the experience of the participant and the level of difficulty of tasks, but obtaining better quality is possible when certain conditions are ensured (Kosmala et al., 2016). In one study, researchers examined the accuracy of identification of shark species in terms of data validation, and they found that citizen scientists were able to identify different shark species with minimal error (Gibson et al., 2019). In another study examining the reliability of volunteer-collected data on the dissolved oxygen levels in freshwater streams, researchers found that it can provide reliable results in the context of their study (Safford & Peters, 2018). Researchers in a different study about biodiversity monitoring on a wood-boring insect prepared a semi-automated method to increase the correct identification of the species, and they found that even the inexperienced volunteers managed to identify it correctly (Goczał et al., 2017). A study concerning the sample collection from marine surface waters further confirmed the reliability of citizen science collected data as the authors highlighted that the measurements made by citizen scientists are comparable with the scientific measurements (Schnetzer et al., 2016).

In another study on pika observation, Moyer-Horner et al. (2012) investigated the observer variability among professionals, among volunteers, and between professionals and volunteers. Their findings suggested that volunteers were reliable in detecting pika site occupancy. However, they advised data collection by professionals because they found volunteers to be less reliable. (Moyer-Horner et al., 2012).

In a different study, Wiggins and He (2016) examined the predicting factors of data validation in the context of an online application, iNaturalist, and they found that socialisation positively affected community validation efforts. They also highlighted a trade-off in citizen science between engagement with the platform and data quality. They underlined that the PC is more likely to be used to upload bird-related data that is more valid compared to the mobile application. They

further emphasised that the taxon being observed determines the data verification efforts of the community (Wiggins & He, 2016).

In summary, research showed that the data collected by citizen scientists is accurate enough to consider in scientific research. However, in some fields, data collected by professionals may be of better accuracy.

b) Ways to Ensure the Quality and Trustworthiness of Citizen Science Data

The common tools to ensure data quality include using automatic filters (Bonter & Cooper, 2012; Hochachka et al., 2012), training and education of the participants (Parrish et al., 2018), expert reviews (Bonter & Cooper, 2012; Hochachka et al., 2012; Kosmala et al., 2016), and field-specific technical solutions (Wu et al., 2021).

Several researchers emphasise the use of automatic smart filters in citizen science projects (Bonter & Cooper, 2012; Hochachka et al., 2012). Smart filters warn users in case of a potential mistake; however, the authors underline that even though these mechanisms manage to detect incorrect entries, they fail to detect if an entry is incorrect but plausible (Bonter & Cooper, 2012).

Another approach to ensure high-quality data collection in citizen science is proper training and education of the participants in different fields. Previous examples include citizen science projects dedicated to measuring and recording groundwater levels (Manda et al., 2021), segmentation of the spine from a dataset of magnetic resonance images (Meakin et al., 2019), and monitoring bees (Mason & Arathi, 2019). However, researchers underlined that achieving such an outcome is very demanding in terms of time and effort (Manda et al., 2021). Parrish et al. (2018) also highlighted that training provided by experts and using properly designed materials are efficient factors in ensuring data quality, especially in small to medium-scale projects (Parrish et al., 2018). Review by experts and volunteers is another way of ensuring the quality of data collected by citizen scientists (Bonter & Cooper, 2012; Hochachka et al., 2012; Kosmala et al., 2016).

An alternative approach for better accuracy of citizen science data has focused on the secondary analysis of the already obtained data in the projects (Peterman et al., 2022). The authors showed that by using this data, it is possible to evaluate the skills of citizen scientists, potentially resulting in understanding the participants better and having better data accuracy (Peterman et al., 2022).

As a way to obtain better quality data and increase data reliability, some citizen science projects use field-specific technical solutions. For example, using analytical techniques to identify and quantify data retrospectively, such as species distribution modelling used in eBird (Hochachka et

al., 2012), using prediction models such as decision tree methods, which allow the detection of errors and outliers in the dataset exemplified in the field of hydrology (Wu et al., 2021), or percentile-based outlier removal used in plant phenology (J. S. Li et al., 2020). Another study also highlighted that when the data collection is simple and the process is backed up with algorithm voting, statistical pruning, or computational modelling, it is possible to ensure high-quality data with high participation levels (Parrish et al., 2018).

Egerer et al. (2019) underline that improving the dialogue between citizen scientists and researchers is another key point to improve the validity of data reporting. In their paper on biodiversity conservation, Egerer et al. (2019) found that citizen scientists interpret instructions differently, and as a result, they report in different ways, whereas scientists want clarity and consistency in reporting (Egerer et al., 2019).

In a more recent study, researchers examined the data management practices of citizen science projects and provided recommendations to improve data management in citizen science. Their recommendations were about data quality, infrastructure, governance, documentation, and access, aiming to provide a guide for more productive use of citizen science data (Bowser et al., 2020).

To summarise, the methods used to ensure the quality of data that fits the requirements of different fields vary. The common methods include automatic filters, technical solutions for specific fields, training of citizen scientists, and having professionals included as reviewers.

c) Privacy of Citizen Science Data

Previous studies in citizen science raised the issue of data privacy. One study highlighted that collected data might include sensitive information about private land and endangered species; thus, the authors emphasise trade-offs between having valuable open data and privacy concerns (Anhalt-Depies et al., 2019). Fox et al. (2019) highlight concerns about citizen science data regarding possible undesired adverse effects on conservation, potential violations of privacy, and commercial usage of collected data. The authors suggested finding ways to use the data for the benefit of science and society in the best possible way while restricting the use of data commercially and protecting sensitive data (Fox et al., 2019).

Having presented the issues about data validity, quality, and privacy in citizen science, next, I discuss the organisational factors, more specifically, factors related to design in citizen science.

2.3.2 ORGANISATIONAL FACTORS: PROJECT/PLATFORM DESIGN IN CITIZEN SCIENCE

The design of the citizen science project stands out as one of the main issues in citizen science literature, which is also an instrument to address some challenges. I examine the design principles under four headings:

- a. Focus on the needs of and outcomes for participants: learning, inclusion, and motivations
- b. Focus on the needs of and outcomes for science and scientists
- c. Focus on the local needs and outcomes
- d. Communication and collaboration

I explain each heading in more detail below.

a) The needs of and outcomes for participants: learning, inclusion, and motivations

Taking into consideration the participant's needs and outcomes is essential for high-quality participation (Shirk et al., 2012), participant retention, and increasing participation (Rotman et al., 2012). In a study on the MyShake platform, which is a global platform for recording earthquakes, researchers redesigned the user interface considering the needs and motivations of the participants, showing that needs and motivations play an important role in the design process (Rochford et al., 2018). Similarly, the importance of accounting for personal advantages (Killion et al., 2018), providing benefits to participants (Chesser et al., 2020), ensuring a favourable user experience (Golombic et al., 2020), creating meaningful experiences for participants, tailoring the citizen science projects according to different segments of the public (Lakomý et al., 2020), and adding up to the skills of participants (Dean et al., 2018) are crucial for effective citizen science projects. The user-centric design in a citizen science project is important for the retention of participants (Golombic et al., 2019), showing how needs and motivations are entangled with the design process.

Setting specific learning objectives for the participants by acknowledging that learning will not occur by itself (Bonney et al., 2016) and ensuring that participants learn and develop new skills as a result of being part of the project (Shirk et al., 2012) are important when designing a citizen science project. For example, in a study conducted in the field of marine citizen science, recreational scuba divers, as citizen scientists, were surveyed in two different diving areas, and the authors concluded that specified training courses should be provided according to the different expectations of divers (Hermoso et al., 2021). In addition, respecting cultural differences and beliefs and employing necessary safety precautions for the physical, psychological, and cultural well-

being of all parties is critical (Chesser et al., 2020).

Considering participants' motivations during the design process is crucial for participation to be sustainable (Rotman et al., 2012). So as to ensure retained motivation and participation, paying attention to timing to make sure of using appropriate materials at the right time is vital (Rotman et al., 2012). Golumbic et al. (2020) underlined the importance of creating motivation and empowerment for a successful citizen science project (Golumbic et al., 2020). Shirk et al. (2012) highlighted that the extent of involvement of participants in scientific processes like data collection or analysis is important to consider in designing a citizen science project because it affects the project outcomes. Furthermore, the authors state that the alignment and relevancy of project goals with the requirements and interests of participants are points to consider in design processes to ensure the desired impact on environmental conservation (Shirk et al., 2012).

Martin et al. (2016) underlined that perceived barriers to participation are also among the factors to consider when designing citizen science projects. Such barriers might be beyond the control of the project team, like the weather, or they might be reflected in the design process, for example, the possibility to enter data in case of the absence of an internet connection (Martin et al., 2016).

Participant-specific aspects are also important to measure, like "interest in science and nature, self-efficacy for science and environmental action, motivation for science and environmental action, skills of scientific inquiry, data interpretation skills, knowledge of the nature of science, and environmental stewardship" (Bonney et al., 2016, p. 11).

Inclusion is a different point to consider in project design. Ensuring the inclusion of minorities and marginalised groups (Chesser et al., 2020; Fiske et al., 2019) and adapting projects to provide opportunities for the participation of different publics (Chesser et al., 2020) were among the points researchers emphasised. Lack of technology savviness and the digital divide can be obstacles to inclusiveness (Fiske et al., 2019). For example, in a study about the role of citizen science in medical research, researchers highlighted the limited accessibility of the benefits that citizen science provides, especially for people with a lack of resources, minorities, marginalised groups, and those who were out of the healthcare networks (Fiske et al., 2019).

A way of increasing participation and its quality is gamification. For example, using games as a tool can increase the competence of citizen scientists in the identification of birds correctly (Bonter & Cooper, 2012). Gamification can increase the number of participants and the time they spend on the project and further motivate participants by providing rewards (Brazil & Albagli, 2020).

However, a warning regarding gamification is the possibility of directing the actions of participants by limited choices on the interfaces of platforms (Brazil & Albagli, 2020). Similarly, designing the citizen science project as a game is important to increase participation (Loureiro et al., 2019; McCallum et al., 2018), enjoyment on the side of participants (Tang & Prestopnik, 2019) and the levels of engagement of participants (Palacin-Silva et al., 2018).

In summary, while designing citizen science projects, it is crucial to consider the user side and their experiences. Understanding what motivates participants, their needs, and the ways to align these with the project objectives are important factors to consider when designing citizen science projects that ensure good quality participation.

b) The needs of and outcomes for science and scientists

A different point in design processes is concerned with the needs of and the outcomes for science and scientists. For example, having robust scientific goals (Golumbic et al., 2020) and ensuring that scientists benefit (Walker et al., 2021) are important to consider when designing citizen science projects. More specifically, for environmental conservation projects, Shirk et al. (2012) stated that the project's impact on environmental conservation should be ensured by considering the research outcomes, which are scientific findings (Shirk et al., 2012).

c) Local needs and outcomes

Another key factor is focusing on local needs and outcomes, for example, taking into consideration the local interests (local fauna, local flora, local groups) (Rotman et al., 2012) and ensuring that communities benefit (Walker et al., 2021). This point was exemplified in a study on the development of a marine monitoring toolkit that was useful as a response to community needs (Johnson et al., 2020). Previous studies also highlighted that projects should be designed to ensure a positive impact on the social-ecological systems (Shirk et al., 2012).

d) Communication and collaboration

Taking into consideration the communication and collaboration options between all parties, including but not limited to scientists and participants, is crucial when designing citizen science projects. This can be done by building networks, defining common standards for entry, storage, and publication of data, designing a system that matches scientists, participants, and tasks, and breaking tasks into small pieces (Rotman et al., 2012). Moreover, by giving feedback to participants about the use of the data they provided (Rotman et al., 2012), customising interactions with the participants to inform them about the updates and thanking them (Krželj et al., 2020), and keeping

the feedback channels open among the researchers, facilitators, volunteers, and the community (Parra et al., 2020) lead to open communication and further collaboration. Thus, prioritising communication and social practices (Golombic et al., 2020) are factors to consider when designing a citizen science project.

The organisational factors focus on the best practices and elements to consider in the design processes of citizen science projects. In summary, the needs of participants, the requirements of scientists in the project and the expectations of local communities, as well as the outcomes for these stakeholders, are important to consider for design. Having open communication channels between the users, scientists, and other parties involved is also important for feedback and collaboration. In the following section, I discuss the factors related to participants, more specifically, motivations and participation.

2.3.3 USER-RELATED FACTORS: MOTIVATIONS AND PARTICIPATION BEHAVIOUR

User-related issues are not separate from the data-related and design-related topics explored above. In fact, users are at the heart of data and design issues in citizen science. Therefore, it is no surprise that data-related and design-related studies highlighted taking into consideration the citizen scientists' needs, motivations, and how they approach the projects. In this section, I review the motivations identified in the context of citizen science and investigate the reasons for participants to take part in citizen science projects. I examine the reasons and the ways that motivations change over time. I then review the barriers to participation in relation to users in citizen science.

a) Motivations

The UN underlined motivating and providing incentives to the participants as one of the organisational challenges citizen science faces (UN Environment, 2019). Sullivan et al. (2014) emphasise the importance of understanding the needs of the participants by underlining that this will increase the number of participants as well as the amount of information they share (Sullivan et al., 2014). The needs of participants are directly related to their motivations, considering that motivation is a "driving force within individuals by which they attempt to achieve some goal to fulfil some need or expectation" (Mullins, 2016, p. 221).

Many former studies investigated the motivations that energise people to engage in citizen science projects. Below are some examples of research that investigated motivations in citizen science projects:

- Projects under Zooniverse
 - Galaxy Zoo (Raddick et al., 2010, 2013; Reed et al., 2013)
 - Planet Hunters Project (Curtis, 2015; Jackson et al., 2015)
- Folding@home (Curtis, 2015)
- Foldit (Curtis, 2015)
- Stardust@home (Nov et al., 2014)
- The Citizen Science Weather Observer Program (CWOP) (Nov et al., 2014)
- The Berkeley Open Infrastructure for Network Computing (BOINC) (Nov et al., 2014)
- Various biodiversity recording schemes in the UK in one study (Big Garden BirdWatch, Big Pond Dip, Garden BirdWatch, What the Cat Brought In, Migrant Watch, British Waterways Wildlife Survey, Barn owl recording scheme and nest box installation, Leeds Garden Pod Survey, Amphibian Record Collection) (Hobbs & White, 2012)
- Happy Moths (Crowston & Prestopnik, 2013)
- Online amateur weather networks (Gharesifard & Wehn, 2016)
- CONECT-e Citizen Science Project (Benyei et al., 2021)
- Tomnod online mapping project using satellite images (Baruch et al., 2016)
- Marine citizen science platforms in Australia (Martin et al., 2016)
- Second South African Bird Atlas Project (SABAP2) (Wright et al., 2015)
- Flying Beauties Citizen Science Project (Dem et al., 2018)
- Our Outdoors Initiative (Lehman et al., 2020)
- Bumble Bee Watch (MacPhail et al., 2020)
- EyeWire (Tinati et al., 2016, 2017)
- Foldit, Folding@home, and Planet Hunters (Curtis, 2018)

Previous studies identified various motives behind participation in citizen science, as presented in Table 5.

Table 5. Motivations and Drivers of Participants Identified in Previous Research

Motivations and drivers	References
Joy, enjoyment	(Gharesifard & Wehn, 2016; M. G. Jones et al., 2018; Martin & Greig, 2019; Nov et al., 2011; Phillips et al., 2019; Raddick et al., 2010; Sandhaus et al., 2019; Wright et al., 2015)
Relaxing	(Martin & Greig, 2019; Raddick et al., 2013; Tinati et al., 2017)

Continuing a hobby or a previous activity, recreational purposes	(Curtis, 2018; Domroese & Johnson, 2017; Hobbs & White, 2012; Rotman et al., 2012; Wright et al., 2015)
Having fun	(Curtis, 2018; M. G. Jones et al., 2018; Raddick et al., 2010; Tinati et al., 2016, 2017)
Curiosity	(Asingizwe et al., 2020; Raddick et al., 2013; Rotman et al., 2012; Tinati et al., 2016, 2017)
Contributing to science / scientific research, helping scientists, increasing knowledge of science	(Alender, 2016; Asingizwe et al., 2020; Beza et al., 2017; Curtis, 2018; Del Savio et al., 2017; Dem et al., 2018; Domroese & Johnson, 2017; Ellis, 2020; Ganzevoort et al., 2017; Ganzevoort & van den Born, 2020; Gharesifard & Wehn, 2016; M. G. Jones et al., 2018; Land-Zandstra et al., 2016; Larson et al., 2020; T. K. Lee et al., 2018; Lehman et al., 2020; MacPhail et al., 2020; Marshall et al., 2015; Martin et al., 2016; Maund et al., 2020; Meakin et al., 2019; Noel-Storr, 2019; Phillips et al., 2019; Raddick et al., 2010; Reed et al., 2013; Sloane & Pröbstl-Haider, 2019; Tinati et al., 2016, 2017; Wright et al., 2015)
Learning, asking others, increasing own knowledge	(Asingizwe et al., 2020; Curtis, 2018; Del Savio et al., 2017; Dem et al., 2018; Domroese & Johnson, 2017; Ganzevoort et al., 2017; Ganzevoort & van den Born, 2020; Gharesifard & Wehn, 2016; Jakositz et al., 2020; M. G. Jones et al., 2018; T. K. Lee et al., 2018; Lehman et al., 2020; MacPhail et al., 2020; Martin et al., 2016; Maund et al., 2020; Merenlender et al., 2016; Noel-Storr, 2019; Phillips et al., 2019; Raddick et al., 2010; Rotman et al., 2012; Sandhaus et al., 2019; Tinati et al., 2016, 2017; Wright et al., 2015)
Previous interest in science	(Curtis, 2018; Raddick et al., 2010; Rotman et al., 2012)
Love of science	(M. G. Jones et al., 2018)
Discovering something new, exploring	(Baruch et al., 2016; Curtis, 2018; M. G. Jones et al., 2018; Raddick et al., 2010, 2013)
Useful for career, career step	(Phillips et al., 2019; Rotman et al., 2012)
Socialising, being a part of a community and interacting with other like-minded people, social connectedness, social motivations, social interactions	(Beza et al., 2017; Curtis, 2018; Ganzevoort & van den Born, 2020; Gharesifard & Wehn, 2016; M. G. Jones et al., 2018; Larson et al., 2020; T. K. Lee et al., 2018; Lehman et al., 2020; Mankowski et al., 2011; Merenlender et al., 2016; Phillips et al., 2019; Raddick et al., 2010; Reed et al., 2013; Rotman et al., 2012; Tinati et al., 2017; Wright et al., 2015)
Having the results and the data being open to other people and to other researchers	(Curtis, 2018)

Fame, getting recognition	(Asingizwe et al., 2020; Gharesifard & Wehn, 2016; Raddick et al., 2013; Rotman et al., 2012)
Competitions, competitiveness	(Curtis, 2018; Raddick et al., 2013; Tinati et al., 2016, 2017)
Teaching other people, helping others learn, increasing student interest	(M. G. Jones et al., 2018; Phillips et al., 2019; Raddick et al., 2010; Rotman et al., 2012)
Sharing information, ideas	(Beza et al., 2017; M. G. Jones et al., 2018)
The interface design of the platform website and app	(Curtis, 2018; Jackson et al., 2015; Jay et al., 2016; Martin et al., 2016; Reed et al., 2013; Tinati et al., 2016, 2017; Wright et al., 2015)
Well-communicated requirements and results, good communication and social connections with the ones behind the platform, getting feedback, face-to-face communication	(Baruch et al., 2016; Beza et al., 2017; Cappa et al., 2016; Martin et al., 2016; Rotman et al., 2012)
For health benefits (physical activity, mental wellbeing), to improve own health or family health	(Del Savio et al., 2017; Jakositz et al., 2020; Lehman et al., 2020; Sandhaus et al., 2019)
Connection with nature	(Ganzevoort et al., 2017; Ganzevoort & van den Born, 2020; Merenlender et al., 2016)
Contributing to the conservation of nature/species, preservation of the environment	(Alender, 2016; Ganzevoort & van den Born, 2020; M. G. Jones et al., 2018; Larson et al., 2020; MacPhail et al., 2020; Phillips et al., 2019; Sandhaus et al., 2019)
Spend time outside, experience nature	(Ganzevoort & van den Born, 2020; Martin & Greig, 2019; Phillips et al., 2019)
Personal interest in the subject	(M. G. Jones et al., 2018; Mankowski et al., 2011; Marshall et al., 2015; Meakin et al., 2019; Phillips et al., 2019; Reed et al., 2013; Tinati et al., 2016, 2017)
Sharing your own experience in citizen science on social media	(Martin & Greig, 2019)
Procrastination	(Tinati et al., 2016, 2017)
Gaming	(Tinati et al., 2016, 2017)
Challenge	(Tinati et al., 2016, 2017)
Beauty, visually beautiful aspects	(Mankowski et al., 2011; Tinati et al., 2016, 2017)
Addiction	(Tinati et al., 2016, 2017)
Having a certificate	(Merenlender et al., 2016)
Fulfilling a dream (being an astronomer, physicist, or astronaut)	(Mankowski et al., 2011)

Research on the motives behind citizen science drew upon different motivation and behaviour theories. For example, by using the Theory of Planned Behaviour (TPB) (Ajzen, 1991), researchers investigated the drivers and barriers of participation in online amateur weather networks . Another study examined the drivers and barriers to participation in the case of Project FeederWatch⁶ (Martin & Greig, 2019). In a different study on community-based monitoring systems, authors examined the incentives and barriers in community-based monitoring systems by accounting for all stakeholders, including scientists and policymakers, by using the Theory of Planned Behaviour (TPB) (Wehn & Almomani, 2019); the authors underlined that it is necessary to consider the motivations of all stakeholders, instead of the current focus on the motivations of only citizens. Nov et al. (2011) used Theory of Reasoned Action (TRA) (Ajzen & Fishbein, 1980), which is an earlier version of TPB, and model of Klandermans (Klandermans, 1997) on voluntary participation in social movements, to explore the motivations and participation intentions in two citizen science projects: Stardust@home⁷ and SETI@home⁸ (Nov et al., 2011). In a different study, researchers investigating the motivational messages that lead to participation in a citizen science project underlined that participants even share personal sensitive information when faced with motivational messages (Rudnicka et al., 2019), indicating the relationship between motivations and behaviour.

The Self-Determination Theory (SDT) (Deci & Ryan, 2015; Ryan & Deci, 2000b) is also a framework to account for motivations in citizen science. Jones et al. (2018) compared science hobbyists who are citizen scientists and non-citizen scientists by investigating the factors that encourage their participation using SDT (M. G. Jones et al., 2018). Ellis (2020) investigated the motivations of hunters as citizen scientists by using SDT (Ellis, 2020). Nov et al. (2014) were inspired by SDT and Klandermans' framework concerning motivations to participate in social movements in their study of participation motivations in various online citizen science projects (Nov et al., 2014). Finally, the Volunteer Functions Inventory (VFI) (Clary et al., 1998) framework is also used in the studies concerning citizen science and motivations in the literature; for example, Maund et al. (2020) examined the reasons for participating in citizen science using VFI (Maund et al., 2020).

b) The Changing Nature of Motivations

⁶ Large-scale North American citizen science project aiming to identify and count the types of birds visiting feeders in winter (Martin & Greig, 2019)

⁷ Online citizen science project aiming to classify images from NASA's Stardust spacecraft (Nov et al., 2011).

⁸ Volunteer computing Project, which requires being downloaded and installed, and no further human contribution (Nov et al., 2011).

Some studies seek to understand the changing nature of individual motivations as participants progress their journey in the citizen science project. Curtis (2018) found that the initial motivation to participate in Folding@home was the interest in computer hardware, but later, participants developed an interest in the research itself (Curtis, 2018). In another study, Jackson et al. (2015) found that participants initially engaged in activities related to supporting knowledge acquisition; then, they started sharing knowledge with other participants, and later, they started to participate more (Jackson et al., 2015).

Crowston and Fagnot (2008) underlined the evolving and changing nature of participation in their study, where they proposed three levels of participation in massive virtual collaborations (MVC), where many contributors collectively create content as initial or sustained contributors (Crowston & Fagnot, 2008). They suggested that participation differed at each level, and thus, the motivations should be investigated by considering these differences (Crowston & Fagnot, 2008). West and Pateman (2016) contributed to the examination of the reasons why people initiate and continue to be involved in citizen science projects by reviewing the literature and making recommendations to the project and platform managers in citizen science (West & Pateman, 2016). Their recommendations included taking into consideration the participants' motivations, personal characteristics, demographics, and awareness about the project or platform when organising or designing a citizen science project (West & Pateman, 2016).

Another study on the citizen science program, Coastal Observation and Seabird Survey Team, found that the different motivations of new and experienced participants were different. In particular, newer participants favoured learning more, whereas science-related motivations such as monitoring or contributing to science were more significant for more experienced participants (He et al., 2019).

Rotman et al. (2012) point out the dynamic and changing motivations of participants and highlight the importance of addressing these motivations for sustaining the participants (Rotman et al., 2012). They emphasised that the initial participation largely occurred with egoistic motivations at play; later, collectivistic and altruistic motivations arose and affected longer-term participation (Rotman et al., 2012).

Bonney et al. (2016) approached the changes in participation in citizen science from a broader perspective and highlighted that the way participants engage with the issues, their interests, their empowerment and self-efficacy, and their relationship with programs are dynamic, so they change as time passes. The authors also highlighted the need for research to understand the impact of

citizen science on participants (Bonney et al., 2016).

In their paper on citizen science applications for malaria control in Rwanda, Asingizwe et al. (2020) outlined the different stages of participation in a citizen science program by emphasising the changing nature of motivations from the initial participation stage to ongoing participation. They found that the initial motivations included curiosity, willingness to learn, helping others, and contributing to malaria control. However, with time, ease of use of reporting materials and gaining recognition became important (Asingizwe et al., 2020).

Similarly, in another study examining the motivations of participants in Audubon's Christmas Bird Count, Larson et al. (2020) noted that motivations change throughout the involvement of participants. They further highlighted that even though participants have diverse motivations, motivations regarding conservation and scientific contribution increase as time passes, whereas other motivations decrease (Larson et al., 2020).

Cox et al. (2018) underlined the changing motivations in a different study on the Galaxy Zoo-Zooniverse. They found that motivations related to learning about scientific research and the importance given to science are important in the early stages of participation. In contrast, motivations related to protecting oneself, such as running away from problems or feeling lonely, gain importance as time passes (Cox et al., 2018). A study on lionfish monitoring in the Dutch Caribbean also showed the change in motivations for participating in citizen science initiatives over time (Carballo-Cárdenas & Tobi, 2016).

The retention of participants is an important aspect to consider in citizen science. In a study concerning FreshWater Watch⁹, researchers investigated the retention level following training and concluded that intrinsic motivation may be an important factor for citizen scientists to continue to be involved in the project following training (August et al., 2019).

In summary, the motivations of participants change in citizen science projects. The motivations of participants who recently started participating in a citizen science project are likely to be different than the ones who spent more time on the project. Citizen science projects in various fields showed this dynamic nature of motivations.

⁹ A global citizen science project aiming to understand freshwater ecosystems by physical and chemical analysis (August et al., 2019)

c) Non-participation, Barriers to Participation

Some studies examined the barriers to participation in citizen science with the idea that we can avoid the barriers if we know what they are (MacPhail & Colla, 2020). I summarise these barriers under two categories: user-related barriers and contextual-organisational barriers.

User-Related Barriers

Lack of sustained availability of financial resources (Gharesifard & Wehn, 2016; Hobbs & White, 2012; Martin & Greig, 2019) and lack of time to spare (Benyei et al., 2021; Gharesifard & Wehn, 2016; Hobbs & White, 2012; Lehman et al., 2020; Martin & Greig, 2019) are among the common user-related barriers. Lack of awareness of the projects/platforms to participate, lack of motivation, belief of being incompetent, and deterioration of health are some of the other user-related barriers (Hobbs & White, 2012).

Asingizwe et al. (2020) distinguished barriers to getting involved and staying involved. They stated the lack of awareness about the recruitment process and lack of time as specific barriers that participants face for getting involved at the beginning. They found that barriers to staying involved include contextual factors (Asingizwe et al., 2020); I elaborate on them in the following subsection.

In a study on participation in amateur weather observation networks, researchers found project-specific barriers like the lack of technical skills, such as setting up and maintaining the necessary equipment, together with the absence of general IT skills, perception of having a sufficient amount of official data, and fear of theft of the equipment (Gharesifard & Wehn, 2016). McBride et al. (2019), in their study on the citizen science case of preparation for earthquakes, found that the main barrier to participation was embarrassment, as it was especially difficult for children, the elderly, and people with disabilities to use the drill (McBride et al., 2019).

In another study investigating the motivating factors for citizen scientists to engage in the “Our Outdoors¹⁰” initiative, the authors examined the demotivating factors (Lehman et al., 2020). They concluded that the lack of awareness about the meaning of the term citizen science, the different perceptions concerning the words “science” and “citizen”, the difficulty of tasks, fear of the inability to meet the expectations of the project team, and objective of making changes in societal levels as a difficult to reach the goal as factors that demotivate participants to take part in the citizen

¹⁰ Our Outdoors is a citizen science initiative which aims to understand the impacts of urban and rural shared outdoor spaces on the health and wellbeing of humans (Lehman et al., 2020)

science initiative (Lehman et al., 2020).

Another study on the barriers to participation in the CONECT-e¹¹ project found that distrust of the institutions that manage the project and a lack of self-esteem about one's data were among the user-related barriers (Benyei et al., 2021). In their study, Rotman et al. (2012) examined barriers to participation from two perspectives: those faced by participants and those faced by scientists. They found that participants often lack trust in scientists, while scientists often lack awareness of participant motivations (Rotman et al., 2012).

To summarise, user-related barriers can be about the resources of users, like time and funds. They can also be related to personal issues such as self-esteem to use the equipment or identify the species and being motivated to get involved in the project. Another factor can be the relationship and communication between the participants and the related institutions and/or science professionals.

Contextual and Organisational Barriers

The common contextual barriers include not having an internet connection (Gharesifard & Wehn, 2016; Martin et al., 2016) and difficult-to-use interface design of the web platform and application (Benyei et al., 2021; Gharesifard & Wehn, 2016; Martin et al., 2016).

In a project-specific finding concerning amateur weather observation networks, the authors highlighted the absence of the necessary weather observation material that is proper and affordable and the absence of the availability of physical space to set up the observation equipment among the main contextual barriers (Gharesifard & Wehn, 2016).

Asingizwe et al. (2020) distinguished barriers to getting involved and barriers to staying involved. The authors identified a lack of belief in the efficacy of the mosquito trap used in the program, pressure to collect more mosquitos, and difficulties in changing the batteries of the tools (Asingizwe et al., 2020) as contextual barriers to participation.

In a study about the project CrowdHydrology¹², authors identified barriers to participation as limited communication between the participants and scientists, which is a generalisable outcome, and difficulty in accessing certain stations where participants report the water levels, which is a

¹¹ CONECT-e is a citizen science project which uses an online platform to document traditional ecological knowledge (Benyei et al., 2021).

¹² CrowdHydrology is a citizen science project aiming to monitor water levels in lakes and streams (Lowry et al., 2019).

more project-specific outcome (Lowry et al., 2019).

Regarding the barriers to participation or non-participation, the literature shows that there are project/program-specific obstacles as well as more generalisable obstacles. All these findings provide insights into ways to initiate, increase, and retain participation.

In this section, I reviewed the prominent themes in citizen science following the bibliometric analysis. The themes include factors related to data, design, and users. I examined data-related factors in terms of validity, quality, verification, and privacy of data. I investigated factors about design by considering the needs and outcomes of different stakeholders like participants, scientists, local communities involved in the project, and communication among these stakeholders. I reviewed factors related to users by focusing on the motivations and participation behaviour in citizen science, showing that citizen scientists are among the major factors to consider when designing effective projects. It is essential to have a better understanding of the motivating factors and how these affect the engagement of citizen scientists.

2.4 THEORETICAL BACKGROUND OF THE THESIS

Motivations and behaviours of participants in citizen science platforms are very important for the success of these projects. For instance, studies seek answers to questions such as how to ameliorate data quality that is shared, submitted or analysed by participants (Gibson et al., 2019; Peterman et al., 2022; Wiggins & He, 2016), how to design these projects to better fit the needs and expectations of participants (Chesser et al., 2020; Rochford et al., 2018), what motivates participants in citizen science (MacPhail et al., 2020; Wehn & Almomani, 2019), what cause people to participate or not participate (Martin & Greig, 2019; Rudnicka et al., 2019), or how to retain people once they start participating (Adler et al., 2020; August et al., 2019). Previously, many different drivers of participation are identified concerning different citizen science projects, such as enjoyment, relaxing, curiosity, learning, socialising, and science contribution (Martin et al., 2016; Raddick et al., 2010; Tinati et al., 2017), among others. These studies provide valuable insights about the motivations in citizen science, but the need for further analysis, preferably by making use of theories in psychology, on motivations and participation dynamics is underlined in the literature and shown by the growing body of research (Benyei et al., 2021; Burgess et al., 2017; Hobbs & White, 2012; Wehn & Almomani, 2019).

I address this need in this thesis by combining the Institutional Analysis and Development (IAD) framework along with knowledge commons theory and Self-Determination Theory (SDT)

specifically in Chapter 5, which I use to analyse the motivations. In addition, I make use of the Multi-Sided Platforms (MSPs) approach from the business and management field in Chapter 4, to dissect into the actors, various interactions, participation dynamics, and motivations in the platforms. These are complementary because the IAD framework permits an analysis of the governance of knowledge commons, while MSPs provides a platform perspective with multiple sides involved. However, these are not sufficient to examine the psychological foundations of participation in digital citizen science platforms, which I undertake by including SDT. In this section, I present the theoretical background of the thesis, along with an explanation of how these approaches are complementary in the case of citizen science.

2.4.1 INSTITUTIONAL ANALYSIS AND DEVELOPMENT (IAD) FRAMEWORK

Ostrom underlines the general tendency to use frameworks, theories, and models interchangeably and highlights the fact that these are different concepts by referring them a “nested set of theoretical concepts”. (Ostrom, 2005, p. 27). She explains frameworks to be the “most general forms of theoretical analysis” (Ostrom, 2011, p. 8), and that they are used for identifying the elements and relationships in a general sense. Theories, on the other hand, “enable the analyst to specify which elements of a framework are particularly relevant to particular questions and to make general working assumptions about the shape and strength of these elements” (Ostrom, 2011, p. 8). She highlights that usually multiple theories are compatible with a framework. For example, “economic theory, game theory, transaction cost theory, social choice theory, covenantal theory, and theories of public goods and common-pool resources are all compatible with the IAD framework.” (Ostrom, 2011, p. 8). In addition, “models make precise assumptions about a limited set of parameters and variables”, and they can be compatible with multiple theories (Ostrom, 2005, p. 28). I argue that MSPs approach also has a place in the IAD framework in our case, as it brings the platform perspective to the analysis.

The IAD framework is a tool that is used to analyse commons (Hess & Ostrom, 2007). The term commons is broadly defined as “a resource which is shared by a group of people” (Hess & Ostrom, 2007, p. 4). Further definitions of commons include a “form of community management or governance” (Strandburg et al., 2017, p. 10) and “the institutional arrangement of resources, the community, a place, or a thing” (Frischmann et al., 2014, p. 2). In the case of knowledge commons, Frischmann et al. (2014) highlight the critical issues involved in the governance of sharing and creating data, information, knowledge, or other intellectual resources (Frischmann et al., 2014). The

IAD framework is used for analysing such issues in governance (Frischmann et al., 2014; Hess & Ostrom, 2007).

Keeping in mind that the traditional definitions of commons are widening, and knowledge is also being considered as a common resource in certain conditions, Hess and Ostrom (2007) adapted the IAD framework to the analysis of knowledge commons, following the long history in its use in analysing traditional commons. Frischmann et al. (2014) recognised this as a preliminary step for understanding the framework's use concerning knowledge commons, and they further developed the analysis. They underline that whereas in knowledge commons, participants both share the resource and contribute to the creation of it, in natural commons, people only share the resource. And a community of knowledge is not necessarily limited by geographical boundaries (Frischmann et al., 2014), which makes it possible to expand the framework to the study of online platforms as well.

Figure 6 shows the IAD framework. On the left side of the framework, biophysical characteristics, attributes of the community, and rules-in-use are shown. To adapt the IAD framework to the analysis of knowledge commons, Frischmann et al. (2014) propose taking into consideration the background context of the commons, originally shown as biophysical characteristics on the left side of the framework (Figure 6). They argue that biophysical characteristics refer to a natural environment where there are shared and managed natural resources. However, knowledge commons require understanding the cultural background by looking at human social interactions, human-made environment, laws, history, practices, traditions, and social norms. They underline that in this context, history and narratives of creation are essential to understanding the basic attributes of knowledge commons and also to obtain information about individuals and their relationships (Frischmann et al., 2014). I use these insights in Chapter 3 when presenting the platforms that I analyse in this study.

Under the attributes (left side on Figure 6), Frischmann et al. (2014) include the resources that are both created and used, their characteristics, and the technologies and skills required for their creation (Frischmann et al., 2014). They further include community members, goals, and objectives under the attributes (Frischmann et al., 2014). Hess and Ostrom (2007) also highlight that the community can be understood by examining the users, providers, and managers/policy makers of the commons. They refer to users as the ones who use the digital information; providers as who provide content, as well as who provide software, hardware and infrastructure to the knowledge commons; and managers/policy makers as self-governing community (Hess & Ostrom, 2007).

On the left side of the IAD framework (Figure 6) we see the rules-in-use. Hess and Ostrom (2007) explain rules-in-use at three levels: operational, collective choice, and constitutional. The rules at the operational level determine how individuals interact with each other and the nature of the physical environment of the commons for daily decisions (Hess & Ostrom, 2007). At the collective choice or policy level, people interact to identify the operational rules, such as policy decisions (Hess & Ostrom, 2007). At the constitutional level, rules define who must, must not, and may take place in making decisions about collective choices (Hess & Ostrom, 2007). As rules regulate which behaviours are favoured and which are not, at every level, they affect the patterns of interactions and outcomes; therefore, it is necessary to examine them to understand the results they cause (Hess & Ostrom, 2007).

Property rights determine the actions that individuals are allowed or not allowed to take against others (Hess & Ostrom, 2007). Hess and Ostrom (2007) define seven different property rights regarding digital knowledge commons: access, contribution, extraction, removal, management/participation, exclusion, and alienation.

These rights can be defined in the context of digital knowledge commons as follows: access is the right to enter to the platform website; contribution is “the right to contribute to the content” of the platform; extraction is “the right to obtain resources” from the platform; removal is the right to remove one’s own contributions from the knowledge resource; management/participation is “the right to regulate internal use patterns” and making improvements on the resource; exclusion is “the right to determine who will have access, contribution, extraction, and removal rights and how those rights may be transferred”; alienation is “the right to sell or lease extraction, management/participation, and exclusion rights.” (Hess & Ostrom, 2007, p. 52). In the following chapter, while presenting the platforms, these rights in the three citizen science platforms in this study will be explained for each of them and summarised in Table 6.

For the analysis, Frischman et al. (2014) proposed a set of guiding questions corresponding to the elements of the IAD framework to understand the knowledge commons being studied. For this study, I utilise these guiding questions to present the citizen science in Chapter 3. These are:

Background environment or biophysical characteristics:

- What is the context?

Attributes – Resources:

- What are the resources?
- How are they created?

- What are their characteristics?
- What is needed for their creation?

Attributes – Community members:

- Who are the community members?
- What are their roles?

Attributes – Goals and Objectives:

- What are the goals and objectives of the commons and its members?
- What are the obstacles?

Rules and governance:

- What are the governance mechanisms and rules?
- Who are the decision-makers?
- What are the governing institutions and infrastructures for decision-making?
- What are the informal norms?
- What institutions govern the interactions of members and non-members?

Patterns and Outcomes:

- What are the benefits for the members and others?
- What are the costs and risks, including the negative externalities? (Frischmann et al., 2014)

The elements on the right side of the framework (Figure 6) are observable through the websites of the platforms that I study in this thesis and through other resources published on these platforms, such as academic publications. On the other hand, the examination of the action arena action situations, actors and their interactions with the platforms require a further investigation. This is carried out in Chapter 4 through semi-structured, in-depth interviews, by integrating the use of Multi Sided Platforms in the action arena of the IAD framework. I use another theory in Chapter 5, Self-Determination Theory (Deci & Ryan, 2015), from the psychology literature, for the formal analysis of the motivations by further diving into details of motivations of actors inside the action arena of the IAD framework.

In the middle part of the framework, the action arena includes the action situation and actors. The action arena is important to explain why knowledge commons and MSPs approach are used together in this thesis. Inside the action arena, an action situation is a space where actors interact in various ways (Ostrom, 2011). Analysis of the action situations is more complicated because of the multitier structure of the IAD framework. Ostrom (2005) underlines the IAD framework to be “a multitier conceptual map”; in which action situations are dissected into tiers to investigate the interactions of participants inside (Ostrom, 2005). Here, Ostrom (2005) refers to *participants* in

action situations as *any decision-making entity* such as corporations, nations, NGOs etc. and not necessarily individuals.

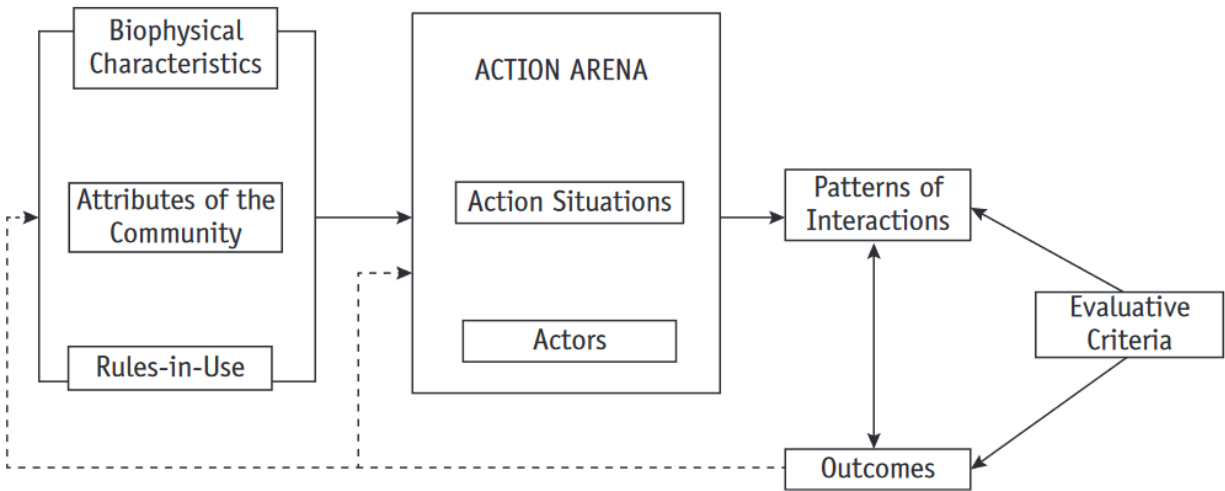


Figure 6. The Institutional Analysis and Development (IAD) Framework

Source: (Hess & Ostrom, 2007)

In other words, an action arena is a “social space” in which “participants with diverse interests interact, exchange goods and services, solve problems, dominate each other, or fight”, among others (Ostrom, 2005, p. 14). This social space can be analysed by zooming in with the assistance of appropriate theories and models.

In the case of this thesis, the appropriate theories I use at this *tier* of the IAD framework are knowledge commons, Self-Determination Theory (SDT) and the MSPs approach. Because digital citizen science platforms are knowledge commons, embedded in a platform structure. Therefore, the action arena in our case are online citizen science platforms. Thus, incorporating the understanding of *platform dynamics* to the examination of the action arena is very useful in analysing the complexities going on in these platforms when the participation dynamics, motivations, and further interactions and relationships are concerned.

As mentioned in the beginning of this section, a framework provides an overall look, a general set of factors to consider when first conducting an analysis (Ostrom, 2005). Whereas theories “focus on parts of a framework and make specific assumptions that are necessary for an analyst to diagnose a phenomenon, explain its processes, and predict outcomes” (Ostrom, 2005, p. 28). The IAD already stands out as a tool to analyse commons, and knowledge commons (Frischmann et al., 2014; Strandburg et al., 2017). The citizen science platforms that I present in Chapter 3 are both

knowledge commons and digital platforms. This unique position of the digital citizen science platforms is best analysed by using the knowledge commons theory and MSPs approach together. Following the above discussion about the IAD framework, its different elements, and its application together with different theories and models, I now present the MSPs approach.

2.4.2 MULTI SIDED PLATFORMS (MSPs)

Multi-Sided Platforms (MSPs) are “platforms that enable interactions between multiple groups of surrounding consumers and ‘complementors’ ” (Boudreau & Hagiu, 2009, p. 163). MSPs are distinguished by the interactions and interdependences between the multiple sides of the platform, which results in network effects (Boudreau & Hagiu, 2009). More precisely, more participation from one side attracts more participation from the other sides (Boudreau & Hagiu, 2009). Consequently, MSPs try to attract users as much as they can, striving to leverage network effects, as a result of which the value of MSPs increases (Abdelkafi et al., 2019). An example is Facebook; where an increase in the number of users leads to more people joining in, which increases the utility of users as they have more potential links and attract advertisers, as more users means more potential customers (Abdelkafi et al., 2019). Other successful examples of MSPs are Airbnb, eBay, Uber, Google, and Apple (Abdelkafi et al., 2019).

The characteristics of MSPs are:

- 1) Having two or more distinct groups of users, such as retailers and customers in a shopping mall, game developers and users considering video game consoles, or buyers and sellers in an e-commerce website. One person can assume different roles, for instance, sometimes being the buyer and sometimes being the seller (Evans, 2003).
- 2) The interactions of these different sides create externalities, where an increased number of users on one side increases the benefits of adoption for the other side. For example, the more sellers accept VISA cards, the more users will adopt it, which will consequently increase the number of sellers accepting it, and so on (Evans, 2003).
- 3) It is more efficient for all sides when an intermediary coordinates the interactions between different sides (Evans, 2003).

MSPs were previously studied in the context of maximising the profits of the platform owners through different pricing strategies by quantifying the network effects (Boudreau & Hagiu, 2009; Trabucchi & Buganza, 2021). Business growth and financial success were previously focused on in

the context of MSPs (Abdelkafi et al., 2019). However, the roles of MSPs are not limited to pricing strategies, and various other regulatory roles are defined for them, such as “imposing rules and constraints”, guiding and persuading the actors, and “shaping behaviours” (Boudreau & Hagiu, 2009, p. 165). These *non-price tools* solve multi-sided market failures, and so MSPs have a role in regulating the ecosystem that surrounds them (Boudreau & Hagiu, 2009).

I focus on these non-price tools of MSPs in the analysis, because often, online citizen science platforms neither include financial transactions nor do they prioritise financial goals. I approach this non-price regulatory function of MSPs as the value deals that the citizen science platform makes with different roles around it. At the same time, by making these value deals through setting rules and shaping behaviours of actors, citizen science platform coordinators also aim at maximising data flows in the citizen science platform.

Evans (2012) highlights that MSPs create positive externalities between the different sides of the platform. Evans (2012) also underlines that there are negative externalities or “bad behaviours”, which is a common outcome in communities, and these can be addressed by developing governance mechanisms to reduce bad behaviours (Evans, 2012). Externalities are the indirect effects of the actions of one stakeholder on other stakeholders (Laffont, 2008). Externalities are positive when others receive benefits and negative when others bear costs (Kreitmair & Bower-Bir, 2021).

It is further underlined that in MSPs, both sides should be “on board”; otherwise, the platform is not valuable (Trabucchi & Buganza, 2021, p. 66), which is also consistent with the Frischmann’s (2014) approach on knowledge commons: the resource in the case of knowledge commons is both created and used by the participants. Therefore, citizen science platform would not be valuable if the resource were not created and used. Different sides in citizen science platforms need to be “on board” to share data to create the resource, and only afterwards it can be available for use. This point is the main focus when it comes to the analysis of negative externalities and how platforms address these negative externalities, which is empirically examined in Chapter 4.

2.4.3 COMMONS, KNOWLEDGE COMMONS, AND NEGATIVE EXTERNALITIES

The concept of negative externalities is of particular interest because it can influence the motivations of participants. And in both knowledge commons and MSPs; externalities are part of the dynamics of interactions.

In the traditional commons studies, the differentiation between commons as a resource system (common pool resources) and commons as property rights in a legal sense are highlighted (Hess & Ostrom, 2007). However, this distinction may not be very important in the studies of knowledge commons, because, online knowledge sharing, cultural resources on the internet, or new mediums for information and knowledge resources are the central concepts in knowledge commons (Hess, 2012).

There are basic differences between traditional commons and knowledge commons. Traditional commons are subtractive (or rivalrous), meaning that when someone uses the resource, it reduces the availability of it to other people (Hess & Ostrom, 2007; Ostrom et al., 1994). The other issue with the traditional commons is excludability, meaning that certain people can be excluded from the use of a good (Hess & Ostrom, 2007; Ostrom et al., 1994). In the economics literature, knowledge is considered a public good, and unlike the traditional commons, the use of knowledge by one person does not subtract from someone else's possibility to use it (Hess & Ostrom, 2007). However, the exclusion issue is not straightforward because, on the one hand, it is difficult to exclude people once the knowledge is out there, and on the other hand, there is a more complex side of it, such as intellectual property rights, open source software, or open access publishing; which brings the need for a commons governance (Hess & Ostrom, 2007). Understanding knowledge as a common resource is rooted in this complexity.

In the case of natural resources, people share already existing resources, such as water or land, with others, so that the use of only one person does not deplete the resource and that everyone who wants to use the resource can be better off (Hess & Ostrom, 2007; Ostrom, 1990). In the case of knowledge as a resource, people not only use but also share their data, information, and knowledge, to create new knowledge; so knowledge commons are both created and shared by the participants (Frischmann et al., 2014). This concept of both creating and sharing the knowledge is central to the understanding of negative externalities in digital citizen science platforms in this study.

In the traditional natural commons, the problem of overuse is exemplified by the concept of "tragedy of the commons". The term "tragedy of the commons" (Hardin, 1968, p. 1243) was first used by Garret Hardin and refers to the subtractive nature of traditional commons. Hardin argues that if everybody acts according to their interest by believing in the freedom of the commons, then the limited resources will be depleted for everybody; so this will be harmful to everybody in the end (Hardin, 1968), thus creating indirect negative external effects or negative externalities for

others (Hanna et al., 1995). The tragedy of the commons is an example of a social dilemma situation. Social dilemmas or collective action problems are situations when the group is worse off because of individual self-interest, and collective action problems result from negative externalities (Ostrom, 1990).

Social dilemmas related to knowledge differ from those related to natural resources. However, they still exist and require a corresponding understanding and a governance mechanism. Previously, social dilemmas in knowledge commons were put forward in different ways. Free riding is approached as one form of social dilemma, where exclusion of people from the use of the resource is difficult (Frischmann et al., 2014; Hess & Ostrom, 2007). Similarly, as knowledge resources are non-depletable or non-rivalrous, the boundaries for use do not naturally exist but rather are created (Frischmann et al., 2014). Therefore, governing or managing these issues becomes essential. Even though the knowledge itself is not rivalrous, it depends on rivalrous inputs to be created, such as time and money, and may result in rivalrous outputs, such as money and fame, which are referred to as coordination, combination, and competition issues (Frischmann et al., 2014). Thus, proper governance is required for effectively using the knowledge resource. The MSPs approach is helpful in understanding the governance dynamics in the citizen science platforms that I study in this thesis, because it introduces the platform perspective to be utilised together with the knowledge commons structures embedded in these platforms.

2.4.4 SELF-DETERMINATION THEORY (SDT)

Finally, the last theory I use is the Self-Determination Theory (SDT) from the psychology literature. SDT is a motivation theory aiming to understand drivers of human behaviour (Deci & Ryan, 2015). Motivation is a psychological concept that relates to internal drives which initiate, energize, and sustain behaviour aimed at achieving a goal or reward (Weiner, 1989). I use SDT in Chapter 5 to model the motivations of participants, and how they relate with participation behaviour. Here, I briefly explain the place of the SDT in the multitier structure of the IAD framework, so as to provide a complete picture of the theories I draw upon together with the IAD framework. Later in Chapter 5, I explain the SDT in more detail.

As clarified above, the IAD is a general framework consisting of multiple tiers, and several theories can be compatible with it. I also mentioned that the social spaces -action situations- in the action arena are usually complex, as almost any social situation in life, and may require focusing on the elements inside these action situations. To analyse the motivations of participants in this level of

the IAD framework, I use SDT in Chapter 5, along with the findings from Chapter 4.

Figure 7 represents the theoretical structure of the thesis. The IAD framework acts as the umbrella framework, and it is complemented by knowledge commons, MSPs approach, and SDT.

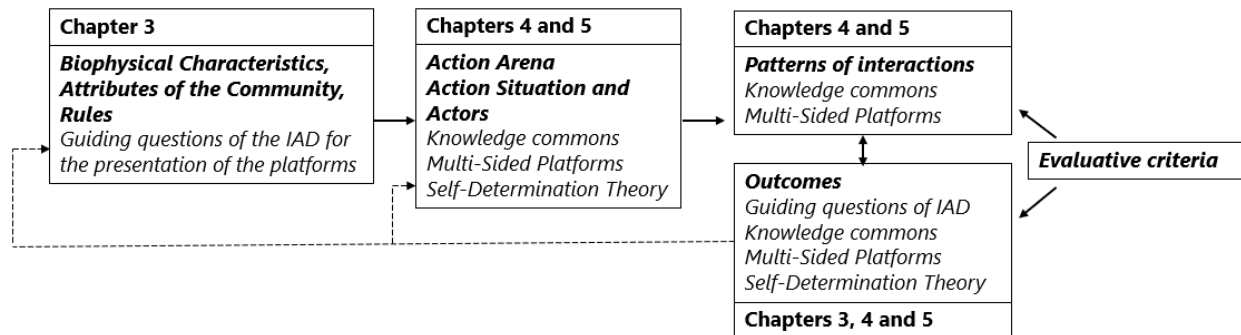


Figure 7. Demonstration of the Theoretical Background of the Thesis

2.5 SUMMARY AND CONCLUSION

In this chapter, I first provided a comprehensive review of citizen science research by focusing on the challenges that citizen science faces, how to address these challenges and the role of participants and their motivations in citizen science by examining the common themes. Then I presented the theoretical background of the thesis. For the review of the literature, I adopted an exploratory approach by using bibliographic coupling analysis and content analysis of the abstracts of all articles in the dataset and of the core cluster articles, which I identified as a result of the bibliographic coupling analysis. Later, I extended the research beyond the initial dataset used for the bibliometric analysis and included other papers in the review that were not among the initial dataset.

I found an increasing trend in the number of articles published, in line with the previous literature (Bautista-Puig et al., 2019; Follett & Strezov, 2015; Kullenberg & Kasperowski, 2016; Pelacho et al., 2021).

The common themes I identified are data-related factors, organisational factors, and user-related factors. Data-related factors include the quality, validity, verification, and consistency of data and privacy concerns. Organisational factors include design and organisation-related subjects, as well as topics about inclusiveness, the digital divide, and technology savviness. Among the user-related factors, I found studies focused on the ways of increasing participation, engaging new participants,

retention of participants, and learning. Motivations for participation are also among the user-related challenges.

Regarding data-related and design-related factors, I saw that the user was at the heart of these issues. Thus, motivations appear to be crucial for all three of the themes identified. Concerning the data-related challenges that citizen science faces, the quality and the trustworthiness of data stand out as important topics, and high-quality participation using high-quality data can be achieved by understanding the participants' needs and outcomes (Shirk et al., 2012).

When it comes to design-related organisational factors, I found that focusing on the needs and outcomes of the participants is one of the main points to consider when designing citizen science projects. Rotman et al. (2012) highlighted that understanding the motivations is crucial for retaining participants and for increasing participation (Rotman et al., 2012).

The user-related issues in citizen science are directly linked with the motivations of participants. Even though there are previous studies that identified the individual motivations, the changing nature of motivations, and barriers to participation, there is a need to approach motivations from different angles to reveal the not-yet-identified aspects of the participant motivations, which evidently contribute to efforts for increasing participation and ensuring sustained participation (Rotman et al., 2012).

I also identified additional themes: student and education, policy implications, and SDGs. This indicates that citizen science has a place in education (Aivelo & Huovelin, 2020; Kocman et al., 2020; Schneiderhan-Opel & Bogner, 2020) and is being used as a tool to engage students in citizen science starting from an early age. This finding also shows that citizen science is increasingly considered as a tool for policymaking, especially following the acknowledgement by the UN (UN Water, 2018; UNEP, 2016), and previous studies investigated the possibilities of utilising citizen science to accomplish the SDGs (Fraisl et al., 2020; Quinlivan et al., 2020b; Schleicher & Schmidt, 2020; Shulla et al., 2020; Wuebben et al., 2020). Moreover, the EU acknowledges the potential of citizen science and encourages it through several projects, such as the EU Citizen Science project under Horizon 2020 or EU missions and citizen engagement activities under Horizon Europe.

I saw that the previously highlighted challenges in literature are being addressed as the field progresses, such as the research concerning data quality and validity issues, design issues, and user-specific issues. Further research on the role and place of motivations in design and data issues by considering their central place in citizen science research and projects will enrich this evolution

and advancement of the field. To contribute this line of research and investigate the motivations and participation dynamics in citizen science platforms, I use the Institutional Analysis and Development (IAD) framework as the umbrella framework in this thesis; and I further use two other theories, knowledge commons and Self-Determination Theory (SDT) together with Multi Sided Platforms from the field of business and management.

Based on these findings, in the following chapters, I present the results of two research projects, one using qualitative and the other using quantitative methodology, that I carried out in the context of this thesis. These projects are on motivations and platform engagement in citizen science. I thereby aim to contribute to the literature on user-related research and motivations in citizen science with the purpose of designing better citizen science projects in the future. In the following chapter, I present the three platforms that I examine in this thesis.

3 PRESENTATION OF THE PLATFORMS

3.1 INTRODUCTION

In this chapter, I present the platforms that I examine in this thesis. The platforms that are examined are: Faune-France from France, and eKuşbank (eBird Turkey) and Trakuş from Turkey. To do so, I explain in detail their features, governance structures, how they work, and what they provide to the participants. I do so by using the Institutional Analysis and Development (IAD) framework. The IAD framework provides a set of guiding questions for the examination of knowledge commons, as mentioned in Chapter 2. These questions lead to understanding the background context and history of the platforms, the resources they use and also create, the members of the community, the goals of the platforms and of their members, and the rules and governance mechanisms of these platforms (Frischmann et al., 2014).

3.2 PRESENTATION OF THE ONLINE CITIZEN SCIENCE PLATFORMS USING THE IAD FRAMEWORK

In this chapter, I explore the case studies; I explain in detail their features, governance structures, how they work and what they provide to the participants. Environmental sciences and, more specifically, ornithology stand out as being among the oldest and most widespread fields of citizen science (Kullenberg & Kasperowski, 2016; Pelacho et al., 2021), which I demonstrate in Chapter 1. Considering the prominence of the field of environmental sciences and ecology, I decided to select the case platforms of the study from that field, which harbours ornithology as a widely preferred subject. The selected platforms are Faune-France in France. eKuşbank (eBird Turkey) and Trakuş in Turkey.

These two countries exhibit different dynamics in terms of institutional, social, and economic contexts. According to World Bank classifications, Turkey is an upper-middle-income country, whereas France is a high-income country (World Bank, 2023). In broadband access, Turkey is below the OECD average of 34.3 per 100 inhabitants with 21.6 per 100 inhabitants, while France is above it with 46.2 per 100 inhabitants (OECD, 2021). Despite these distinctions, internet usage in both countries appears to be close to each other, with 81% of the population using the internet in Turkey and 86% in France (World Bank, 2021). An analysis of these two countries will highlight the similarities and differences in terms of their online citizen science participation dynamics and

provide insights about intervention policies for online participation in different contextual settings.

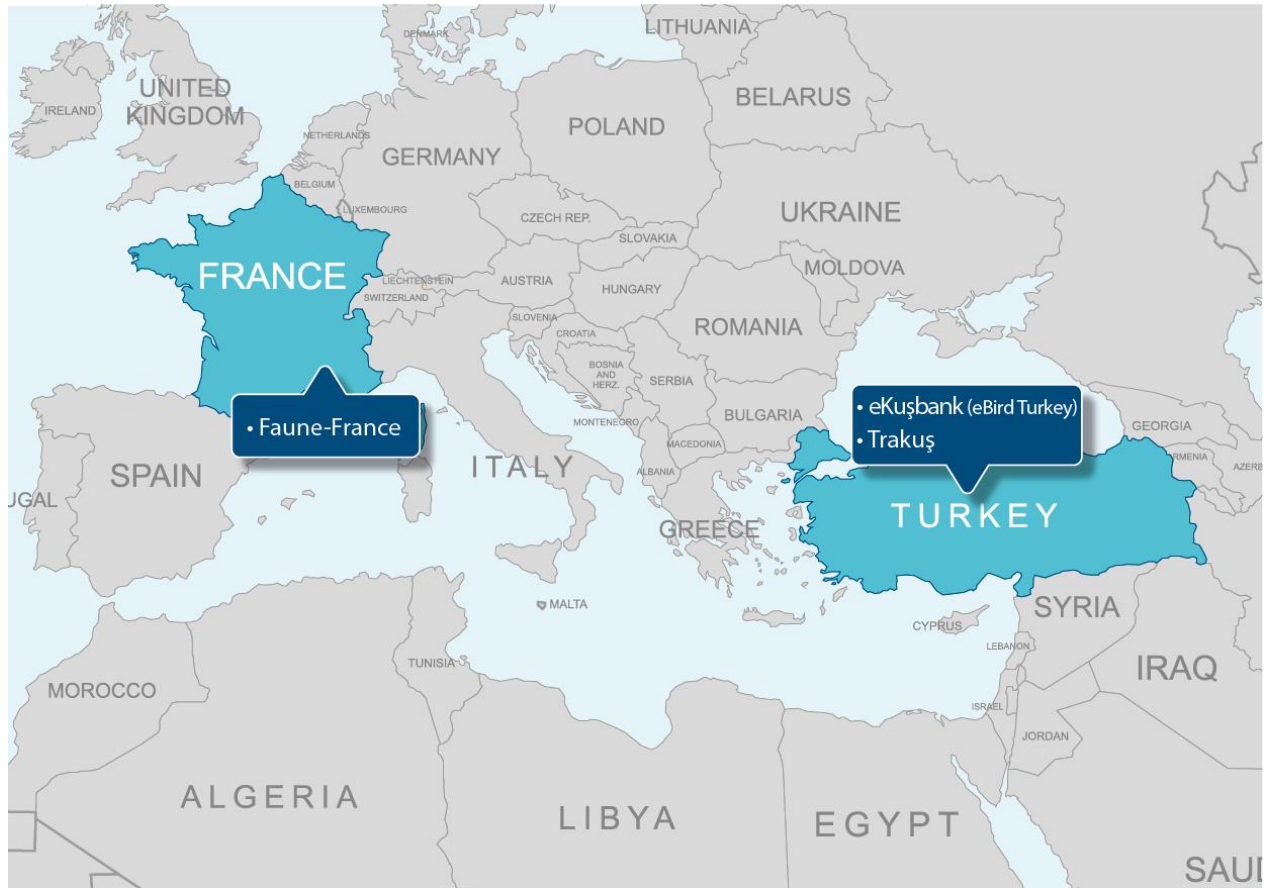


Figure 8. Platforms' Country Map

I examined the platforms by using the Institutional Analysis and Development Framework (IAD), which has been used by many scholars to analyse commons since the end of the 1970s and was adapted to knowledge commons Hess and Ostrom (2007) (Hess & Ostrom, 2007). As mentioned earlier, the IAD framework is a diagnostic tool consisting of a set of questions aiming to understand the institutional structure and individual and group behaviours regarding the common that is analysed (Hess & Ostrom, 2007). Previously, in the context of citizen science, the Galaxy Zoo project was analysed using the IAD framework by Madison (2017), exemplifying that the commons approach allows for the analysis of the institutional environment for sharing information and knowledge (Madison, 2017).

In the following sections, I examine each platform by using the guiding questions for analysis as mentioned previously regarding the IAD framework. I start with the background information about

each platform, then present the resources they use and create, their characteristics, the community members and what they do in the platforms, and the rules and their management structures. The chapter closes with the comparison table of the three platforms based on the examination made by using the elements on the IAD framework.

3.2.1 FAUNE-FRANCE

Faune-France was founded under the French League for the Protection of Birds (Ligue pour la Protection des Oiseaux – LPO) in 2017, with the objective of the conservation of nature in France through participative science (LPO France, 2021). As of September 19 2023, it has 190.435 registered observers. Faune-France can be accessed through <https://www.faune-france.org/>.

LPO is a national association in France. It is composed of LPO France and the LPO associations, which are legally and financially autonomous, and it is part of BirdLife International, which is a global alliance of NGOs aimed at the protection of nature (LPO France, 2021). Faune-France is a platform/portal of LPO France under its pole for protecting nature. So, LPO France is the provider of the platform, providing the infrastructure to the platform.

Decision-making is in a shared structure in Faune-France: there are the signatories and the partners, where the former signed the Charter of the Faune-France, and the latter share common ideals and agree to share the data that they collect without signing the charter (LPO France, 2021). There are validators who are mostly volunteers to check and evaluate the data. An automatic filtering system also flags entries and warns validators in case of suspicious entries.

Participants in the platform include people who make observations of different species and/or take their photographs, who then may share their observations and photographs on the platforms. Faune-France does not focus on only birds and birdwatching, and it is possible to contribute by sharing data of 23 other animal and plant species. However, most of the contributions are for the bird species.

Faune-France utilises the Biolovision infrastructure for data collection. Biolovision is a small technology company in Switzerland that aims to provide tools for protecting nature through citizen science (Biolovision, 2022). They offer the tools of Ornitho web portals and the NaturaList smartphone application. The data is entered through the web portals or the application, and it is automatically transferred to the Faune-France platform. Biolovision is also a provider of the platform.

Participants share their observations through the application NaturaList, the Ornitho web portal, or the Faune-France website, as well as through other local websites connected to Faune-France. Participants use their time, knowledge, and the resources created by the platform to make contributions. With the shared data, the following are hosted on and created by the platform:

- Bird photographs, bird observation data, bird sounds, information about species, and French names of the species.
- Photos and observation data of the other 23 species, information about these species, and their names in French.
- Reports and publications of LPO by using various data sets of Faune-France.
- The data is provided to French Bird Atlas and Euro Bird Portal.
- Input for national surveys STOC, SHOC, and counting of wintering water birds

When it comes to rules, LPO France determines operational-level rules. These rules are stated under the General Conditions of Use. Faune-France Steering Committee makes policy decisions, and LPO France implements these decisions. At the constitutional level, local steering committees or associations are responsible for determining the rules in the collective decision processes of Faune-France.

Below, I examine the property rights:

Access to data, photographs, and other information on the website is possible by simply connecting to it. What is meant by access is displaying these items.

Contribution is possible by becoming a member. Becoming a member is simplified by filling in an online form. Figure 9 shows the registration screen of Faune-France.

Extraction is not possible through downloading the data. Extraction for the purpose of using it in dissertations/thesis or scientific publications should be consulted to the Steering Committee. The request can be made in written form by sending an email to the administrator (*Faune-France*, 2021). Also, at the local level, Local Steering Committees or associations can decide on the use of the data they collect. Therefore, the possibility of extraction depends on the decision of the Steering Committee or the Local Steering Committees.

Figure 9. Faune-France Registration Screen

Source: (Faune-France, 2021) https://www.faune-france.org/index.php?m_id=61

Removal is granted to every member if they wish to remove the data they entered. Faune-France has automatic filters which inform the committees or *verifiers* who are responsible for validating the entries at the regional level. These committees ensure the entry is authentic and correct by contacting the person who made the entry and requesting additional information, such as a photograph.

Management/participation is granted to LPO France by running and administering the Faune-France portal.

Exclusion is a right of LPO France, and with this right, LPO France can determine who will have access, contribution, extraction, and removal rights, as highlighted by Ostrom (2007).

Alienation is a right granted to LPO France by intervening in case it is necessary, such as the violation of the General Conditions of Use.

3.2.2 eKUŞBANK (EBIRD TURKEY)

eKuşbank (eBird Turkey) is one of Turkey's major birdwatching platforms, with 4362 registered users as of January 5th, 2023. It aims to address the need for a platform to have timely information about the conditions of bird species, their number, habitats, and threats in Important Bird Areas (IBAs) (Özesmi & Per, 2006). It can be accessed through <https://ebird.org/turkey/home>.

KuşBank project started with two workshops that birdwatchers attended, highlighting the need for

such a system (Özesmi & Per, 2006). The word “kuş” means bird in Turkish. So, the exact translation from Turkish to English is “Bird Bank.” Initially, KuşBank was named “Internet Based Citizen Science Project for the Protection of Birds” in 2004 (Boyla et al., 2019). Between the years 2007 and 2014, the KuşBank platform was under a worldwide project named WorldBirds, which was an initiative of BirdLife led by Doğa and Erciyes University, with the support of the Royal Society for the Protection of Birds (RSPB) (Özesmi & Per, 2006). Until 2014, individual initiatives were prominent in the continuation of the KuşBank project¹³ (Özesmi & Per, 2006). Since 2014, it has operated under the eBird platform of Cornell University Ornithology Lab. It is managed in collaboration with the Turkish Bird Records Committee and Doğa, an association working for nature conservation in Turkey. The “Turkish Bird Records Committee” comprises 11 members and is responsible for monitoring, evaluating, and approving the records entered (*Kuş Kayıt Komitesi – Turkish Bird Records Committee*, 2021). Decision makers and providers are nested (Hess & Ostrom, 2007), and Cornell Lab of Ornithology, Turkish Bird Records Committee and Doğa are the current providers and decision makers concerning the platform. Users include people who make observations of birds and take photographs of birds.

The application “Merlin” allows entering records by using a smartphone. Data can also be entered through the eKuşbank website. So, the resources used to participate are participants’ time and expertise, as well as, in a more indirect manner, the resources published by the platform, which provides information to increase their knowledge about the bird species and birdwatching in general. With the data collected, the platform hosts and creates the following resources:

- Bird photographs, recorded bird sounds, and observation data.
- Kuşbank reports.
- Academic publications.
- Turkish Breeding Bird Atlas, January 2019.
- The data was provided to the 2nd European Breeding Bird Atlas (EBBA2) in December 2020, which is one of the biggest biodiversity citizen science projects.

When we consider the rules in eKuşbank (eBird Turkey), operational level rules are defined in “terms of use” by Cornell Lab of Ornithology, and approval is necessary for the creation of membership online. Furthermore, there are implicit rules among the community members that

¹³ See Özesmi and Per (2006) for a detailed discussion about its history.

regulate the behaviour in the field, including but not limited to respecting birds and all other animals while making observations and taking photographs of them, not bothering birds in their nests, not leaving trash in the nature, and protecting the nature.

For policy level rules, Cornell Lab of Ornithology defines the policy rules under the “terms of use” and “privacy policy” sections, and the Turkish Bird Records Committee is the responsible body that chose to be a part of eBird infrastructure. They do not have the right to interrupt the workings of the portal. They can personalise to a certain degree, such as sharing Turkey-specific content or news, and act as reviewers and moderators on the side of Turkey.

At the constitutional level rules, the Turkish Bird Records Committee is responsible. It is mainly formed by informal arrangements and relationships (interview in July 2020)¹⁴ with the criteria of being very interested in birds, being an experienced birdwatcher, and getting along well with the other committee members (not arguing in discussions but having a scientific point of view during the discussions in the Committee) (interview in October 2020)¹⁵.

When the different property rights are considered:

Access is granted to anyone with an internet connection and connects to the website “www.ebird.org”. Access to most of the content is open without membership, for example, the content in the news section or the free eBird essentials course. However, creating an account is required to request to download the observation data. Creating an account is a simple online process and can be completed by entering one’s name, surname, username, email address, and password.

Contribution is possible after creating an account. Anyone with an account can contribute. Figure 10 shows the registration screen of eBird.

Extraction is possible after creating an account. Anyone with an account for non-commercial use can download the data. Before downloading, a short abstract is requested to learn the reasons for using the eBird data.

¹⁴ Interviews are elaborated in the Methods section of the Chapter 4.

¹⁵ Interviews are elaborated in the Methods section of the Chapter 4.

Your account lets you access any of these projects

Bird Academy
Birds of the World
Celebrate Urban Birds
eBird
Great Backyard Bird Count
Macaulay Library
NestWatch
Project FeederWatch

If you've already registered with any of these projects, you don't need a new account. [Sign in](#)

Create a Cornell Lab account

The registration form includes the following fields and elements:

- Two input fields for "First name" and "Last name".
- A single input field for "Choose a username".
- A single input field for "Choose a password" with a placeholder text "Enter at least 8 characters".
- A single input field for "Email address".
- A prominent blue button labeled "Create account" at the bottom.

Figure 10. eBird Registration Screen

Source: (The Cornell Lab of Ornithology, 2021)

<https://secure.birds.cornell.edu/cassso/account/create?service=https%3A%2F%2Febird.org%2Flogin%2Fcas%3Fportal%3Dbeta&locale=tr>

Removal is a right of anyone who enters their observation data. People can remove the data that they entered. Also, if the Turkish Bird Records Committee does not validate the data, and/or if there is a problem with the entry, then the Committee can remove it if the authenticity of the record cannot be proven.

Management/participation right belongs to Cornell Lab of Ornithology. They decide on the improvements and changes to be made on the platform.

Exclusion is a right partially granted to the Turkish Bird Records Committee and Cornell Lab of Ornithology. It is partially granted because the Turkish Bird Records Committee reserves the right to determine its members who have the right to remove records; also, Cornell Lab of Ornithology reserves the right to delete comments or terminate accounts associated with inappropriate or offensive behaviour such as adding offensive, threatening, abusive content, and providing falsified documentation to support records or observations (*Terms of Use - Cornell Lab of Ornithology, 2021*).

Alienation is a right reserved by the Cornell Lab of Ornithology, the platform's provider of infrastructure.

3.2.3 TRAKUŞ

Trakuş was founded by Serhat Tigrel, a businessperson, to address the need for a Turkish resource about the birds of Turkey, increase the number of birdwatchers in Turkey, and create awareness about the conservation of birds (*Trakuş - trakus.org*, 2021). Just like eKuşbank, it operates in the field of birdwatching and bird photography with 7886 registered users as of January 5th, 2022. Trakuş can be accessed through <https://www.trakus.org>.

The platform is funded by the sponsoring company ESIT Electronics, where Serhat Tigrel is the manager. The server sponsor is doruk.net. Trakuş is sustained through sponsors and volunteers. Besides the users, the platform has fourteen different volunteer management roles, including the President, Calendar Team, Software Team, Scientific Council, Event Management Team, Photograph and Forum Control Team, Observation Team, News Team, Media Team, Species Page Team, Species Identification Committee, Membership Affairs Team, Video Team, and Social Media Team. The Species Identification Committee of Trakuş operates similarly to the Turkish Bird Records Committee of eKuşbank. They control, evaluate, approve, and update the species that are shared; also, they are responsible for alerting the Forum Control Responsible about the photographs or species that they think are not in line with the rules and should be deleted (*Trakuş - trakus.org*, 2021). Providers include the sponsors ESIT Electronics and doruk.net. Decision makers share responsibilities among the fourteen volunteer management roles. Users are similar to the users in other two platforms: people who observe birds and take photographs of them.

Unlike in eKuşbank, Trakuş has forum sections where participants can interact and discuss topics related to birdwatching and photography, as well as platform and community-related issues. There are also different sections devoted to photographs, like a photo gallery and a species gallery, where participants can post the photographs of birds they take. They can also share information about the photograph and have the opportunity to learn about the species from the other participants by asking them or following the conservations. Another difference between Trakuş and eKuşbank is organising events such as camps, which encourage people to get to know each other and become a part of the community.

Similar to eKuşbank, the data is collected through data entry either by using the smartphone application of Trakuş: TrGozlem or through the Trakuş website. Moreover, similar to the other two

platforms, they use their time, expertise, and the resources provided by the platform to enrich their knowledge base and participate. With the collected data and information, Trakuş hosts and creates the following:

- Bird photographs, observation data, bird sounds, information about species, and local names (in Turkish).
- Forum discussions.
- Trakuş publications (Kertik Reports, Trakuş e-journal).
- Trakuş Birds of Turkey book, first published in 2021.
- Photographs and information that are provided to various other publications.

Operational-level rules are written on the website, and it is required to approve them to become a member. Membership is a simple online process. The rules are divided into two categories: personal rules and environmental rules. Personal rules include:

- "Do not disturb the animal that you photograph or observe, and leave the field if necessary.
- Do not throw trash into the living space of the animal.
- Use proper camouflage without interrupting their surroundings.
- Do not chase the animal or get close to the nest.
- Go away in case of the realisation that the parent animal did not come back to the nest in the past 30 minutes.
- Do not break the branches of trees for a better photograph.
- Stay away from nests, nest colonies, feeding grounds, and crowded roosts.
- Do not use artificial light unless absolutely necessary, and do not touch the animal, egg, or nest.
- Warn the members that do not follow the rules.
- Do not leave any trash in the field except the lasting memories and photographs. " (*Trakuş - trakus.org*, 2021)

Environmental rules include:

- "Remember that we are visitors in nature.
- Respect the whole ecosystem by remembering that we are intruders in nature.
- Accept that during our presence in nature, we should not change the place of anything.
- Use the worn paths in order to minimise the impact on the environment.
- Accept that each animal and its habitat are unique.
- Do not enter private property without the permission of the owner." (*Trakuş - trakus.org*, 2021)

The volunteer management team and the president determine policy-level rules.

For the constitutional level rules, the community seems to be the defining factor together with the management team, which means the most active people who are experienced and knowledgeable take responsibility for different volunteer roles defined above.

Considering the property rights:

Access is given to anyone who can connect to the website. It is possible to display all sections and all the information, including the observation data, forum discussions, photographs, and species information, without becoming a member.

Contribution is possible by becoming a member, which is a simple online process. Figure 11 shows the registration screen of Trakuş.

I want to become a member

New Membership

Fill the required information into the membership form completely and free of any misleading information. Your application will be reviewed based on the information you provide. Thank you.

First Name *

Surname *

Email address *

Username * Must not be longer than 16 char and contain no Turkish char

Password * Should not be more than 16 char and should not contain Turkish char

Password (re-enter) *

Phone Number *

Gender Please select. v *

Briefly about you (your occupation, location, education)
Note: This paragraph will be displayed on the site.

Address *

City Please select a city v *

District ----- v *

Figure 11. Trakuş Registration Screen

Source: (Trakuş - [trakus.org](https://www.trakus.org), 2021) https://www.trakus.org/kods_bird/uye/?fsx=2fsdl7@d

Extraction is tricky because it is not possible to click a button and download the observation data from the system. However, it is open to everyone, and anyone can access the information through the website. The data collected on Trakuş has long been desired to be used by researchers in the

Turkish birder community, as mentioned in the interviews; however, so far, there is only one study by Özgencil et al. (2021) that uses the data obtained from Trakuş (Özgencil et al., 2021).

Removal rights are given to the Photograph and Forum Control Team, Observation Team, and Species Identification Committee according to their defined responsibilities. Also, anyone can remove the data and photograph that they entered.

Management/participation right is given to the president.

Exclusion is given to the Membership Affairs Team, which determines the application criteria and approves the new membership requests, replies to messages from members, or informs the team that is expected to reply and performs the suspension and banishment of processes by informing the member about the reasons.

Alienation is reserved by the founder and president of the platform.

3.2.4 COMPARING THE THREE PLATFORMS

Each platform is widely used in their respective countries. Both Trakuş and Kuşbank were born with individual initiatives, but Trakuş was a product of non-scientist initiatives, whereas scientists led the way in the beginning of eKuşbank (eBird Turkey). Faune-France was also initiated from a scientific background under LPO. Both eKuşbank and Trakuş operate in Turkey and the same field. There are two connected platforms to Trakuş, which focus on mammals and butterflies, but they are situated as different platforms, with different landing pages. In Faune-France, there are also 23 other species, but they are positioned on the same platform as birds. The most popular species with the highest number of records is birds in Faune-France.

There are many common users of eKuşbank (eBird Turkey) and Trakuş. However, Trakuş is positioned in a more photography-oriented, community-building manner, whereas eKuşbank (eBird Turkey) is more science and data-oriented. This difference can be observed in their main objectives as well. During the interviews, this difference was also apparent in the testimonies of participants:

"I use Trakuş more for sharing photographs and eBird for sharing observations."

"I think of Trakuş as an encyclopaedia with photographs. eBird is more of a scientific resource for me."

This difference seems to act, in a way, to strengthen the birdwatching community in Turkey and feed the knowledge base. An example of this mutual support is a major update on the Merlin

Application Turkey package in April 2022, in which the data is updated by using the Turkish names of all the identified birds in Turkey that are published in the Trakuş book, Türkiye'nin Kuşları (Birds of Turkey) (Karataş et al., 2021). This difference in their positioning further feeds the different needs of the same public.

In Trakuş, the community members can communicate with each other through the forum section. Members can ask about species or inform the community about related activities and updates. Volunteer management teams can also share news and updates through the news section. In eKuşbank and Faune-France, platform coordinators share related news and in platforms' news sections. However, it is not possible for community members to directly communicate like in Trakuş. Moreover, Trakuş organises events and activities which provide opportunities for the community to gather, observe together, and take bird photographs.

Faune-France is more similar to eKuşbank (eBird Turkey) in terms of science and data orientation. In both platforms, photographs of species are welcomed, but there is no focus on photography. The photographs do not need to be aesthetic or pleasing; the criterion for the photographs is being clear enough for the identification of the species.

Table 6 below demonstrates the summary of the examination of the three platforms according to the IAD framework.

Table 6. The Summary of the Three Platforms Examined According to the IAD Framework

	Faune-France	eKuşbank (eBird Turkey)	Trakuş
Characteristics: Subject	23 animal and plant species, largest contributions on birds	Birds	Birds
Attributes: Background	<ul style="list-style-type: none"> - Scientific activities are primary. - Sustained through an NGO (LPO) - Birdwatching is the focus; photography is secondary. 	<ul style="list-style-type: none"> - Scientific activities are primary. - Sustained through a university (Cornell Lab of Ornithology) NGO (Doğa), volunteers. - Birdwatching is the focus; photography is secondary. 	<ul style="list-style-type: none"> - Social activities are primary. - Sustained through sponsors and volunteers. - Bird photography is the focus; birdwatching is secondary.
Attributes: Users/members	Birdwatchers, bird photographers, naturalists, nature photographers, interested people	Birdwatchers, bird photographers, interested people	Birdwatchers, bird photographers, interested people
Attributes: Providers	LPO, Biolovision	Cornell Lab of Ornithology, Turkish Bird Records Committee, Doğa	ESIT Electronics, doruk.net
Attributes: Decision makers	Validators, signatories, partners	Cornell Lab of Ornithology, Turkish Bird Records Committee, Doğa	Fourteen volunteer management roles
Attributes: Resources used by the users	Individual time, expertise, resources of the platform, and other related resources	Individual time, expertise, resources of the platform, and other related resources	Individual time, expertise, resources of the platform, and other related resources

Attributes: Resources created	Bird photographs, observation data, bird sounds, species information, French names of species, photos and observation data of other 23 species, reports and publications of LPO using datasets of Faune-France, the data provided to French Bird Atlas and Euro Bird Portal	Bird photographs, observation data, bird sounds, Kuşbank reports, academic publications, Turkish Breeding Bird Atlas, the data provided to 2 nd European Breeding Bird Atlas	Bird photographs, observation data, bird sounds, species names in Turkish, forum discussions, Trakuş publications, Trakuş Birds of Turkey book, photographs and information provided to other publications
Attributes: Goals, objectives	Act as an online participatory science platform on which people share their observations, consult for available information and contribute to creating knowledge and protecting nature (<i>Faune-France - LPO (Ligue Pour La Protection Des Oiseaux), 2022</i>).	Address the need to have timely information about the bird species, including their habitats and Important Bird Areas (Özesmi & Per, 2006).	Address the need for a Turkish resource regarding the birds of Turkey, increase birdwatchers in Turkey, and create awareness about the conservation of birds (<i>Trakuş - trakus.org, 2021</i>).
Rules: Operational rules	Determined by LPO, stated under General Conditions of Use.	Determined by Cornell Lab of Ornithology under Terms of Use.	Determined by the President and volunteers, written on the website, and divided into two categories: personal rules and environmental rules.
Rules: Collective choice rules	Determined by Faune-France Steering Committee,	Determined by Cornell Lab of Ornithology under the Terms of Use	Determined by the volunteer management team and the president.

	implemented by LPO.	and Privacy Policy.	
Rules: Constitutional rules	Determined by local steering committees or associations	Determined by the Turkish Bird Records Committee.	Determined by the community, management team, and the president.
Rules: Property rights	Access by connecting the platform; contribution by becoming a member; extraction by request; removal of own data is possible; management is granted to LPO by running and administering Faune-France; exclusion and alienation are given to LPO.	Access by connecting the platform; contribution by becoming a member; extraction for non-commercial use is possible after creating an account and writing a short explanation regarding the extraction of data; removal of own data is possible; management is granted to Cornell Lab of Ornithology; exclusion is shared between Cornell Lab of Ornithology and Turkish Bird Records Committee; alienation is granted to Cornell Lab of Ornithology.	Access by connecting the platform; contribution by becoming a member; extraction is not easy, but records can be accessed and saved one by one; removal rights are granted to the Photograph and Forum Control Team, Observation Team, and Species Identification Committee, and removal of own data is possible; management right is given to the president; exclusion right is granted to Membership Affairs Team; alienation is possible by the founder and president of the platform.

3.3 CONCLUDING REMARKS

In this chapter, I presented the three platforms examined in this study by using the guiding questions of the IAD framework: Faune-France, eKuşbank (eBird Turkey), and Trakuş. These three platforms can be considered as long-term data collection and monitoring projects in terms of the focus of the platforms, based on the classification of Dickinson et al. (2010)¹⁶. In other words, these platforms are mainly data collection platforms, which we can see from the analysis made in this chapter. Therefore, they are different than the data analysis platforms such as GalaxyZoo, for instance. In terms of the degree of participant involvement in the project, Faune-France and eKuşbank (eBird Turkey) resemble the characteristics of contributory projects according to the classification of Bonney et al. (2009), in which scientists design the project and public contributes. Trakuş has a slightly different nature considering that it was created by citizen-led initiatives together with scientists, therefore carrying the characteristics of a collaborative platform, according to the classification Bonney et al. (2009).

Being long-term data collection and monitoring projects mean that the data that is being shared on the platform is crucial for these platforms, which corresponds with the arguments of MSPs approach and knowledge commons theory. As according to MSPs approach, platform is meaningful as long as different sides are "on board" regarding the best interests of the platform and others connected to the platform (Trabucchi & Buganza, 2021). And according to theory of knowledge commons, the resource is both created and used by its participants (Frischmann et al., 2014). Therefore, data sharing is one of the most important factors to consider in an analysis of these platforms. In Chapter 2, literature review also revealed that major challenges that citizen science faces include data-related issues, organisational or design-related issues, and user-related issues. Data sharing is connected to the participant motivations and their participation dynamics, because why and how they share data can be understood by examining their motivations and participation dynamics. It is also related to the data-related factors detailed in Chapter 2. The importance of data quality (Bonter & Cooper, 2012) and validity (Gibson et al., 2019) is evident in the literature, because that's how it will be possible to ensure that the this data is of high quality and valid to be used in scientific studies.

Considering these factors, in the next chapter, I present the study investigating the participation

¹⁶ The different categorisations of citizen science projects were previously discussed in the Introduction chapter.

dynamics, interactions, different roles, and negative externalities in these platforms. This investigation gives insights into action situation dynamics, as mentioned in the IAD framework, and lead to a better understanding of the internal workings of these platforms, as well as their participants. Furthermore, platform managers will gain insights about better designing and better interacting with participants in order to ensure correct, timely, and more flow of data into the platform.

4 ROLES, MOTIVATIONS, NEGATIVE EXTERNALITIES, AND PARTICIPATION IN CITIZEN SCIENCE PLATFORMS

4.1 INTRODUCTION

Understanding participants' perspectives is necessary for developing successful citizen science projects (Raddick et al., 2013). In this regard, the design stage of a citizen science project is particularly important to ensure sustainable collaboration between the public and the scientists. Considering the participants' needs during the design process lead to high quality (Shirk et al., 2012) and sustainable participation (Rotman et al., 2012). Understanding the motivational factors is the first step to reaching those objectives (Rotman et al., 2012). By understanding these behavioural determinants that boost or hamper participants from collecting and sharing data, strategies can be developed to engage them further (Gharesifard & Wehn, 2016).

Even though previous research provides a foundation for understanding the motivational dynamics in citizen science, further investigation of motivations is necessary, given the complex structure of online citizen science platforms, as shown in the previous chapter. Hence, it is useful to take into account the different roles that users undertake in the platform, different participation types, and the negative externalities that may arise from the interactions between the users and the platform. In this chapter, I aim to adopt such an inclusive approach, providing a unique perspective for better design and management strategies in citizen science projects/platforms.

Understanding these factors are important because through this understanding, better citizen science projects/platforms can be designed (Raddick et al., 2013; Shirk et al., 2012), and the potential benefits of citizen science can be achieved. These benefits include environmental benefits such as providing data in investigations of environmental pollution, climate change, and distribution and extinction of species (Dickinson & Bonney, 2012); societal and individual benefits such as leading to learning opportunities about science and scientific method, and helping community building (Adler et al., 2020); and creating collaboration opportunities either among scientists or between the public and scientists (Adler et al., 2020; Dickinson & Bonney, 2012). It also provides data for hundreds of scientific publications in variety of fields such as ecology, ornithology, astronomy, humanities, or climate, among others (NASA - Citizen Science, 2024; Publications - eBird Science, 2024; Publications - Zooniverse, 2024); and leads to democratising the science (Giardullo et al., 2023), which is observable through the scientific publications that are co-authored by citizen scientists (Fung et al., 2020; Martinis et al., 2022; NASA - Citizen Science, 2024;

Nishimura et al., 2023). These benefits briefly exemplify the importance and the motivation of this study. Hence, I dissect into the internal workings and interactions in the citizen science platforms I examine. In other words, I dissect into the action arena in the IAD framework. To do so, the research questions in this chapter are explained below.

First we need to clarify the attributes of actors in a citizen science platform, which is part of the IAD framework. Who participates? In the case of MSPs, participants have different roles. And to explore the motivations of different roles, we first need to identify the different roles of participants. Therefore, the first research question is:

RQ1) What different roles exist in online citizen science platforms?

In addition to the roles, I also investigate the motivations of participants, as it is the main concern of the thesis and one of the major factors to consider for better designing citizen science platforms (Rotman et al., 2012; Shirk et al., 2012).

RQ2) What are the different motivations of participants in online citizen science platforms?

Previous research has approached participation in terms of voluntary participation (Nov et al., 2011) and examined drivers of participation without distinguishing between different types of participation (Gharesifard & Wehn, 2016; Martin & Greig, 2019). These participation dynamics can be examined in the action arena of the IAD framework. Therefore I aim to understand the different modes of participation in the third research question:

RQ3) What types of participation can be distinguished in online citizen science platforms?

Finally, I focus on the possible externalities and how they can influence participation, as they are the main issues in knowledge commons and MSPs.

RQ4) What are the negative externalities arising from the relationship between the participants and the platforms, and how do platforms address these negative externalities?

For the analysis of research questions 1 and 4, I used the Multi-Sided Platforms (MSPs) approach to examine the different roles in the platforms and their interactions with the platforms. When I analysed the interactions, I observed that there are negative externalities arising as a result of those interactions, and platforms make value deals with each role.

In the analysis, I use the IAD framework as the general framework and the concept of negative externalities to better analyse the network effects in the context of MSPs. I presented the IAD framework, MSPs approach, and knowledge commons theory in Chapter 2, and focused on the

analysis of the platforms in terms of their characteristics, attributes, their rules, and some of the outcomes in Chapter 3. In this chapter, I shift the focus to the examination of interactions inside the *action arena* of the IAD framework and resulting externalities as outcomes (see Figure 6 in Chapter 2), together with investigation of different roles that actors can undertake. The MSPs approach fits well into the investigation of *action situations* and related elements in the IAD framework. In this approach, multiple groups are connected to the platform, which results in network effects (Boudreau & Hagiu, 2009). To my knowledge, the roles and network effects in citizen science platforms have not previously been studied in the context of MSPs. Incorporating knowledge commons with MSPs approach under the umbrella of the IAD framework provides a better understanding of the motivational and participation dynamics in citizen science platforms, which in turn will lead to better design of these platforms to reach the scientific, environmental, individual, and societal benefits of citizen science.

Besides its theoretical contribution and empirical contribution concerning the application of the IAD framework with knowledge commons theory and MSPs approach in the case of citizen science platforms, this study also contributes MSPs and citizen science literature by examining the value deals that these platforms makes with the different roles and the negative externalities arising from the interactions between these roles and platforms, which have practical implications as well.

To address research questions 2 and 3, I reviewed the literature regarding the motivations and participation studies in citizen science to understand the different motivations of platform participants and different ways to participate in these platforms. Previously, motivations in the context of citizen science were examined largely by identifying drivers or motivations such as contributing to science, learning, or socialising (Raddick et al., 2010; Tinati et al., 2017), as analysed in Chapter 2. In other studies, the researchers highlight that motivations change as time passes and as they advance through the project (Bonney et al., 2016; Crowston & Fagnot, 2008; Jackson et al., 2015). Approaching the role of motivations from a broader perspective by considering the motivations of all stakeholders involved was emphasised to be essential for future research (Wehn & Almomani, 2019).

Taking into consideration the above gap, I analysed the motivations from a wider perspective. Alongside those identified in previous research, I also found that these drivers can be grouped under two different kinds of motivations: motivations for the subject of the citizen science platform, which is birds in our case, and motivations to engage with the platform. Even though interest in the subject of the citizen science project was previously identified in the literature as a

motivation (Mankowski et al., 2011; Marshall et al., 2015; Meakin et al., 2019; Reed et al., 2013; Tinati et al., 2016, 2017), it was not studied comprehensively by distinguishing between the two groups of motivations as I did in this study. This distinction is crucial because they are rooted in two different behaviours: subject-related behaviours and platform/project engagement behaviours.

I used a qualitative approach using semi-structured in-depth interviews to investigate the research questions. The analysis is based on qualitative empirical research in which I examined the three online citizen science platforms that were presented in Chapter 3, eKuşbank (eBird Turkey) and Trakuş in Turkey and Faune-France in France.

I argue that the platform acts as a regulating body for all parties to maximise knowledge flows in the most effective way by reducing each party's tendency to avoid sharing data, information, and knowledge. The platforms I examine do not exist independently from their participants. Participants are the ones who provide the inputs for the creation and sustainability of the database of the platform (Frischmann et al., 2014). The platform itself or other parties use this data and information to create knowledge. Without the participants, the platform has no use and cannot create new knowledge. Thus, the motivations of participants to use the platform and share information become central to the effectiveness of the platform, as discussed in Chapter 3.

In the next section, I present the data and methodology section concerning the qualitative study in this chapter, followed by the findings, which include the identification of roles, motivations and participation modes, and negative externalities and value deals. What follows is the summary and discussion of the findings, including the presentation of the Citizen Science Platform Interactions Model, and, finally, the conclusion.

4.2 DATA AND METHODOLOGY

The data was collected through semi-structured, in-depth interviews between June 2020 and November 2021 with the participants, volunteers, and the coordinators of the platforms. Participants are the ones who participate by using the platform in any way. Volunteers are people who volunteer to verify the data shared by participants. Volunteers also include people who take place in other volunteer committees depending on the volunteering options in the platform, which was explained in detail in Chapter 3. Coordinators are the ones who hold either volunteer or formal coordinator positions in the platform. Table 7 summarizes the information about the interviewees. It also displays the "roles" that interviewees have in the platform that I will further explain in the

findings section below. The platforms in Turkey are Trakuş and eKuşbank (eBird Turkey), and the platform in France is Faune-France.

In-depth interviews are important to address the research questions because they allow for examining the experiences of people and the meanings that they assign to those experiences (Seidman, 2006). I preferred the interviews to be semi-structured because it enables researchers to keep the focus of the interviews with each participant and, at the same time, allows them to explore further based on the flow of the interviews (Adeoye-Olatunde & Olenik, 2021).

A total of 9 interviews were conducted in Turkey and 17 interviews in France, with a total of 26 interviews. We conducted the interviews during the COVID-19 pandemic when there were significant restrictions in terms of social contact, together with lockdowns. Because of this reason, the majority of the interviews were conducted through online video conferences, and 2 of them were carried out by phone conversation. A total of 17 hours and 20 minutes of interview data was recorded and then transcribed. The interviews in French were conducted together with Nicolas Jullien to ensure that participants who prefer to speak in French are well included. I used Vosk speech-to-text API for the transcription of the interviews in French and English. The errors were later corrected manually by relistening. Interviews in Turkish were manually transcribed, considering that Vosk did not work well enough for transcriptions in Turkish. The coding of the interviews for the analysis was done using QDA Miner qualitative analysis software. Table 7 displays detailed information about the interviews.

Table 7. Summary of Interviews

No	Gender	Duration	Language	Date	Medium	Status in platform	Role	Country
Int. 1	Male	1:31:25	Turkish	17.06.2020	Online without video	Coordinator, participant	Scientist, birdwatcher	Turkey
Int. 2	Female	51:24	Turkish	26.09.2020	Online video	Participant	Scientist, birdwatcher	Turkey
Int. 3	Male	41:31	Turkish	08.10.2020	Online video	Volunteer, participant	Scientist, birdwatcher	Turkey
Int. 4	Female	34:31	Turkish	10.10.2020	Online video	Participant	Scientist, birdwatcher	Turkey
Int. 5	Male	39:22	Turkish	24.11.2020	Online video	Coordinator, participant	Birdwatcher, bird photographer	Turkey
Int. 6	Male	1:22:17	English	20.07.2021	Online	Coordinator	Scientist,	France

					video		birdwatcher	
Int. 7	Male	1:06:08	French	22.09.2021	Online video	Volunteer, participant	Birdwatcher, bird photographer	France
Int. 8	Male	37:40	Turkish	11.10.2021	Online video	Participant	Brdwatcher, bird photographer	Turkey
Int. 9	Male	1:12:28	Turkish	12.10.2021	Online video	Participant	Birdwatcher, bird photographer	Turkey
Int. 10	Male	37:06	Turkish	14.10.2021	Online video	Participant	Birdwatcher, bird photographer	Turkey
Int. 11	Male	56:54	Turkish	18.10.2021	Online video	Participant	Birdwatcher, bird photographer	Turkey
Int. 12	Male	22:49	English	18.10.2021	Online video	Participant	Birdwatcher, <i>naturalist</i> ¹⁷	France
Int. 13	Male	42:43	English	19.10.2021	Online video	Participant	Birdwatcher, bird photographer	France
Int. 14	Male	52:58	French	19.10.2021	Online video	Volunteer, participant	Birdwatcher, <i>naturalist</i>	France
Int. 15	Male	43:22	English	21.10.2021	Online video	Participant	Scientist, birdwatcher	France
Int. 16	Male	27:49	English	21.10.2021	Phone	Participant	Birdwatcher, bird photographer	France
Int. 17	Male	36:37	English	22.10.2021	Online video	Participant	Birdwatcher	France
Int. 18	Male	32:20	English	23.10.2021	Online video	Participant	Birdwatcher, bird photographer	France
Int. 19	Male	52:20	English	26.10.2021	Online video	Participant	Birdwatcher, <i>naturalist</i>	France
Int.	Male	41:57	English	27.10.2021	Online	Participant	Scientist,	France

¹⁷ In Faune-France, the data for 23 other species different than birds can be shared. We covered this in Chapter 3. Some interviewees highlighted themselves to be *naturalists*, underlining that they also observe other species. We didn't include naturalists as a separate role in the findings section because they assume a similar role with the birdwatcher role but they observe other species as well. We also kept the focus on the birds considering that other two platforms had the focus on birds.

20					video		birdwatcher, bird photographer	
Int. 21	Male	26:23	English	04.11.2021	Online video	Participant	Scientist, birdwatcher, <i>naturalist</i>	France
Int. 22	Male	59:57	English	10.11.2021	Online video	Volunteer + Participant	Scientist, birdwatcher	France
Int. 23	Male	1:03:57	English	12.11.2021	Online video	Participant	Birdwatcher, bird photographer	France
Int. 24	Male	53:22	French	17.11.2021	Online video	Participant	Birdwatcher, bird photographer, <i>naturalist</i>	France
Int. 25	Male	43:15	English	18.11.2021	Phone	Participant	Scientist, birdwatcher	France
Int. 26	Male	1:07:08	English	29.11.2021	Online video	Participant	Scientist, birdwatcher, bird photographer	France

The first interviews in both countries were held with coordinators on the platforms. I asked the same questions as I did to other participants, and I sought additional information concerning the workings of the platforms.

Participant selection was based on the volunteering of users. In Turkey, there are two WhatsApp groups that birdwatchers and bird photographers actively use. I was informed that these groups cover the majority of the active birdwatching and bird photographer community in Turkey, bearing in mind that there are other smaller, local groups as well. The participants of these groups use at least one of the platforms I study in Turkey. For the recruitment of interviewees among the community members in Turkey, I used these WhatsApp groups. Even though the forum section of Trakuş is actively used, the news section of eKuşbank does not provide an equally engaging platform compared to the Trakuş forum section. Moreover, there is no equivalent forum section in eKuşbank. Therefore, using the forum discussions of Trakuş to recruit interviewees might have created a bias toward the users of Trakuş. WhatsApp permitted a better sampling. The number of members in the WhatsApp groups changes as new people are added and others leave. The number of participants was approximately between 120-150 at the time of the interviews, and as of March

2023, they have 196 and 159 members. There are also joint members in both groups.

I was added to these groups in June 2020 to follow the conversations and contact the members of the community in Turkey. The first interviewee suggested us to contact interviewees 2-5 because they are long-term members of the community. Given that the birdwatching and bird photography community in Turkey is relatively young, dating back to the 1990s (Boyla et al., 2019), I found these contacts to be important. I later realised during the analysis that these initial interviews had set a solid foundation for the rest of the work by covering most of the information raised later. However, to avoid bias, I sent messages on the two WhatsApp groups, which were being very actively used, and asked for volunteers who wished to participate in the research project. The interviews were finalised when saturation was reached¹⁸.

In France, after the first interview with the coordinator, an invitation was published in the news section of the Faune-France Platform to recruit volunteer interviewees¹⁹. I contacted all volunteers who reached out and set interview dates with the ones who wanted to continue the process. A total of 36 volunteers contacted the research team. Two volunteers stopped communication after initial contact. As volunteers were still contacting the research team as interviews continued, I informed the remaining 17 volunteers that I would contact them in case additional interviews were needed. Additional interviews were not set because of reaching saturation.

In the interviews, I aimed to understand the motivations of participants concerning birdwatching, bird photography, the environment, and the platforms that are the focus of this study. I also asked about their history with the platforms, as well as their engagement with the platforms. I investigated their points of view about birdwatchers and bird photographers and examined the reasons for and ways of not participating. These insights were important to understand the different users of the platform in relation to the MSPs. In addition, I inquired into different motivations and their connections with the platform and their experiences. As the interviews were semi-structured, I let the conversations flow for the interviewees to express themselves better. I present the findings of the analysis of the interviews in the following section.

¹⁸ Saturation is defined as the point where additional data cannot be found (Glaser & Strauss, 1967/2009).

¹⁹ See appendix A.

4.3 FINDINGS

4.3.1 RQ 1: IDENTIFICATION OF ROLES

Approaching online citizen science platforms with the lens of MSPs offers a comprehensive perspective to understand the nature of these platforms. MSPs were mostly studied in the context of profit-seeking platforms (Abdelkafi et al., 2019; Boudreau & Hagi, 2009; Trabucchi & Buganza, 2021); however, citizen science does not have a financial goal. Therefore, I focused on the concept of non-price regulatory strategies (Boudreau & Hagi, 2009), which were previously highlighted in the literature in the context of profit-seeking platforms (Abdelkafi et al., 2019; Boudreau & Hagi, 2009; Trabucchi & Buganza, 2021). In this study, I refer to these non-price tools as the value deals that MSPs make with different roles surrounding them. I also refer to them as value offers throughout this study when talking about a value offered from one party to another, such as from the platform to one of the roles.

The importance of the platform design was highlighted to be crucial for ensuring high-quality participation (Shirk et al., 2012), retaining participants, and increasing participation (Rotman et al., 2012), but the structure of these platforms was not studied in the context of MSPs by considering the roles that different sides of these platforms take and the value deals that the platforms make with each role. In online citizen science platforms, there are the providers of data and information and the users of data and information. An individual may assume the role of provider at one point and user at another point in time. Platforms facilitate value exchanges among various roles. Here, multiple distinct groups interact, generating externalities that are optimized when an intermediary coordinates their interactions (Evans, 2003). In the previous literature, examples of roles were given as buyers and sellers, for example, in eBay (Abdelkafi et al., 2019).

Concerning the citizen science platforms in this thesis, I identified four different “sides” or “roles” based on the interviews: 1) birdwatcher, 2) bird photographer, 3) scientist, and 4) hunter²⁰. The first three roles, birdwatcher, bird photographer, and scientist roles, were expected roles to find in these citizen science platforms. Hunter role is interesting, and I specifically wanted to include this role because of its impact on other roles, especially on birdwatcher and bird photographer ones. Interviewees in both countries mentioned hunters without being directly asked about hunters.

²⁰ There might be other roles not revealed in the interviews. These four roles were the ones that the interviewees mentioned during the interviews.

They largely referred to their interactions with hunters in the field settings:

Now it's the hunting period in France, began one month ago. And there aren't a lot of natural areas you can go to. Because there are hunters, and you can be shot. If you don't take care, it can be dangerous. And for me, nature should be for everyone and not just for a small group. You can go for hike, there are hunters 100 meter from you, with their guns. You don't want to be there.

If you are in the countryside where you have hunters, and you go to observe; and they are just near you.

Especially here in Southwest France, so many times when I sense the animals, I try not to scare them; so that they don't have to go away where they could be killed by the hunters. In France, hunting is really a big issue.

You know, there are people who poach, who know no borders, who hunt at night, who hunt with flashlights. And the animals that we photograph, try to photograph, or travel for kilometres just to see... They finish the job in one go, they destroy the animal. I think this should be prevented. Maybe hunting used to be normal in the past, but now we have come to such a state that we have pushed nature aside in a very bad way in many respects, we have taken away their habitats and we continue to do so rapidly.

They also mentioned some photographers to be former hunters, and I elaborate on this point further below when talking about the similarities that bird photographer and hunter roles share:

Some bird photographers come from a hunting background (referring to the community in Turkey).

And they mentioned hunter's knowledge and affection about the nature, which I further elaborate on below concerning the similarities between the bird photographer and hunter roles:

In France there are also people who knows the nature but not have the same approach to the nature, which are the hunters. In fact, when you speak with hunters, they know the birds and different species really well.

They love hunt and they love the nature.

Prior to the interviews, I didn't expect hunters to be a factor to take into account in these citizen science platforms. Therefore, I didn't ask questions about hunters during the interviews. But I include the hunter role among three others, because it became obvious that without it, the

examination of the *action arena* and interactions would not be complete. I elaborate on the hunter role, together with the other three roles, in the following sections. In terms of the examination of motivations, I mainly focus on the birdwatcher and bird photographer roles; and when it comes to the negative externalities and value deals, I focus on all four roles in the sections below.

I argue that each of these roles has different motivations and expected benefits for using the platform. Previously, accounting for the motivations of all stakeholders was highlighted as a crucial gap for research (Wehn & Almomani, 2019). By identifying the roles, I have taken a step to address this gap. Moreover, the previous emphasis was on citizens as participants and scientists and policymakers as other stakeholders (Wehn & Almomani, 2019). I think that this categorisation is a good start to look at the different parties of the platform. But I take a step further and consider two different roles under the categorisation of Wehn and Almomani's (2019) citizens as participants: the birdwatcher and the bird photographer roles. This allows us to look at the motivations of these two different roles separately and together to understand the breakdown of motivations better.

As mentioned, I also differentiate these roles as "users" and "providers" of data and information. To ensure the clarity of terminology, I would like to provide definitions for data, information, and knowledge, as I will frequently use these terms in the rest of the study. Data can be explained as an objective set of facts (Davenport & Prusak, 1998). As Machlup puts it, data is the "records of observation" (Machlup, 1984/2016, p. 207). Data needs to be processed to acquire meaning. As a result of the cognitive processing of the data, information emerges (Baskarada & Koronios, 2013). By adding value to data, it becomes information (Davenport & Prusak, 1998). Hess and Ostrom (2007) refer to Machlup's division of data-information-knowledge as data being raw pieces of information, information being organised data, and knowledge being absorption of information by understanding the ways of using it (Machlup, 1983, as cited in, Hess & Ostrom, 2007). Foray approaches knowledge as "something more than information", which empowers the ones who possess it with "the capacity for intellectual or physical action"; so, knowledge is a form of "cognitive capability" (Foray, 2004, p. 4).

Following the examination of the platforms and the interviews, I found that hunter and scientist roles use the data and information, whereas the birdwatcher and bird photographer roles both provide and use the data and information. As mentioned before, one individual can have more than one role. For example, a participant can be a scientist and use the data shared on the platform. The same person can also be a birdwatcher and provide data to the platform. The ones who

provide data to the platform are the provider roles: birdwatcher and bird photographer. I previously discussed the importance of data flows to the platform in Chapter 2, underlining that when data is not shared, these platforms cannot maintain the database and the knowledge based on this data will not be created. In other words, the resource is both created and used by the participants in knowledge commons (Frischmann et al., 2014).

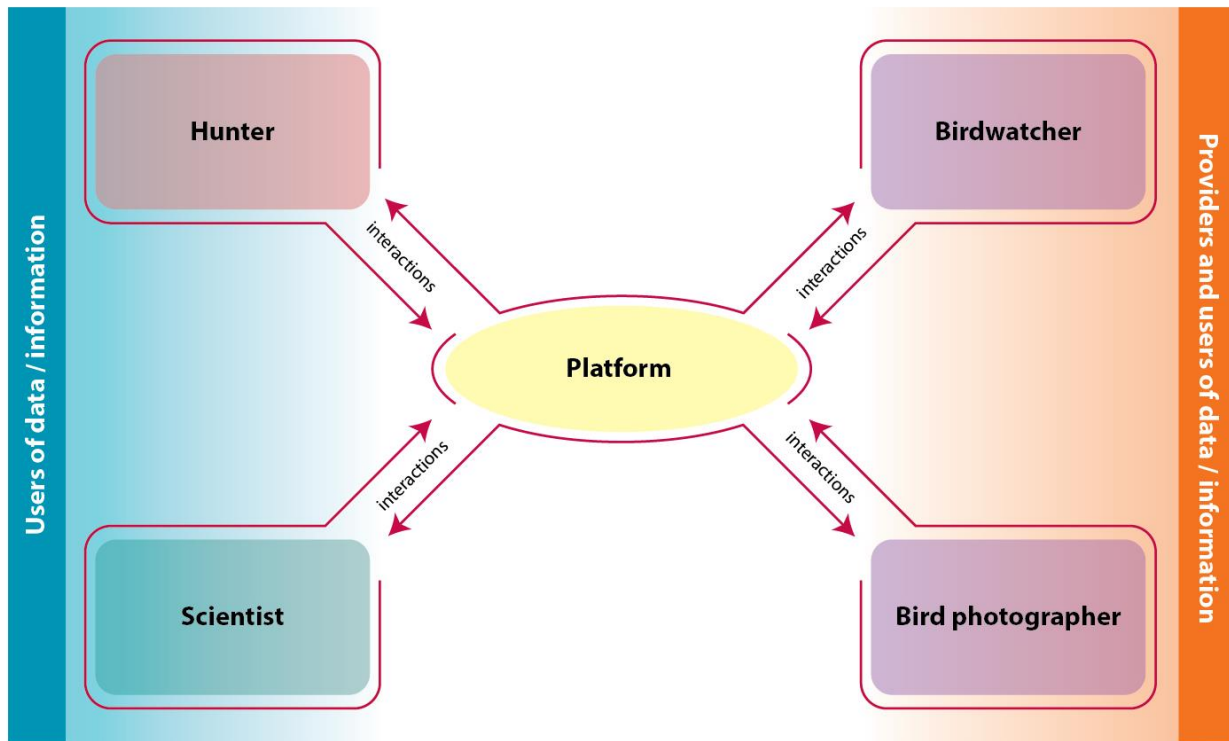


Figure 12. Interactions Between the Platform and Different Roles

These citizen science platforms act as an intermediary between different roles and facilitate their interactions, similar to what Evans (2003) highlighted about MSPs. I also found that the interactions are created in accordance with the value deals that each role makes with the platform. As a result of these interactions, negative externalities might emerge. For instance, a participant might be motivated by getting recognition. The platform provides the space to get recognition, leading to interactions between participants, as well as addressing their motivations. However, this motivation might lead the participant to hide data about a rare species, as they may not want to share their achievement, which may lead to the creation of negative externalities. I consider not sharing data as a negative externality because platforms maintain their databases through data sharing and this is how every role in the platform is better off. Without the data shared, these platforms cannot

fulfil their objectives. The process of interactions is visualised in Figure 12 and elaborated in the following sections. Identification of roles paves way for explaining the value deals between the different roles and the platform. It also provides a structure to explore motivations of different roles..

In the examination of motivations and participation modes, I focused on the birdwatcher and bird photographer roles as these are the ones that provide data to the platform. Among the 26 interviewees, there were 11 people who also had the role of scientist. More specifically, 4 interviewees in Turkey and 7 interviewees in France were also scientists working in a related field to ornithology and potentially use the data on the platform in their scientific research. But I didn't focus on their motivations in their role as the scientist during the interviews considering that my main objective was to investigate the data provider roles and the motivations of people in these roles. However, considering that the scientist role together with the hunter role, gives a more complete picture of the actors in the *action arena*, as well as the interactions between different actors, as highlighted in the IAD framework, I explain the value deals and negative externalities related to these two roles in the following sections.

In other words, I don't get into detail of the motivations of the scientist role considering that my focus is on data provider motivations. And I don't get into detail of the motivations of the hunter role because of two reasons: firstly because prior to conducting the interviews, I didn't expect hunters to have a role in the platforms as the literature on hunters with relation to citizen science is new and narrow; and secondly, similar to the reasoning regarding the scientist role, I kept the focus on the data provider roles in the platform, rather than "data user" roles.

Additionally, literature review showed that the citizen science projects should be designed to ensure that scientists benefit from it (Shirk et al., 2012; Walker et al., 2021). Scientists benefit from the citizen science data by using them in scientific research and publications. For instance, eBird global tracks the scientific publications that use eBird data, and as of March 2024, they list over 930 scientific publications (*Publications - eBird Science*, 2024). A different citizen science platform, Zooniverse, also holds records of the scientific publications that use data collected through various Zooniverse projects, and they list over 480 publications as of March 2024 (*Publications - Zooniverse*, 2024).

4.3.2 RQs 2 AND 3: IDENTIFICATION OF MOTIVATIONS AND PARTICIPATION MODES

An important result of this analysis is the need to distinguish between two types of motivations: “motivation for the subject” and “motivation for platform engagement”. I believe this distinction is necessary because there are two separate behaviours and two separate motivation sources concerning the citizen science platform. The first set of behaviours includes birdwatching and taking bird photographs. Engaging with the platform is the second type of behaviour. I distinguish the corresponding motivations for these behaviours as “motivations for the subject” and “motivations for platform engagement”, as stated above. In our case, the former corresponds to motivation about birds, specifically the motivation for birdwatching and bird photography; and the latter, to the motivation to engage with the platform by sharing observation data, reading articles, commenting on photographs, or taking part in competitions.

The data shared on the platform is collected through birdwatching and/or taking bird photographs. This data is shared by participating in the platform. It should be kept in mind that platform engagement does not always refer to sharing data but includes other activities like reading the posts and/or commenting on the photographs, depending on the available platform content. I elaborate on these modes of participation in the following sections.

I identified various drivers or motivations under *motivations for the subject* and *motivations for platform engagement*, as well as some common ones. Below, I examine these two types of motivations for the two corresponding data provider roles that I identified previously, birdwatcher and bird photographer.

4.3.2.1 RQ 2: Motivations for the Subject: Motivations for Birdwatching and Bird Photography

Based on the interviews, I identified motivations for the subject, which is birds in our case. I examined these for birdwatcher and bird photographer roles. I found joy, having fun, curiosity, discovering, adrenaline, having a family activity, avoiding boredom, relaxing, escaping from stress sources, travelling, continuing a hobby, and challenge as the common motivations for the roles of birdwatcher and bird photographer. Some drivers are only specific for bird photographers, like capturing the beauty of birds, aesthetic concerns, and taking photographs as a memory.

Table 8 shows the motivations were identified concerning the subject (birds), with related quotes from the interviews.

Table 8. Motivations for the Subject (Birds)

Roles	Motivation: Subject (birds)	Quotes from Interviews
BOTH (Birdwatcher and bird photographer)	Joy	<i>"For me, it started with the joy of being in nature and seeing its beauty." "I am an amateur in this, and this is extremely enjoyable for me" (Referring both to birdwatching and bird photography).</i>
	Having fun	<i>"I have fun doing challenges in the mountains; I take photos of all the species that I come across."</i>
	Curiosity	<i>"I think people are just curious about what to see, what's around them."</i>
	Discovering something new	<i>"Discovering, being the first person to step into a place where nobody knows and nobody has been to, motivates me".</i>
	Adrenaline and excitement	<i>"You are searching for a specific bird, and you find it. You want to take a beautiful picture with nice lights, colours, and bird posing. So, there is your chance. You have to be fast. That's adrenalin."</i>
	Family activity	<i>"When I visit nature, I mostly go with my son and wife. My wife prefers plants and trees. But we go together, and there is enough to see for everybody."</i>
	Avoid boredom	<i>"I started birdwatching and taking their photographs because of being bored."</i>
	Relaxing	<i>"I am very fond of nature, you know; I escape anytime I can, to go outside, to the field, or to the forest to relax and observe what is all around me since I was a little child". "It's a good way to stop thinking about work and just enjoy nature." "I think birdwatching is a relaxing hobby which is easy, cheap, and easily accessible for people who work in very stressful conditions in a highly stressful country." (Referring to Turkey)</i>
	Escape from stress sources, escape from work	<i>"Because I live in Paris, it's (birdwatching) a way to see something wild." "There is a will to get away from the city, from the stress."</i>
	Travelling	<i>"It is a tool for travelling. There is not much of a difference between the birdwatchers and bird photographers when it comes to travelling as motivation."</i>

	Continuing a hobby	<i>"I observe animals in nature as a leisure activity."</i>
	Challenge	<i>"I think part of it is because there is a challenge because you have to identify birds."</i>
Bird photographer	Photographing the beauty of birds	<i>"I enjoy the colours, the behaviour, and I think that birds are very pretty."</i>
	Aesthetic concerns	<i>"When it comes to taking photographs (of birds), there are aesthetic concerns. There is the art dimension."</i>
	Taking photos as a memory	<i>"I don't think that I am a good photographer. I take photographs as a memory, not to get the perfect portrait."</i>

4.3.2.2 RQ 2: Motivations for Platform Engagement

As far as the motivations for platform engagement are concerned, the common motivations for both roles were taking part in the co-creation of knowledge, contributing to science, helping scientists, educating and encouraging other people, learning, keeping records for personal archives, keeping records for others, and sharing knowledge. At the same time, birdwatchers are motivated by completing lists as a motivation for platform engagement, and bird photographers are motivated by selling photographs and displaying photographs as a portfolio. The motivations for engagement with the platforms are shown in Table 9, together with quotes derived from the interviews.

Table 9. Motivations for Platform Engagement

Roles	Motivation: Platform Engagement	Quotes from Interviews
BOTH (Birdwatcher and bird)	Co-creation of knowledge	<i>"It (referring to Trakus) is about co-creating the (information) resources."</i>
	Contributing to science	<i>"I found it really interesting to use my passion to help science". "My observations and photographs contribute to the science and ornithology, and they will last."</i>
	Help scientists	<i>"I think the most important motivation is that we can participate in something bigger than we are, to something useful for the birds, for nature, and help people who work for the sake of those." "And for me, the most important motivation is to be useful. To be useful for the community and for the researchers who have dedicated their lives to this kind of</i>

photographer)		<i>research."</i>
	Educating and encouraging other people	<i>"So, I guess when I go into nature and share the information that I collect of these birds or dragonflies, it is to make aware other people that we have great biodiversity in France."</i>
	Learning	<i>"When there is a knowledge network, then people start to join to reach that knowledge and information." "I was actually surprised by the things I picked up just from Faune-France; it's quite crazy. You learn many things with this site. It's a bit of a gold mine." "Next week I'm going on a holiday near the Atlantic Ocean. And I'm checking Faune-France to see the previous observations, to learn what I can see once I'm there, and to know if I can identify them. So, it's about getting information to be prepared." "I can communicate with people on Trakuş and have feedback in a very short time when I ask about a bird."</i>
	Keeping records for myself	<i>"I very quickly noticed that it was a very powerful and efficient way to save your observations. And I very often go back to my previous observations, asking myself <Okay, where did I already see this bird?>" "I think sharing is the byproduct. For me, when you are a bird lover, it's nice to have all your observations easily accessible." "One of the reasons that I use eBird (eKuşbank) is to be able to track and remember my observations."</i>
	Keeping records for others	<i>"I wanted other people to be informed about these records, and the first place that I shared was Trakuş. Now I share mostly on eBird."</i>
	Share their knowledge	<i>"I began sharing on Instagram as well, and my friends started messaging me saying that they were noticing birds that they didn't before. This increased my interest in birdwatching and bird photography."</i>
Birdwatcher	Completing lists	<i>"Launching small personal challenges to see certain species and ticking them when I see them is something I do." "There's a collection which waits for me to collect." (Referring to bird species)</i>
Bird photographer	Sell photographs	<i>"Sometimes photographers want to sell photographs."</i>
	Display photos as portfolio	<i>"Sharing on Faune-France is a bit like keeping a portfolio."</i>

Learning appeared as a frequently referred motivation for platform engagement in the interviews. In general, interviewees referred to learning about the bird species and different animal species, learning the locations where they can observe the birds, and learning about the birds that are close to where they live.

The material curated from the data and information shared by the participants becomes a resource, (Frischmann et al., 2014), because these platforms are knowledge commons, allowing participants to learn by using it. In our cases, this resource can be online or printed and/or scientific or non-scientific. For example, the papers published using the data shared on eKuşbank (eBird Turkey) are scientific publications, while the book curated from the data and information on Trakuş, "Türkiye'nin Kuşları" (Birds of Turkey) (Karataş et al., 2021), is a non-scientific publication. It was first published in June 2021 and became Turkey's most extensive source of bird species. The package of Turkey on the Merlin application of eBird was also updated according to the information about species shared in this book in April 2022. Considering these, the book appears to be an important source for birdwatchers and photographers in Turkey. Even though there are experts and scientists among the editors, preparing and publishing the book was possible only with the information and photographs shared by participants on Trakuş. Experts among the editors included ornithologists, making it a good example of citizen science that allows cooperation between scientists and citizen scientists, which is highlighted in the literature as one of the major benefits of citizen science (Dickinson & Bonney, 2012). In other words, this book exemplifies the collaboration opportunities between the scientists and the platform participants that Trakuş provides compared to the other two platforms, which I covered in Chapter 3. This shows that the platforms respond to the learning drives of participants by sharing resources. As a result, participants enrich their knowledge base and contribute by using what they have learned. The interviewees exemplify this process:

"For me, it's a very efficient tool for knowledge." (Referring to Faune-France)

"Some people started participating in Trakuş to be able to recognise the species and learn about their characteristics."

Furthermore, participants also use the platforms to learn about the species in their living environment and/or places they plan to visit.

"The best way to know where the birds are is through sharing information. Using Faune-France and Faune-Savoie is a good way to know where and when I can see the birds."

"I discovered Faune-France when I was looking for information about where I can find some

animals.”

“As a verifier, I am very much interested in the observations of others because it allows me to see that a species is seen on several points of an area by different observers. Also, if I haven’t seen it yet, I keep an eye out to see it.”

“I discovered Faune-Charente-Maritime (connected to Faune-France) when I was looking for information about what kind of birds are found in the region.”

“People learn the locations of birds from each other.”

“When we share the photographs we take, we sometimes share the information about in which region or during which season to take a better photograph of a bird.”

4.3.2.3 RQ 2: Common Motivations for the Subject (Birds) and Platform Engagement

Based on the interviews, I also identified common motivational factors for the subject (birds) and for platform engagement by taking into consideration the roles of birdwatcher and bird photographer. These are, previous interest in science, conservation of nature, biodiversity, and birds, being a part of a community and socialising, getting recognition, being appreciated, and competition for the roles of birdwatcher and bird photography. For bird photographers, a common motivation between birds and platform engagement is taking photographs of rare species and sharing them.

Table 10 shows common motivational factors for the two types of motivations, considering the roles of birdwatcher and bird photographer, with quotes from the interviews.

Table 10. Motivations Common for Both Subject (Birds) and Platform Engagement

Roles	Motivation: Both subject (birds) and platform engagement	Quotes from Interviews
BOTH	Previous interest in nature, animals, and birds	“I’ve been watching birds and nature for a long time since I was a child. When I was a child, I began.” “I have been a nature lover since childhood.”
	Conservation of nature, biodiversity, and birds	“Even if biodiversity is declining, we still have it, and it must be protected. So, I guess that’s why I’m doing this.” “For us, it’s because we can help to gather information about species that can help to protect the species.”
	Being a part of a community, socialising,	“And also, I do it for the community feeling.” “Good friendships begin with those as well.” (Referring to birdwatching and bird photography)

(Birdwatcher and bird photographer)	meeting with likeminded people	
	Getting recognition, fame, and reputation	<i>"When you see a different species, you share it and become temporarily famous in the group."</i>
	Being appreciated	<i>"When a new species is seen, then the other birdwatchers will say "Oh, you find this species in this territory, brother, it's amazing; this is the first time."</i>
	Competition	<i>"There can be competition for the transmission of data. I remember that at one point, I had fallen into this cycle, the race for data, which is something that many people have fallen into." "In (bird) photography, there is a competition for taking a more beautiful photograph or taking more photographs."</i>
Bird photographer	Photographing rare species	<i>"We are after rare species."</i>

Some of the motivations were also identified in previous literature. These are shown in Table 11. These different drivers of data provider roles -birdwatcher and bird photographer roles- were largely in line with the previously identified drivers in literature. The drivers that I didn't find in the three platforms include, gaming, having a certificate, procrastination, fulfilling a dream, love of science, improve own health, and useful for a career step. Gaming and having a certificate are not relevant in the cases studied in this thesis. Procrastination, fulfilling a dream, love of science, improve own health, and useful for a career step were not specifically mentioned in the interviews. Not finding all the motivations that are previously identified in the literature is expected, because the literature on drivers of participation in citizen science spans a variety of fields. This detailed identification of drivers is important, nonetheless, considering that they might differ in different fields of citizen science, thus I came up with a novel way of categorising the motivations: motivations for the subject, and motivations for platform engagement, which can be a more overarching approach when it comes to drivers or motivations in different citizen science fields. In doing so, I was led by the literature and the findings.

I also identified some different drivers by approaching the participants through the lens of two data provider roles, birdwatcher and bird photographer. These include, displaying photographs as a portfolio, photographing rare species, selling photographs, and taking photographs as a memory for the bird photographer role specifically. I identified completing observation lists, in the case of

birdwatcher role specifically. And I identified escaping from work and stress sources, family activity, keeping records for oneself, and travelling concerning both birdwatcher and bird photographer roles.

Table 11. Findings In Line With Previous Research - Motivations

Motivation	References
Joy	(Gharesifard & Wehn, 2016; M. G. Jones et al., 2018; Martin & Greig, 2019; Nov et al., 2011; Phillips et al., 2019; Raddick et al., 2010; Sandhaus et al., 2019; Wright et al., 2015)
Having fun	(Curtis, 2018; M. G. Jones et al., 2018; Raddick et al., 2010; Tinati et al., 2016, 2017)
Curiosity	(Asingizwe et al., 2020; Raddick et al., 2013; Rotman et al., 2012; Tinati et al., 2016, 2017)
Discovering something new	(Baruch et al., 2016; Curtis, 2018; M. G. Jones et al., 2018; Raddick et al., 2010, 2013)
Conservation of nature and species	(Alender, 2016; Ganzevoort & van den Born, 2020; M. G. Jones et al., 2018; Larson et al., 2020; MacPhail et al., 2020; Phillips et al., 2019; Sandhaus et al., 2019)
Being a part of a community, socialising, meeting with likeminded people	(Beza et al., 2017; Curtis, 2018; Ganzevoort & van den Born, 2020; Gharesifard & Wehn, 2016; M. G. Jones et al., 2018; Larson et al., 2020; T. K. Lee et al., 2018; Lehman et al., 2020; Mankowski et al., 2011; Merenlender et al., 2016; Phillips et al., 2019; Raddick et al., 2010; Reed et al., 2013; Rotman et al., 2012; Tinati et al., 2017; Wright et al., 2015)
Continuing a hobby	(Curtis, 2018; Domroese & Johnson, 2017; Hobbs & White, 2012; Rotman et al., 2012; Wright et al., 2015)
Learning	(Asingizwe et al., 2020; Curtis, 2018; Del Savio et al., 2017; Dem et al., 2018; Domroese & Johnson, 2017; Ganzevoort et al., 2017; Ganzevoort & van den Born, 2020; Gharesifard & Wehn, 2016; Jakositz et al., 2020; M. G. Jones et al., 2018; T. K. Lee et al., 2018; Lehman et al., 2020; MacPhail et al., 2020; Martin et al., 2016; Maund et al., 2020; Merenlender et al., 2016; Noel-Storr, 2019; Phillips et al., 2019; Raddick et al., 2010; Rotman et al., 2012; Sandhaus et al., 2019; Tinati et al., 2016, 2017; Wright et al., 2015)
Educating others, teaching	(M. G. Jones et al., 2018; Phillips et al., 2019; Raddick et al., 2010; Rotman et al., 2012)
Sharing information	(Beza et al., 2017; M. G. Jones et al., 2018)
Challenge	(Tinati et al., 2016, 2017)
Getting recognition, fame	(Asingizwe et al., 2020; Gharesifard & Wehn, 2016; Raddick et al., 2013; Rotman et al., 2012)
Competition	(Curtis, 2018; Raddick et al., 2013; Tinati et al., 2016, 2017)

Previous studies also emphasised that motivations can change over time as participants spend more time on the platform and as they accumulate experience (Asingizwe et al., 2020; Bonney et al., 2016; Carballo-Cárdenas & Tobi, 2016; Cox et al., 2018; Crowston & Fagnot, 2008; Curtis, 2018; He et al., 2019; Jackson et al., 2015; Larson et al., 2020; Rotman et al., 2012). Keeping in mind that I didn't conduct a longitudinal study to be able to examine the change in motivations of the interviewees, I would like to highlight some quotes from the interviews which exemplify their changing motivations. I found it worthy to note because changing motivations sometimes might lead to change of roles as well. For example, changing from photographer to birdwatcher, as mentioned by interviewees below:

"For me, it started as enjoying nature and observing its beauty. But later, it became some kind of an addiction."

"I started with the hobby of photography. But I can say it evolved in six years to become birdwatching. Now I feel the same satisfaction only by birdwatching, without taking photographs."

"I think bird photographers are on the way to becoming birdwatchers. Because the satisfaction that you get from photographs is not enough after a point. And also to take better photographs, you have to know where and when a specific bird is at."

4.3.2.4 RQ 3: Modes of Participation

As mentioned before, participation does not occur only by sharing observations and bird photographs. Platforms provide different opportunities for users to engage with the platform and with each other. These opportunities depend on what the platform offers, like news sections that enable users to follow the updates. Another example is the possibility of following the entries of data or photographs by other users. Engaging with the platform by means other than sharing data or information is exemplified by the interviewees as:

"That's kind of funny because two weeks ago, I was searching for a kind of bird in the countryside. And I saw on Faune-France where I can find it. It was near my dad's place, so it was good for me. I went there and met the guy who put the data on Faune-France. I told him that I've been looking at his data for a few weeks."

"I look at the data a lot. I have friends who are validators on the platform. And so, if I come across a piece of data that seems strange, I report it to a friend who asks for verification."

"You can see the time of the entry on the online platforms (referring to eKuşbank (eBird Turkey)). So, you say to yourself <it was 8 hours ago; it cannot have gone far away in 8 hours>. And you go to search for it."

"Some people don't want their names displayed but follow Trakuş. They want the information,

but they don't want to be seen."

"Being interested in computers, I got registered to eBird as a researcher. Then, I realised that I could download the data and do anything I wanted with the data. Then I started to like eBird."

I classified these two modes of participation as active and passive participation. Active participation refers to sharing any form of data and information. Passive participation, on the other hand, refers to other forms of engaging with the platform, different from sharing data, information, or photographs. This distinction in participation modes is important because data sharing is what is desired by all parties, rather than data access. After all, access would not be possible without data sharing. Therefore, understanding the active and passive participation types is important for understanding the action arena and later come up with practical implications of this distinction in participation.

This finding reflects the previous studies on social media participation, which also differentiated participation as active and passive (Gainous et al., 2021; Pagani et al., 2011). Pagani et al. (2011) underline that it is important to distinguish these two ways of participation because, in this way, companies can develop strategies to target the correct audiences to promote their products and services (Pagani et al., 2011). The same principle is applicable in citizen science as well; the platforms can be designed, and strategies can be developed for more and higher quality data sharing by appropriate targeting of the participants. Moreover, Curtis (2015) refers to a type of passive participation in the context of citizen science as volunteer computing, in which the computer of the participant contributes to the analysis (Curtis, 2018). However, the approach to passive participation in this thesis is different and it refers to engaging with the platform in a way besides sharing observations.

4.3.2.5 RQs 2 and 3: Non-Participation

What are the barriers to participation? This question was highlighted as an important one previously (Martin et al., 2016). Therefore, to further investigate the workings in our *action arena*, I examined the reasons or motivations for not participating to understand the mechanisms platforms use to promote active or passive participation. Furthermore, I wanted to examine the roots of negative externalities in the form of non-participation.

Externalities are the indirect effects of the actions of one stakeholder on other stakeholders (Laffont, 2008). These externalities are positive when others receive benefits and negative when others bear costs (Kreitmair & Bower-Bir, 2021), as stated before. I consider the results of not

participating as forms of negative externality. To exemplify, when the data is shared on the platform, it is in the best interest of every role in the platform. Because as Frishman (2014) argues, in knowledge commons, such as the citizen science platforms in this study, participants both share the resource and contribute to its creation (Frischmann et al., 2014). In other words, the platforms do not exist independently from the data provider roles. Thus, when data sharing does not take place, this makes the platform itself, and other roles in the platform worse off. Because the platform uses this information to create knowledge, as previously mentioned. When the knowledge cannot be created because of not shared data due to several reasons, then non-participation becomes a form of negative externality, as it poses costs on the other parties in the platform. Similarly, sharing faulty data, sharing late, and sharing incomplete data are considered as negative externalities. Because similarly, these too hinder the knowledge creation process and pose costs on the platform and other roles.

This participation related negative externalities are one group of negative externalities that were identified. The second group concerns the birds. For example, when a photographer acts in a way to harm the bird in order to take a unique photograph of the bird, this behaviour is considered unethical by a birdwatcher. And this may cause some birdwatchers to conceal their data so as to avoid photographers to harm birds in that place. Thus, the second group of negative externality situations are based on the harmful behaviours towards birds. In the following sections I provide details about the potential negative externalities created by different roles. In this section, I focus on non-participation of the two provider roles.

For the roles of birdwatcher and bird photographer, there are reasons related to personal issues, interaction with the community, interaction with the platform, technical features of the platform, and the subject (birds). Table 12 shows the reasons for non-participation.

a) Non-Participation for Birdwatcher and Bird Photographer Roles

The interviews revealed that the reasons for not participating are twofold for the two provider roles. Firstly, they want to protect the birds by avoiding disclosing data about birds, which is highlighted in the testimony of one interviewee:

"I know some (people) say <I don't want to mark this because somebody will come and disturb the animals>."

The interviewees in the study of Martin et al. (2016) also stated their concern about the possibility of causing harm to the marine species in case of sharing observations.

Secondly, birdwatchers and bird photographers are sometimes unaware of the importance of every piece of data and think that what they have is not valuable. Therefore, they do not share it. For example, not sharing the data of the common species is mentioned by a participant as:

"We tend to note only rare birds".

Platforms address these concerns by setting protection mechanisms for sensitive data. Platforms also raise awareness about the importance of sharing all types of data regardless of how common the observed species is.

The personal reasons behind non-participation include the lack of technological savviness, not being aware of the platform, and belief of incompetence to correctly identify and share the different species. These findings confirm the previously highlighted barriers to participation, which are a lack of awareness of the project/platform, the belief of incompetence (Hobbs & White, 2012), and a lack of technical skills (Gharesifard & Wehn, 2016). The issue of technology savviness is mentioned by an interviewee:

"Sometimes it is hard for people to use the eBird app, for instance, my mother."

The lack of awareness of the project/platform is stated by an interviewee:

"I know that sometimes people are not aware of these platforms (referring to eKuşbank and Trakuş). And how do I know this? Because these people discover these platforms at one point, they become a part of the community, so we learn about their previous unawareness."

And the belief of personal incompetence is asserted by an interviewee:

"I have a friend who follows data on Faune-France. We sometimes go together for birdwatching. But he doesn't share the data that he collects. He believes he doesn't know birds well enough to share their data."

Platforms have communities with which they can assist people about how to use the applications or websites, spread the word about the platform, and provide information about different species so that people can learn and gain confidence for sharing.

The interviews showed that the factors related to the interaction between people also result in non-participation in some cases. This can be about the interaction between the people in the community or the interaction of participants with the platform. The first point is exemplified by a participant:

"There are conflicts between some people in the community. When there is resentment, people stop sharing."

The disputes between the community members can be addressed by promoting community building and communication among the people. The second point, not sharing because of a negative interaction with the platform or related institutions, is mentioned by an interviewee:

"The reason for not sharing for some people is because of their resentment against the platform's management team."

This finding can be considered to be related to a previous finding of a different study, which highlights the lack of trust in the institutions that manage the citizen science project as a barrier to participation (Benyei et al., 2021).

The technical features of the platform, which shape user experience, might also act as a barrier to participation. If it takes too much time to share an observation because of the many steps to be completed and/or if the app or the website does not have a user-friendly and intuitive interface, then participants do not share, as highlighted by interviewees:

"My girlfriend comes with me when I go birdwatching. She doesn't use the platform because she thinks the website is not user-friendly." (Referring to Faune-France)

"It was easier to enter data to Trakuş. The interface of eBird was more scientific and more difficult to use".

Old looking interface is also mentioned as a reason for non-participation:

"Trakuş is nice, but the website looks old, like it's from the first days of the internet. On the one hand, it's nice, like a historical artefact. But I don't feel like using it so much, to be honest."

Finally, the availability of the application in different operating systems is important as people use different operating systems. Platforms can improve technical features so as to increase participation. The findings regarding the technical features are in line with the previous finding of interface design potentially being a barrier to participation (Benyei et al., 2021; Gharesifard & Wehn, 2016; Martin et al., 2016).

b) Non-Participation for the Birdwatcher Role

For birdwatchers, personal reasons behind non-participation include being busy with other matters, apathy, desire to limit the time spent in front of a screen, and not finding sharing data satisfactory anymore. For example, being busy is stated by an interviewee as:

"Sometimes, I am back from the field, and I have a lot of things to do; I'm very busy. So, I don't share."

An interviewee highlights an example of apathy:

"I want people to share their observation data, but sometimes I'm too lazy to share myself."

An interviewee mentions the desire to limit screen time:

"I already work in front of a computer the whole day. I don't want to spend more time in front of screens to share."

Moreover, as an example of the exceeding of satisfaction point, an interviewee explained the issue as follows:

"I know some people who were sharing (observation data) years ago, but they have reached a satisfaction point, and they don't share anymore."

Because these include personal issues, the options of the platforms to address these issues are limited, but they raise awareness regarding the importance of sharing and encourage people to become more active sharers.

The findings showed non-participation related to interaction with the community or with the other roles as, the desire to keep one's specialization to oneself and not share their expertise with others, and the fear of being plagiarized. This point was mentioned in the interviews:

"Sometimes people don't want to share because they are specialists, and they want to keep being recognised as specialists."

"Some people are used to stealing others' work, and even some academicians steal the work of others. It happened to me. Somebody used my observation data in a conference and didn't cite me. It makes you think <Ok, I won't share anymore>".

Platforms promote community building and communication among their participants. In this way, the relationships will get stronger and possibly lead to the avoidance of interaction-related problems.

I also found that interaction with the platform can act as a barrier to participation when participants do not want to be "questioned" by the validation committees, as an interviewee mentioned:

"Sometimes, they ask you questions and ask you to provide proof about your observation. Some people don't like it when they are asked for proof."

One of the most interesting findings for non-participation for the birdwatcher role is related to the subject (birds). When people derive a strong pleasure for birdwatching, taking bird photographs, and/or simply being in nature, they tend not to share because they do not want to spend their time on their phone or to interrupt their time in nature. In other words, motivation for the subject of citizen science can interact with motivation to share.

Table 12. Non-Participation			
Roles	Category	Reasons of non-participation	How Platform Addresses
Birdwatcher	Subject (birds) related	<ul style="list-style-type: none"> • Sharing interrupts the joy of being in nature, the act of birdwatching/observing 	Organise group activities to encourage sharing
	Personal issues	<ul style="list-style-type: none"> • Being busy • Apathy • Wanting to limit screen time – the desire to disconnect from technology • Not satisfactory anymore 	Raise awareness about the importance of sharing
	Interaction with the community (other roles)	<ul style="list-style-type: none"> • Wanting to keep their specialization to themselves (not share their expertise) • Plagiarism (when shared, others sometimes use the data without citing the source. Pretend that they collected it when they retrieved it from a platform.) 	Promote community building and communication
	Interaction with the platform	<ul style="list-style-type: none"> • Do not want to be “questioned” by the data validation committees 	Optimise how they communicate with people
Bird photographer	Personal issues	<ul style="list-style-type: none"> • Wanting to keep the victory and credit to themselves (Ex: sharing the photo but not the information about the location) 	Raise awareness about the importance of sharing
	Subject (birds) related	<ul style="list-style-type: none"> • Protect the birds • Observation of common species and unawareness of the importance of every piece of data 	Have protection mechanisms for sensitive data Raise awareness about sharing
	Personal issues	<ul style="list-style-type: none"> • Cannot use the technology (apps, website, etc.) • Not being aware of the platform • Believing not to be competent enough to share 	Educate through community

BOTH	Interaction with the community (other roles)	<ul style="list-style-type: none"> • Disputes between people 	Promote community building and communication
	Interaction with the platform	<ul style="list-style-type: none"> • Dispute with the platform or its associated institutions • Sharing on a different platform 	Keep communication channels open
	Technical features of the platform	<ul style="list-style-type: none"> • Taking too much time to share • Not having an intuitive, user-friendly interface design for the website and the mobile app • Old-looking website interface • Application availability issues for different operating systems 	Optimise technical features

This is put forward by interviewees in the following ways:

"You know when I go out for birdwatching; I don't want to look at the phone screen and crash my mood. Or in the evening, when I return back home or hotel, I want to have my beer, not look at the computer screen."

"Sometimes, I don't upload my observations. Sometimes, I just want to observe, to sit and watch. I don't want to be on my phone, entering data. It's like a bit disconnecting from science. It's just me and nature."

"When you are on your phone, you cannot see the birds. You cannot concentrate on what you see, what you hear."

Altruistic motivations are relevant in citizen science (Curtis, 2018). However, Jones et al. (2018) questioned the altruistic nature of motivations by highlighting that citizen scientists also receive attention and recognition as a reward (M. G. Jones et al., 2018).

They conclude by underlining the relational nature of altruism (Mattis et al., 2009) and the need for further enquiry into the relationship between giving to others and individual benefits in the context of citizen science (M. G. Jones et al., 2018). My finding might be related to this point, and by considering joy as a personal benefit in the context of citizen science (Martin & Greig, 2019), we may explain why it may hinder sharing data.

c) Non-participation for the Bird Photographer Role

In the case of bird photographers, there may be a personal desire to keep the victory to themselves by not disclosing information about a bird to avoid other photographers from finding and taking photos of the bird as well. This point is mentioned by a participant as:

"Sometimes they share the photograph but don't enter related data. It is like <I took this photograph, and now this is my victory.>"

4.3.3 RQ 4: NEGATIVE EXTERNALITIES AND VALUE DEALS

4.3.3.1 Negative Externalities

Externalities are indirect effects of the actions of one agent on others (Laffont, 2008), which can be positive or negative (Kreitmair & Bower-Bir, 2021). In our context, the actions of each role have the potential to result in various externalities for the other roles. I introduced the negative externality situations above. I highlighted that participants create platforms' knowledge resources by sharing data and information (Frischmann et al., 2014), therefore, not sharing data creates negative externalities because the platform can maintain its database as long as the data is shared. Similarly, sharing faulty data or information, sharing late or sharing incomplete data also lead to the

database of the platform to be worse off.

I also mentioned a second category, which is the potential behaviours that can be harmful for birds. Below I provide further details and examples from the interviews about these negative externalities. For example, I found that the behaviour of collecting data sometimes causes negative externalities, either intentionally or unintentionally. Through the interviews, I saw that the bad behaviour or negative externality concerning the subject (birds) could be acting in ways to harm the birds, as mentioned:

"I know some of them (referring to photographers) disturb birds just to take a photograph. They make the birds fly on purpose just to take a photo of them in the air."

Platforms have mechanisms to address such negative externalities. They also make value deals with each role. The process involving the negative externalities and value deals is visualised in Figure 13. Next, I present the value deals, followed by the examination of negative externalities and value deals for each role identified above.

4.3.3.2 Value Deals

Platforms address the expectations and motivations of different roles by offering specific values to each role. Thus, the flow of data and information continues through the sharing of data and information and the creation of knowledge resources (Frischmann et al., 2014).

The value deal refers to the value offered to the role by the platform or by other roles. These value deals constitute the basis of people's motivations in different roles. In other words, platforms address the motivations of participants. Thus, platforms take into consideration the motivations of different roles when providing value offers to each of them.

Guided by the interviews and examination of the platforms, I analysed the negative externalities caused by interactions and the value deals platforms make with each role. I start with the role of birdwatcher and continue with the roles of bird photographer, hunter, and scientist. As mentioned before, the roles of hunter and scientist are needed to examine to provide a full picture of their impacts on the data provider roles. To do so, I analyse the negative externalities they potentially create and the value deals between these *data user roles* and the platform below.

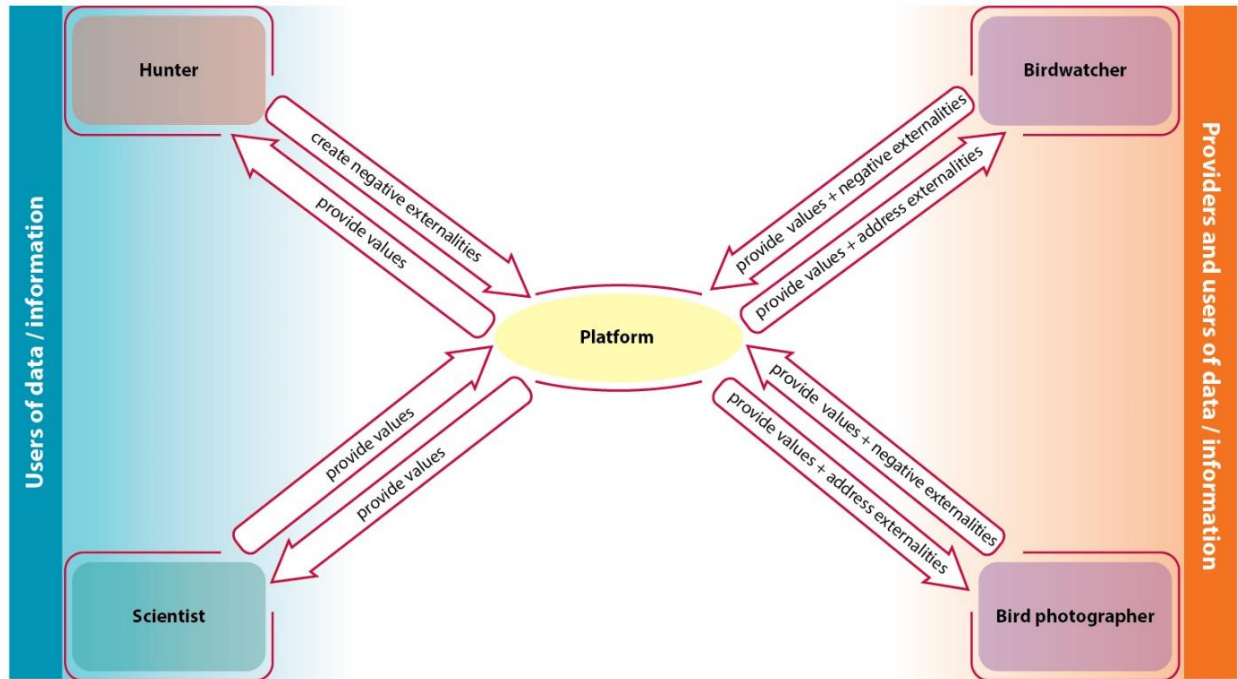


Figure 13. Value Deals and Externalities: From the Role to the Platform, From the Platform to the Role

4.3.3.3 Birdwatchers - Negative Externalities and Value Deals

My findings revealed that birdwatchers are both providers and users of the data and information on the platform. They share, and they also use the data and information shared by other birdwatchers and photographers. When they share data, they participate actively, and when they use the data, they participate passively. The values offered by the birdwatcher to the platform include sharing observation data and information, promoting ornithology and conservation, and promoting the platform. In return, platforms offer:

- Providing a place to keep and track records.
- Providing access to location information of species.
- Providing information about species (appearance, sound, quantity, etc.).
- Providing a community.
- Providing competitions (observing the highest number of species, having the highest number of observations, etc.).
- Activities for the protection of birds and nature (provides data for science, makes publications).
- Providing volunteer positions.

Birdwatchers may create negative externalities by not sharing, sharing faulty data/information, sharing incomplete data, or sharing late. I found that platforms address these negative externalities by:

- Providing validation mechanisms for faulty data (auto filters, validation committees).
- Encouraging full participation by community building and explaining the importance of complete data.

4.3.3.4 Bird Photographers - Negative Externalities and Value Deals

My findings indicate that photographers, like birdwatchers, are also providers and users of data and information on the platform. They also promote ornithology and conservation, and promote the platform. Similarly, they participate actively by sharing and passively by using the data and information. In return, platforms offer:

- Providing a place to share photographs.
- Offering a community.
- Offering competitions for photographs (for example the best photo of the day/month in Trakuş).
- Providing access to location information of species.
- Providing information about the species.
- Activities for the protection of birds and nature (provides data for science, makes publications, protects sensitive data, converts hunters to photographers or observers).
- Providing volunteer positions.

Photographers may act in ways that harm the birds and thus create negative externalities, for instance, for the sake of taking a unique photograph. Other examples are chasing the birds with cars or trucks, throwing objects at them to attract their attention, disturbing the birds by interfering in their nests, and using strong flashes of cameras in a way which disturbs or harms the birds. An interviewee exemplifies this:

"Some people do anything to take a bird photograph. They throw rocks; they enter their nests. The only concern of those people is to have that photograph."

The will to protect the subject (birds) and the knowledge that has the potential to harm it causes negative externalities for participation and, thus, for the knowledge resource by preventing people from sharing data and information. Platforms have mechanisms to address this issue in two different ways. Either the person can hide the information from the public, or some filters automatically hide the data from the public, which is still accessible by the platform for different

publications or scientific research. In this way, the platform provides a protection mechanism for the subject (birds), which is reassuring for the participants who are concerned with the well-being of the rare birds; therefore, they can share in this semi-open, protected manner.

Platforms can also affect behaviour out in the field by presenting guidelines and ethical principles to be followed while birdwatching and taking bird photographs. By regulating these activities, which result in data collection, they are protecting birds. In this way, they codify implicit and common understandings.

For example, in Trakuş, some rules regulate the conditions for taking photographs of birds. For example, it is indicated that chasing birds to take a good photograph of them is prohibited. If a photograph is taken this way, it will not be published, and the user who shared it will face consequences, such as being warned or banned from the platform. The community is also active in this sense. The person who acts against these guidelines and rules might end up being warned inside the community or isolated. The platform acts as a regulating body for these negative externalities.

Bird photographers might also not share or share faulty information either intentionally or unintentionally. It can be intentional, for example, to prevent other photographers from capturing a unique bird. Or they might share incomplete information, such as sharing the photograph without providing information about the location or date, again to prevent rival photographers. It can be unintentional when they do not share because it is a common species and they are not aware of the importance of every piece of data, or when they accidentally entered wrong information.

To summarise, platforms address negative externalities by:

- Codifying implicit rules on how to behave ethically in the field or how to approach birds.
- Providing validation mechanisms for faulty data (auto filters, validation committees).
- Encouraging full participation by community building and explaining the importance of sharing complete data.

4.3.3.5 Hunters - Negative Externalities and Value Deals

Hunter role was an interesting factor to see in the context of citizen science. During the interviews, although I did not ask any questions about hunters, the interviewees brought them up in various contexts.. To introduce how hunter role is perceived by the other roles, I give some examples from the interviews. For instance, they largely mentioned their interactions with hunters in nature. They

also mentioned some of the points that they find problematic when it comes to the hunter role:

There are many hunters here and they are using ancestral techniques to get the birds. They hunt the lark, do you know the species, the lark? They use (the technique) since a very long time; they catch these birds with nets. And they also take small singing birds, they kill them in French alcohol, in order the flesh get the taste of the alcohol. And it's a real delicacy here in Southwest France. It's strictly forbidden since many many times. But everybody does that here. And the hunters do this every day.

There is for example a species of lark. The hunt of this bird is authorized with these recent laws for traditional hunting (referring to recent laws passed being political). But on the field, you can see that the population is decreasing.

I don't know if you've heard about it, but the government changed European laws in which you didn't have the right to use some traditional hunting techniques (now they are legalised). Like when you use glue just to poach the birds. They said that it was specific for a species. You can only kill these species. But it was false, you see 10 other species (glued on).

My findings show that the hunter role does not offer any value to the platforms. Hunters only use the data and resources on the platforms. However, some hunters can be birdwatchers or bird photographers simultaneously and provide data as well, as Ellis (2020) shows (Ellis, 2020).

The following values are offered to the hunter role by the platforms, considering that this information is openly shared -the protected portion of the information which is not openly shared is not included-:

- Providing access to location information of species.
- Providing information about the species.

The hunter role potentially creates negative externalities for the subject (birds) and also for the roles which are motivated by the conservation of birds. The effect of the hunter role is largely highlighted in the context of field interactions by the interviewees. The existence of hunters in the field leads to reluctance to go to field to make observations, which in turn may cause less data to be shared and create negative externalities:

"... there are hunters, and you can be shot. If you don't take care, it can be dangerous. You can go for hike, there are hunters 100 meter from you, with their guns. You don't want to be there.

"If you are in the countryside where you have hunters, and you go to observe; and they are just near you."

Hunters can access current, precise, and open information about the locations of birds, and they

can go there to hunt them. The sharing of sensitive information about private land or endangered species is also a previously highlighted point to consider in citizen science (Anhalt-Depies et al., 2019). Platforms offer various mechanisms to address the negative externalities created by hunters, which are:

- Protecting sensitive data like the data of rare birds.
- Converting hunters into photographers or observers.

The protection of sensitive data is made possible by avoiding its disclosure in the platform. The data will be used for scientific purposes but will not be open for potentially harmful use. Moreover, platforms have the potential to “convert” hunters to photographers and/or birdwatchers. I think this conversion is possible because motivations change over time (Asingizwe et al., 2020; Bonney et al., 2016; Carballo-Cárdenas & Tobi, 2016; Cox et al., 2018; Crowston & Fagnot, 2008; Curtis, 2018; He et al., 2019; Jackson et al., 2015; Larson et al., 2020; Rotman et al., 2012). And hunters and birdwatchers/photographers can have similarities in their motivations. This point is somewhat counterintuitive, but interviewees from both countries highlight certain similarities between photographers and hunters, which sometimes act as a base for this conversion. For example, love of nature is considered a common point for all three roles; an interviewee stated that:

“They (hunters) love to hunt, and they love nature.”

From the interviews, I identified another similar motivation between the bird photographer role and the hunter role as having a “trophy”, a reward. In the case of bird photographers, this can be the aesthetic and/or unique photograph of a rare bird. Whereas for the hunter, it is the hunted animal. The possibility of transferring the drive for reward from hunting to photography is one way that platforms can convert hunters to bird photographer and/or birdwatcher roles. This similarity of having a reward in mind and the possibility of conversion of hunters to bird photographers and/or birdwatchers is mentioned by several interviewees as follows:

“For some people who like to take photographs of birds, it’s like a hunt, you know. They don’t have a gun; they have a camera, but it’s like a hunt for them.”

“When you speak with hunters, you see that they really know the birds and different species. It would be nice if they could move from guns to a camera. Try not to kill but to take a photo.”

“I think many photographers behave like hunters. They chase the prey not to kill but to take the photograph.”

“I find bird photographers similar to hunters. They get in the cars with great enthusiasm. They have cameras in their hands. They catch something. It’s like hunting as a group. They go to the field to take photographs as a group.”

"This is one of my favourite activities: converting bird hunters to bird photographers. We tell them <Do you want to put in the same effort and show a reward? This is also a "shoot" but a "photo shoot". There is also the "trophy", the output.>"

"Some photographers come from a hunting background. They have jeeps, they have cameras, and they will have their rewards. These former hunters have the motivation to protect the environment and introduce birds to the wider public. They became very successful in this. And I find this motivation very important."

4.3.3.6 Scientists - Negative Externalities and Value Deals

In this study, I didn't focus on the motivations of the scientist role. Even though out of 26 interviewees, 11 of them also had the role of scientist in a related field to ornithology, my focus was their role as birdwatchers and/or bird photographers in the platforms. Therefore, I mainly examined the motivations of birdwatcher and bird photographer roles. However, incorporating the roles of scientists and hunters was crucial to gain a comprehensive understanding of the internal dynamics of the action arena from the IAD framework and to identify the interactions between different roles. To do so, I examined the scientist role in terms of the value deals it makes with the platform.

The examination of how platforms function showed us that scientists are users of the data and information that are shared on the platforms. By doing so, they aim to make publications and protect the birds and nature. As the motivations of birdwatchers and bird photographers include the conservation of birds and nature, what scientists provide to the platform are appealing values to these two roles. In turn, the platform becomes more attractive for the provider roles.

I identified the below values that scientist role provide to the platform:

- Making scientific publications
- Conservation of birds and nature
- Aggregating data regarding the species (information, description, location, etc.)

The value offered by the platform to the scientist role is:

- Access to data and information

In the following section, I summarise the findings and present the Citizen Science Platform Interactions Model, developed based on the findings.

4.4 SUMMARY AND DISCUSSION

4.4.1 BEHAVIOURS CAUSING NEGATIVE EXTERNALITIES AND THEIR IMPACTS ON THE SUBJECT (BIRDS) AND THE KNOWLEDGE RESOURCE

Table 13 summarizes the roles, value deals, motivations to participate, potential negative externalities, and the ways that the platforms address the negative externalities. It can be observed that the value deals largely correspond with the motivations. In other words, the platforms address participants' needs and motivations through value deals. It can also be seen that some motivations can cause negative externalities to emerge.

I further showed the possible impact of these negative externalities on the knowledge resource of the platform, which is created through sharing the data, photographs, and information, as well as on the subject (birds). I found that the behaviours that result in negative externalities on the knowledge resource of the platform include not sharing, sharing faulty data or information, sharing incomplete data and information, and sharing late. I believe that the possible consequences of these undesired behaviours include the information shared on the platform being outdated or obsolete, having information hidden from the platform, and sharing late, which prevents timely data and information from being retrieved. As previously stated, I assert that platforms strive to ensure the flow of information by minimizing negative externalities because they depend on the knowledge generated by participants (Frischmann et al., 2014). They can address the negative externalities starting with the correct identification of the negative externalities, for which this study can be helpful.

I also identified the behaviours that have a negative impact on the subject (birds). It is possible, in some cases, for the bird photographer role and hunter role to act in ways that harm the birds. This behaviour is related to their motivations.

Some examples of the bird photographer role include chasing the bird in an unethical way or interfering with their natural habitat to take a better photograph. The impact of the hunter role on the subject (birds) is self-explanatory, and the hunter role may act in ways to harm the birds. However, the roles can change and evolve over time, connected to the change in motivations. This change of roles is sometimes used by the platforms as a way to address negative externalities, for example by converting hunters to bird photographers and/or bird photographers to birdwatchers.

Table 13. Roles, Value Deals, Motivations, Externalities, Impact on Knowledge Resource

	Roles	Behaviours that cause negative externalities		Impact Birds or on Knowledge Resource	Motivations	Value Deals
		Subject (birds)	Participation			
Provider and user of data/information	Birdwatcher		<ul style="list-style-type: none"> - Not share - Share faulty data/information - Share incomplete data/information - Sharing late 	<p>May cause:</p> <ul style="list-style-type: none"> - Outdated or obsolete data or information - Hidden data or information - Polluted data or information 	<ul style="list-style-type: none"> - Being famous, being recognised - Keeping records - Learning the locations of species - Learning about the species - Being part of a community - Competing for the observation of the highest number of different species 	<p>The value offered by the birdwatcher to the platform:</p> <ul style="list-style-type: none"> - Sharing data and information - Promoting ornithology - Promoting the platform <p>The value offered by the platform to the birdwatcher role:</p> <ul style="list-style-type: none"> - Providing a place to keep and track records - Providing access to location information of species - Providing information about species (appearance, sound, quantity, etc.) - Providing a community - Providing competitions (observing the highest number of species, having the highest number of observations, etc.) - Activities for the protection of birds and nature (provides data for science, makes publications) - Providing volunteer positions <p>Platform addressing negative externalities (value for all):</p> <ul style="list-style-type: none"> - Providing validation mechanisms for faulty data (auto filters, validation committees)

					- Protecting birds and nature	- Encouraging full participation by community building and explaining the importance of complete data
Provider and user of data/information	Bird Photographer	Act in ways that harm the birds	<ul style="list-style-type: none"> - Not share - Share faulty data/information - Share incomplete data/information - Sharing late 	<p>May cause:</p> <ul style="list-style-type: none"> - Damage to birds - Outdated or obsolete data or information - Hidden data or information - Polluted data or information 	<ul style="list-style-type: none"> - Being famous, being recognised - Taking the best photo - Learning the locations of species - Learning about the species - Being part of a community - Protecting birds and nature 	<p>The value offered by the bird photographer to the platform:</p> <ul style="list-style-type: none"> - Sharing photographs and information - Promoting ornithology - Promoting the platform <p>The value offered by the platform to bird photographers:</p> <ul style="list-style-type: none"> - Providing a place to share photos - Providing a community - Providing competitions for photographs (best photo of the day/month etc.) - Providing access to location information of species - Providing information about the species - Activities for the protection of birds and nature (provides data for science, makes publications, protects sensitive data like rare birds, converts hunters to photographers or observers) - Providing volunteer positions <p>Platform addressing negative externalities (value for all):</p> <ul style="list-style-type: none"> - Codifying the previously unwritten rules on how to behave in the field, how to approach birds etc.

						<ul style="list-style-type: none"> - Providing validation mechanisms for faulty data (auto filters, validation committees) - Encouraging full participation by community building and explaining the importance of complete data
User of data/information	Hunter	Act in ways that harm the birds		May cause: Damage to birds	Learning the locations of species	<p>No value is offered by the hunter role.</p> <p>The value offered by the platform to the hunter role:</p> <ul style="list-style-type: none"> - Providing access to location information of species - Providing information about the species <p>Platform addressing negative externalities (value for other three roles):</p> <ul style="list-style-type: none"> - Protecting sensitive data like the data of rare birds - Converting hunters to photographers and/or observers
User of	Scientist				Obtaining observation data	<p>The value offered by the scientist role to the platform:</p> <ul style="list-style-type: none"> - Making scientific publications - Protecting birds and nature - Aggregating data regarding the species (information, description, location, etc.) <p>The value offered by the platform to the scientist role:</p> <ul style="list-style-type: none"> - Access to data/information

4.4.2 THE CITIZEN SCIENCE PLATFORM INTERACTIONS MODEL

Based on the findings, I developed the Citizen Science Platform Interactions Model (Figure 14). In the model, I differentiate between two types of motivations: motivations for the subject (birds) and motivations for platform engagement. The model demonstrates the two-way relationship between these: platform value deals and platforms' mechanisms for addressing negative externalities. It is shown that motivations shape the platform value deals and its mechanisms for regulating negative externalities. Similarly, the two types of motivations are affected by what platforms offer and may change and evolve as time passes.

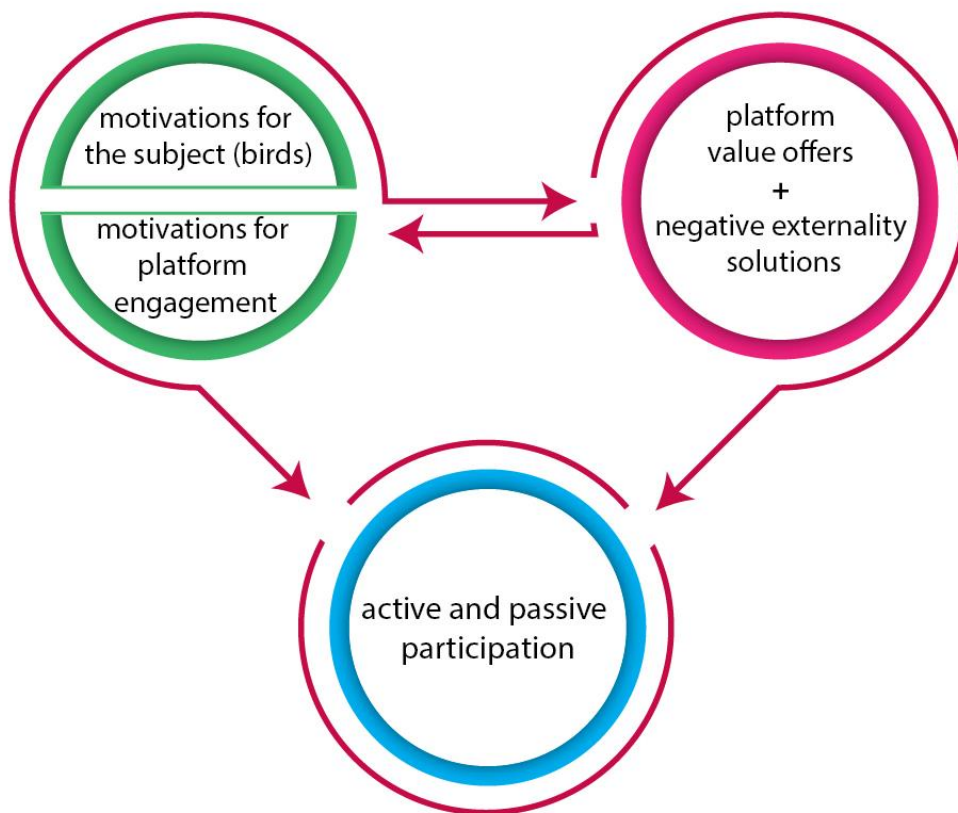


Figure 14. The Citizen Science Platform Interactions Model

Figure 14 also shows the impact of motivations on the two participation types, which are denoted as active and passive participation. In other words, how users participate is related to their motivation. For example, if someone is primarily motivated by learning or having information through the platform, they are expected to display passive participation. Or, if someone is motivated by the competitions on the platform, they are expected to display active participation

by sharing their birdwatching data or photographs. Participation, either active or passive, is what results in the creation of knowledge. For example, through active participation, data and information are shared on the platform. Or, through passive participation, people may interact with the validators and correct an entry. This corresponds with the previous highlight by Frischmann et al. (2014) that knowledge commons are both created and shared by the participants (Frischmann et al., 2014). Therefore, understanding the roots of this creation process is crucial, as I showed in this study.

Figure 14 further demonstrates the role of platform value deals and their ways of responding to negative externalities on active and passive participation. For example, a value that platforms provide is accessing the location information of birds. This enables passive participation by retrieving location information of birds from the platform and may further lead to active participation if the interested person goes to the field, collects data, and shares this data on the platform. Another example is regarding the negative externality response mechanisms of platforms. Platforms provide protection mechanisms to avoid non-participation of users and gather the required data to protect the species. So that sensitive data is not made public.

In the next section, I conclude the chapter by summarising the study presented in this chapter including the theoretical background, data and methodology, and findings.

4.5 CONCLUSION

In this chapter, I examined the roles of participants in online citizen science platforms in the field of ornithology, their motivations, different modes of participation, and negative externalities that arise with the interactions of different roles and how platforms address them. The platforms that I have examined are eKuşbank (eBird Turkey) and Trakuş from Turkey. And Faune-France from France.

I drew upon the frameworks of knowledge commons and the MSPs approach by focusing on the actors and negative externalities as outcomes in the IAD framework to examine these platforms. Approaching citizen science platforms with the MSPs perspective allowed a unique way of analysing these online citizen science platforms. With the the MSPs approach, I identified four different roles: birdwatcher, bird photographer, scientist, and hunter. The roles of birdwatcher and bird photographer provide and use the data and information, whereas the roles of scientist and hunter use the data and information.

The platform serves as a mediator among the various parties involved, facilitating value exchanges

between each role and itself. However, these interactions can occasionally lead to negative externalities.

To further examine these interactions, I identified two kinds of motivations: motivations for the subject (birds) and motivations for platform engagement. This distinction draws upon the previous literature on motivations in citizen science (Curtis, 2018; Nov et al., 2011; Raddick et al., 2010; Rotman et al., 2012) and the findings of this research. For example, previously, interest in the subject and contributing to science were found to be strong motivations for participating in citizen science (Domroese & Johnson, 2017). I approached the drivers or motivations by categorising them under motivations for the subject and motivations for platform engagement.

In this study, the motivations related to birdwatching and bird photography constitute the first set of motivations. Motivations for platform engagement are the second set of motivations. Furthermore, participation modes are active and passive participation, where the former refers to sharing data, information, photographs, and the latter refers to other ways of engaging with the platform, such as by retrieving information or following the news section. Given that knowledge on these platforms is only generated through participation (Frischmann et al., 2014), distinguishing between types of motivation is crucial to understanding the participation dynamics on platforms. I found some joint and separate drivers or motivations regarding these two kinds of motivations.

The distinction between two kinds of motivations allowed us to highlight the negative externalities for both the subject (birds) and the information/knowledge being created and shared on the platform. One interesting finding concerning this point is that sometimes, the joy of birdwatching or taking bird photographs prevents people from sharing the data that they collect because they do not want to interrupt this strong sense of being content in nature, occupied with birds.

Another interesting finding is about the motivation for getting recognition or fame and motivation for competition. These motivations can potentially create negative externalities, including sharing faulty data or information, sharing incomplete data or information, or sharing late. Similar points about creating negative externalities exist for the subject (birds) when the motivation for chasing the birds to take the best or most unique photograph is considered. This sometimes causes the photographer role to act in ways that may harm the birds. The hunter role also causes harm to birds by learning about their locations in real-time and going hunting, which is also a negative externality for the subject (birds). This negative externality caused by the hunter role also has an impact on the motivation of the roles of birdwatcher and bird photographer, given that they favour the conservation of birds.

I discovered that platforms employ various mechanisms to address these negative externalities. They use automatic filters and data validation committees to ensure that the data is not faulty or incomplete. They encourage participation by community building and raising awareness about sharing. Moreover, platforms protect sensitive data, such as the data of rare birds, and prevent people from harming the birds. Platforms regulate the behaviour in the field that is potentially harmful to birds by codifying implicit rules. An interesting role of the platform or the platform community is by converting hunters to photographers or birdwatchers, considering that the motivation for reward can be transferred to taking unique photographs instead of hunting animals. The love of nature is another similar motivation of hunters with birdwatchers and bird photographers, and it can be used to encourage hunters to switch to non-harmful activities concerning birds, such as birdwatching and bird photography.

The Citizen Science Platform Interactions Model was developed to structure these relationships, including the relationship between the different types of motivations of participants, their participation behaviour, and the features and governance mechanisms of platforms.

I also examined barriers for birdwatchers and bird photographers. These range from reasons related to the subject (bird), specific circumstances of people, reasons related to interaction with the community and the platform, and/or the technical features of the platform. The platform is reactive to reasons motivations for not participating and try to addresses them.

My findings are based on the interviews were conducted and the examination of the platforms. Designing the citizen science projects/platforms by taking into consideration these points will result in more and higher quality participation as these would lead to understanding the perspectives (Raddick et al., 2013) and needs (Shirk et al., 2012) of participants.

With the insights I gained in this research, in the following chapter, I present an empirical quantitative study to explore how different motivations and the value deals of citizen science platforms are associated with active and passive participation.

5 THE RELATIONS BETWEEN PARTICIPATION IN CITIZEN SCIENCE, MOTIVATIONS AND PLATFORM VALUE DEALS

5.1 INTRODUCTION

The literature on citizen science platforms highlights the importance of understanding the motivational and need-based foundations of participation for better design of the citizen science platforms/projects and for higher quality data and outcomes (Gharesifard & Wehn, 2016; Raddick et al., 2013; Rotman et al., 2012). In this chapter, through quantitative analysis, I examine how participation is associated with user motivations and platform value deals that were identified in Chapter 4. More specifically, I analyse the role of the following as far as the participation of users in citizen science platforms is concerned: 1) motivations of users towards the subject of observation (birds), 2) motivations of users for platform engagement, and 3.) the importance given by users to some platform features: protection of sensitive data by the platforms and competitions that take place in the platforms. Furthermore, I distinguish between two different participation modes: active and passive (Pagani et al., 2011), which are also among the findings of Chapter 4 of this present work. While the former includes activities of sharing data in the platform, the latter includes activities in which users are engaged with the platform only to access the data and information on the platform without sharing their data.

To address these issues, I used two theoretical frameworks to analyse the inside workings on the action arena in the IAD framework (Chapter 2). First, to model the motivations of users, I use the Self-Determination Theory (SDT) (Deci & Ryan, 2015). Second, to identify the platform's offerings to its participants and the mechanisms to address negative externalities, I employ the Multi-Sided Platforms (MSPs) approach. This approach posits that a digital platform involves multiple parties or sides that interact with one another, and it benefits all parties when an intermediary manages these relationships (Boudreau & Hagiu, 2009; Evans, 2003). By using MSPs, I identify the value offers of the platforms and the ways in which they address negative externalities that arise from the interactions of the participants. Value offers and mechanisms for addressing negative externalities by the platform was presented in Chapter 4. Therefore, these variables are the findings from the qualitative study in Chapter 4. Based on the above, the research questions in this chapter are the following:

RQ1) Can we explain the differences in users' active and passive participation by their motivations for birdwatching and engagement in a digital platform?

RQ2) Regarding active and passive participation, is there an interaction effect between users' motivations for birdwatching and platform engagement?

RQ3) Can we explain the differences in users' active and passive participation by their perception of the importance of mechanisms that platforms use to address negative externalities?

RQ4) Can we explain differences in users' active and passive participation by the values offered by the platform?

To address these questions, a large-scale survey was conducted among the users of the three platforms that focus on birdwatching. These platforms are Faune-France in France, eKuşbank (eBird Turkey), and Trakuş in Turkey, as presented in Chapter 3. The analysis of these two countries also sheds light on the similar and different dynamics in two different country settings concerning the motivations and the priorities of participants in terms of participation and how it relates to different factors.

By addressing these questions, this thesis contribute to the literature in several ways. Firstly, while the importance of understanding motivations for citizen science participation was highlighted in the literature, research on a formal analysis of motivations is scant. By analysing how people can differ in their participation concerning their motivations, this thesis contribute to this literature. Secondly, there are some studies distinguishing between active and passive participation modes, especially in social media, but empirical analyses that distinguish between active and passive participation, from a motivational perspective, in citizen science projects are lacking in the literature. Thirdly, in Chapter 4 of this study, I distinguish and show that two kinds of motivations should be explicitly accounted for: motivations towards the subject of the citizen science platform and motivations towards digital engagement in a platform. These two motivations are different from each other and can determine participation dynamics in different ways. For example, as demonstrated in Chapter 4, a person can be highly motivated to observe wildlife but less motivated to participate actively or passively in a digital platform. Conversely, a person might be primarily motivated to engage in citizen science platforms, but the subject of observation might not be of primary importance. To distinguish between such effects, we need to take into account two types of motivations: motivations for using a digital platform and motivations regarding the subject. Fourthly, this study also has important practical implications, especially to help managers of citizen science platforms design more effective systems in line with the expectations and motivations of their users by managing the multiple roles in their platforms in the best way possible; which in turn will result in more and higher quality data collection for the scientific research.

The chapter is organised as follows. In the next section, I provide the theoretical framework, followed by the presentation of methodology and data. The data analysis consists of two parts. In the first part, I conducted factor analysis, considering that the motivation constructs were latent variables. In the second part, I used Multinomial Logistic Regression to test the models based on the hypotheses. What follows is the discussion of results and conclusion.

5.2 THEORETICAL BACKGROUND

5.2.1 MOTIVATIONS AND PARTICIPATION IN CITIZEN SCIENCE PLATFORMS

Previous literature underlines that understanding the needs and motivations of participants is important for successful citizen science projects (Raddick et al., 2013), in terms of high-quality participation (Shirk et al., 2012), more participation (Sullivan et al., 2014), and sustainability (Rotman et al., 2012).

Previous studies identified many different drivers of participation, as reviewed in Chapter 2. These include enjoyment and joy, learning, social interactions, and fame and getting recognition (Curtis, 2018; Raddick et al., 2010; Rotman et al., 2012). However, the need for a deeper understanding of the drivers of participation in terms of users' motivations was highlighted (Wehn & Almomani, 2019).

A rich literature on motivations exists, spanning a wide range of disciplines. Motivation studies "is the study of why people think and behave as they do" (Graham & Weiner, 1996, p. 63). Motivation is a psychological construct that denotes internal drives which initiate, energize, and maintain behavior directed towards a goal or reward (Weiner, 1989). One commonly used motivational theory is Self-Determination Theory (SDT), which I utilise in this study. It analyses the drivers of human behaviour (Deci & Ryan, 2015). In psychology, there is a relationship between motivation and behaviour. There are different theories aiming to understand the human behaviour, as well as the motivations. One of the widely used theories in predicting human behaviour is Theory of Planned Behaviour (TPB) (Ajzen, 2011).

According to TPB, intention predicts behaviour, and intention is predicted by three factors: attitude towards behaviour, subjective norm, and perceived behavioural control (Ajzen, 1991). Intention is the person's intention to perform a behaviour; attitude toward behaviour is the person's favourable or unfavourable view about the behaviour; subjective norm refers to what other people think about the behaviour; and perceived behavioural control is the person's perception about the "ease or difficulty of performing the behaviour" (Ajzen, 1991, p. 183). However, sometimes there might be

interruptions between the intention and the behaviour, which potentially disrupt the intention leading to behaviour, for example, events that take place between the evaluation of intentions and performing the behaviour may cause changes in intentions, and potentially interrupt performing the behaviour (Ajzen, 2015). Furthermore, motivation and behaviour researchers attempt to link motivational constructs of SDT with the constructs in TPB, as there are various determinants between the motivation and the behaviour such as attitude toward behaviour, subjective norm perceived behavioural control, and intention (Hagger et al., 2006). These behavioural models are usually measured by using Structural Equation Modelling (SEM) which allows for “simultaneously model and estimate complex relationships among multiple dependent and independent variables” (Hair et al., 2021, p. 4). Amidst this background I aim to understand the associations between motivations and participation.

In order to investigate the relationships between motivations and participation, formal modelling of the motivations is the first step. To do so, I use Self-Determination Theory (SDT) in this study. In this theory, two major motivations are distinguished: intrinsic and extrinsic, where the former refers to performing a behaviour due to interest, joy, or fun, while the latter refers to engaging in activities due to an aspiration for rewards, avoidance of undesired stimuli, or wish for social approval (Deci & Ryan, 2015). Figure 15 demonstrates the theory.

Under extrinsic motivation, four different types of regulation are differentiated:

External regulation: It is the most controlled and least autonomous form of extrinsic motivation. It refers to situations when motivation is due to external factors (Deci & Ryan, 2015).

Introjected regulation: The form where the extrinsic motivation is partially internalised (Deci & Ryan, 2015).

Identified regulation: The more internalised form of extrinsic motivation. When people identify by giving personal value to the behaviour, and they are relatively autonomously motivated (Deci & Ryan, 2015).

Integrated regulation: The fully internalised form of extrinsic motivation when people integrate the behaviour fully into their self, values, and needs (Deci & Ryan, 2015).

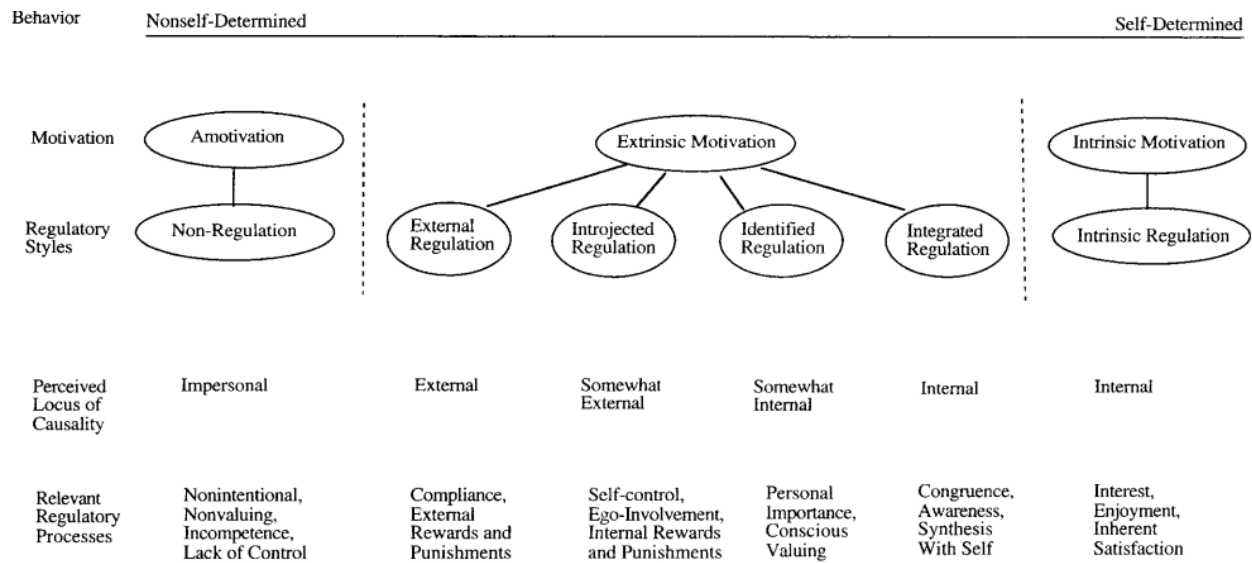


Figure 15. Self-Determination Theory Regulation Styles of Motivations

Source: (Ryan & Deci, 2000b)

When it comes to the application of the SDT to the case of participation in a digital platform, we first need to define the type of behaviour that we are interested in. In other words, we need to answer the question: What does participation in a digital platform mean? Previous literature on social media use shows that people can engage with digital platforms in various ways. In particular, the literature distinguishes between two ways of engagement, active and passive, in various types of digital platforms, like social media platforms (Gainous et al., 2021; Lutz & Hoffmann, 2017; Pagani et al., 2011) and virtual communities (Hornig, 2016). While active participation refers to posting on social media sites, passive participation is viewing and browsing (Pagani et al., 2011).

Pagani et al. (2011) highlighted the use of social media sites by companies to promote their products and services through community interactions; to do so, they emphasise the necessity to encourage people to passively and actively participate (Pagani et al., 2011). They investigated the impact of innovativeness and the extent of displaying one's own identity and values and communication ability to express oneself in social media in their choice to actively and passively participate (Pagani et al., 2011). They found that whereas innovativeness has a positive relation with active and passive participation, the extent of expressing self-identity and social expression has a positive relation only with active participation (Pagani et al., 2011).

In another study, Gainous et al. (2021) examined the relationship between active and passive social media participation and joining protests in real-life settings (Gainous et al., 2021). They found that

active participation in terms of the political use of social media acts as a substitute for offline protests, and passive participants in online settings actually participate in protests in offline settings (Gainous et al., 2021). Horng (2016) examined the influence of individual and social factors on participation in virtual communities from an active and passive participation perspective. He found that active and passive users participate in virtual communities with different goals, resulting in differences in active and passive participation based on individual and social factors. For example, he found that enjoyment had a positive effect on active participation as opposed to passive participation, on which it did not have a significant effect. He also found that reputation and norm of reciprocity positively affect passive participation but did not display a significant impact on active participation (Horng, 2016). So, the same factors can affect active and passive participation differently, as previous research on social media participation shows.

When it comes to citizen science platforms, this active and passive participation can manifest itself in the following way. Some users actively share the data they collect in the field, on the platform. Other users, on the other hand, instead of sharing their data, read the news sections, follow the observations shared by others, read about the bird species, or explore certain statistics. I distinguished these two types of participation as active and passive participation, respectively, which was also a finding of the previous chapter.

This distinction is important in citizen science platforms because it allows for developing different strategies by the platform coordinators. Following examples can be given from the interviews: platform coordinators encourage people to use the platform to learn about different bird species; through learning about different species, people develop a further interest in birds and increase field activities to make bird observations. Platform coordinators encourage people to share all of their observations, even for those species that are not “interesting” -because some participants may not be aware that every piece of data is important-. As participants share more observations (increase active participation), they become more interested in following what other people share or how much data they share, so they increase passive participation. If they are motivated by competing with others, then they increase their birdwatching activities even more, and share more data to be included in the competition. If they are motivated by bird protection, they share more after reading the reports that the platforms publish, and/or reading about the details of how their data is being used for bird conservation efforts, which are forms of passive participation. I aim at measuring such dynamics through the quantitative study in this Chapter.

I investigated the association between motivations and participation by examining the previous

literature on the drivers of participation in citizen science. Previously, research identified different drivers, such as joy, learning, socialising, and recognition, among others. As I aim to go beyond the identification or verification of such drivers, I examined those drivers and saw that they could be differentiated either with being related to the act of birdwatching and bird photography or to different ways of engaging with the platforms. Because these are two different behaviours: bird related behaviours and platform engagement behaviours. The findings in Chapter 4 are in line with this differentiation, as I distinguished motivations related to birds and motivations for platform engagement. So, I constructed the hypotheses by taking into consideration these distinctions in terms of motivations, which are birdwatching and platform engagement and active and passive participation.

In Chapter 4, I distinguished motivations related to the subject (birds) corresponding to motivations of the two roles in the platform, birdwatchers and bird photographers. In this chapter, given that the core goal of these platforms is birdwatching, I took into consideration the motivations regarding birdwatching rather than bird photography. However, in the last chapter of the thesis, I will share ideas regarding future work of similar analysis by taking into account the motivations for bird photography.

Based on the above, I analyse two types of participation behaviour in this chapter: active and passive. I further build the hypotheses based on the understanding that two types of motivations can trigger these two participation modes (active and passive): motivation about the subject, such as observing a physical phenomenon, and motivation for digital engagement.

The first set of hypotheses concerns the positive association between the two motivation types and active and passive participation. Intrinsic motivation is defined as performing a behaviour due to interest, joy, or fun (Deci & Ryan, 2015). In H1a and H1b, based on the interviews, I hypothesise that if people have fun, joy, and interest in engaging with the platform, then they would be willing to follow other people's observations, read the information shared on the platform, follow news about the community, and also actively share their observations. In H1c, based on the interviews and the previous literature on learning as a driver in citizen science participation (Curtis, 2018; Gharesifard & Wehn, 2016; Lehman et al., 2020; MacPhail et al., 2020; Sandhaus et al., 2019); I deduced that if someone has a strong intrinsic motivation for birdwatching, then they would enjoy learning about bird species through the platforms, being informed about the updates in the birdwatching world, or following the sightings shared by others.

H1a) People with stronger intrinsic motivation for platform engagement are more likely to devote

more time to passive participation.

H1b) People with stronger intrinsic motivation for platform engagement are more likely to devote more time to active participation.

H1c) People with stronger intrinsic motivation for birdwatching are more likely to devote more time to passive participation.

The second hypothesis concerns the negative association of intrinsic birdwatching motivation with active participation. Based on the findings of Chapter 4, I argue that if they have deep joy and fun while observing birds, then they will be less willing to spend time sharing data by engaging with digital equipment, such as their phones. Such a possibility was also revealed in some interviews in Chapter 4, as stated by interviewees:

"You know when I go out for birdwatching; I don't want to look at the phone screen and crash my mood. Or in the evening, when I return back home or hotel, I want to have my beer, not look at the computer screen."

"Sometimes, I don't upload my observations. Sometimes, I just want to observe, to sit and watch. I don't want to be on my phone, entering data. It's like a bit disconnecting from science. It's just me and nature."

"When you are on your phone, you cannot see the birds. You cannot concentrate on what you see, what you hear."

By taking into consideration this interesting finding from Chapter 4, I hypothesise that when people have a joy and contentment of being in the field, making observations, enjoying their time in nature with birds, because of this intrinsic motivation for birdwatching, we would expect them to share less of their observations.

H2) People with stronger intrinsic motivation for birdwatching are less likely to spend more time on active participation.

Thus, I hypothesise the platform engagement motivation to be positively associated with both active and passive participation, whereas birdwatching motivation to be positively associated only with passive participation, and negatively associated with active participation.

The third set of hypotheses is concerned with the interaction effects between motivation for birdwatching and motivation for platform engagement, as far as their implications for participation are concerned. More precisely, I hypothesise that these two types of motivations interact with each other in their association with active and passive participation.

As far as active participation is concerned, I expect the two types of motivations (for birds and for platform engagement) to interact with each other. As a result of this interaction, I expect the extent of negative effect of birdwatching motivation (H2) to be reduced in its association with active participation. The reason is as follows. If one person has high birdwatching motivation, we don't expect this person to actively participate (H2); and if a person has high platform engagement motivation, we expect this person to actively participate (H1b). In case of an interaction effect, if the same person has these two types of motivations, I expect the negative effect of birdwatching motivation concerning active participation to be reduced by the platform engagement motivation. For example, someone might enjoy being in nature and making observations, and do not want to share their observations on their phone because they want to enjoy the moment; but the same person might also want to share their observations because they want to continue their engagement with the community and keep learning, following others' observations. So, I expect different levels of both motivations to depend on each other in their relation with active participation.

As far as passive participation is concerned, I again expect the two types of motivations to interact, and augment each other's association with passive participation. For instance, when a person has motivation for birdwatching and for platform engagement, as they spend more time on the platform, they learn about different bird species and follow others' observations; then they become more interested in birds, and they do more birdwatching. As they are occupied with more birdwatching activities, they become more interested in birds and engage more with the platform to learn more about birds or follow others' observations. Thus, birdwatching motivation augments the effect of platform engagement motivation on participation, and vice-versa, resulting in more passive participation.

H3a) The interaction effect between the intrinsic motivation for platform engagement and intrinsic motivation for birdwatching is positive for active participation.

H3b) The interaction effect between the intrinsic motivation for platform engagement and intrinsic motivation for birdwatching is positive for passive participation.

5.2.2 RELATION BETWEEN PARTICIPATION AND PLATFORM OFFERS

To investigate how the platform-related factors are associated with active and passive participation, I took into consideration the findings from Chapter 4 which were obtained by using the Multi-Sided Platforms (MSPs) approach. The MSPs are platforms connecting different groups

or parties that interact with each other, resulting in network effects (Boudreau & Hagiu, 2009). MSPs aim to attract as much participation as possible because the participation of one group attracts more participation from the other group and vice-versa (Boudreau & Hagiu, 2009) and increase the value of the platform in question (Abdelkafi et al., 2019). This effect is an example of the well-known network effects (Katz & Shapiro, 1994).

As the interactions among different parties or sides on the platform increase, various externalities arise. It benefits all sides if an intermediary, such as the platform, manages and coordinates these interactions and externalities (Evans, 2003). The term externality is defined as the indirect effects of interactions between different actors on each other (Laffont, 2008). Externalities can be positive and negative. It is a positive externality when there are beneficial outcomes for others and a negative externality when there are negative outcomes or costs for others (Kreitmair & Bower-Bir, 2021).

An example of a negative externality is the existence of parties who can freeride on the data provided by the platform and perform actions possibly against the values that the platform supports. Another example is, not sharing the data collected so as to keep the victory of the observation to themselves. This is a negative externality because, it is in the best interest of all parties when more data, timely data, and full data is shared. Any factors which interrupt timely, full, and more data sharing result in negative externalities. These factors also include negative externalities about birds. When a role in the platform (photographer or hunter) behaves in ways to harm the birds, then data provider roles may conceal their data. They may also lose interest in passive participation, especially if they think that birds can be harmed as a result of the actions of other roles, and if the platforms are not regulating such actions. The platform managers can design and implement various strategies to cope with the existence of roles that cause negative externalities.

The fourth set of hypotheses investigates whether and how these strategies implemented by the platforms induce differences in peoples' active and passive participation. In what follows, I use the term *value offers* to refer to such activities and strategies used by platform managers. I also investigate the mechanisms that platforms use to address negative externalities. According to the literature on MSPs, platforms set rules or regulate the behaviours of participants to address negative externalities (Boudreau & Hagiu, 2009).

One common mechanism that platforms use to address negative externalities is protecting sensitive data and information about birds. When data on rare birds is shared, platforms keep this

information internal and do not publicly reveal it. This way, potentially harmful contact with birds can be avoided. For example, some bird photographers might be highly enthusiastic about capturing a rare bird, and they might rush to the location of the sighting, resulting in a potentially harmful effect. Or, keeping the sensitive information would prevent hunters from reaching the rare bird. We know from the previous chapter that the birdwatcher role is motivated by contributing to science and also expects sensitive data to be protected; because this role wants to contribute to conservation of birds. In other words, if participants think that this platform feature is important, then we would expect them to spend more time sharing their observations, assured that the platform is protecting sensitive data. Thus, I hypothesise that the perceived importance of the protection of sensitive data by platforms is likely to be associated positively with active participation.

H4a) People who place greater value on platforms' protection of sensitive data, given that the platforms address this negative externality, are more likely to devote more time to active participation.

In the case of citizen science platforms on birds, there are also value offers that platforms provide to their participants. The organisation of competitions regarding the diversity of different species observed is one such value offer, as in the case of Trakuş and eKuşbank (eBird Turkey). Faune France, similarly, publishes the list of most active observers, which shows the number of sightings shared by a user. While platforms devise such value offers to attract more users, to what extent are users' active and passive participation dependent on such competitive opportunities provided by the platform? I propose that, for users who give importance to competition in platforms, both active and passive participation will be higher. First, to be part of competitions, users should share their observations on the platform. Second, to collect information about other users' contributions, users' passive participation would increase.

H4b) People who place greater value on competitions organised by the platform (value offer) are more likely to spend more time sharing birdwatching observations (active participation).

H4c) People who place greater value on competitions organised by the platform (value offer) are more likely to spend more time on activities such as reading articles or following other observations on the platform (passive participation).

The next section presents the data collection process, survey constructs, and the data analysis process.

5.3 DATA AND METHOD

5.3.1 DATA COLLECTION

Data collection in Turkey took place between November 15 and December 15, 2022. The survey was disseminated in Turkey through multiple channels, considering that the community members in Turkey use several channels to interact with each other and follow the daily updates and events about birdwatching and bird photography. Therefore, to ensure to have reached the maximum number of participants, I shared the survey in the two WhatsApp groups that were explained in the previous chapter as being actively used and mostly consisted of people who use either one or both platforms that I examine. The WhatsApp groups had 176 and 144 members at the time of sharing the survey. The survey was also shared on the two platforms in question, eKuşbank (eBird Turkey) and Trakuş. It was shared on the news section of eKuşbank (eBird Turkey) and the forum section of Trakuş, together with a banner on the landing page of Trakuş²¹. Social media platforms were also used to disseminate the survey. Especially the Twitter post of the survey resulted in many interactions²². The survey was circulated among the different members of the community through these multiple channels. I sent the survey to the birdwatching student clubs or societies in two universities, the Middle East Technical University (METU) Birdwatching Society and Ondokuz Mayıs University Birdwatching Society, as they were found to be active.

Data collection in France took place between November 19 and December 30, 2022. The survey dissemination in France was more straightforward compared to the process in Turkey. The survey was shared on the news section of Faune-France and the connected portals and platforms²³. A reminder was posted in the news section on December 20, 2022²⁴. In total, it was shared in the news sections of 38 local platforms connected to Faune-France and on Faune-France.

5.3.2 SURVEY CONSTRUCTS

Active and passive participation are dependent variables. The active participation variable is measured by the hours spent per week sharing observations on the platform. The passive participation variable concerns other ways of engaging with the platform, such as the hours spent

²¹ See Appendices B and C

²² See Appendix D

²³ See Appendix E

²⁴ See Appendix F

per week in the platform for activities like reading articles and following other observations. The response categories for the dependent variables were 0 hours, 0-3 hours, more than 4 hours.

For the motivation constructs, my starting point was the definitions provided for each construct under the SDT (Deci & Ryan, 2015; Hagger et al., 2003; Ryan & Connell, 1989; Ryan & Deci, 2000a) and also the English versions of the scales which are based on the SDT; more specifically, Academic Self-Regulation Questionnaire (SRQ-A), Exercise Self-Regulation Questionnaire (SRQ-E), Friendship Self-Regulation Questionnaire (SRQ-F), and Motivation to Volunteer Scale (MVS). Considering that I had the same survey in two different languages, Turkish and French, I referred to previously conducted studies that included using SDT-based scales in these languages. I referred to the study of Çetin and Çelebi (2021) for the Turkish version of the survey (Çetin & Çelebi, 2021) and to the studies of Pelletier et al. (2017) and Vallerand et al. (1989) for the French version of the survey (Pelletier et al., 2017; Vallerand et al., 1989).

I adjusted the questions according to the context of this study. Motivation constructs consist of the five regulatory styles highlighted under SDT, which are external regulation, introjected regulation, identified regulation, integrated regulation, and intrinsic regulation. Motivations for birdwatching and motivations for platform engagement were measured using these regulatory styles of motivation.

The last group of survey constructs consists of platform variables, which aimed to measure the perceptions of survey participants towards the value deals and the mechanisms for addressing negative externalities that platforms use. For measuring the perceptions regarding the ways that the platform addresses negative externalities, I focused on the approach of platforms towards protecting the birds by restricting the publication of sensitive data. As the value offer, I selected the competitions that platforms organize or host. The control variables include age, gender, and, concerning Models 1 to 4, country. Table 14 shows the variables and survey constructs in the languages that the surveys are conducted, with their translations in English.

Table 14. Variables and Survey Constructs

Variable	Definition	Questionnaire Item	Variable Type
Participation Variables (Dependent Variables)			
Active participation	Hours spent per week to share observations on the platform	TR: Bu platformda gözlemlerinizi paylaşmak için haftada yaklaşık olarak kaç saat geçiriyorsunuz? FR: Approximativement, combien d'heures par semaine passez vous sur Faune-France pour partager vos observations ? EN: Approximately how many hours per week do you spend on this platform to share your observations?	Nominal, ordered categories: 0 hours, 0-3 hours, 4+hours
Passive Participation:	Hours spent per week for other activities on the platform	TR: Bu platformda yazıları okumak, diğer gözlemleri takip etmek vb. Aktiviteler için haftada yaklaşık olarak kaç saat geçiriyorsunuz? FR: Approximativement, combien d'heures par semaine passez vous sur Faune-France pour des activités telles que la lecture d'articles, le suivi d'autres observations, etc. ? EN: Approximately how many hours per week do you spend on this platform for activities such as reading articles, following other observations, etc.?	Nominal, ordered categories: 0 hours, 0-3 hours, 4+hours
Motivation Variables (Independent Variables)			
Birdwatching intrinsic motivation	Intrinsic regulation type of motivation for birdwatching in accordance with SDT	TR: Kuş gözlemi yapmaktan zevk aldığım için. Kuş gözlemi yaparken hissettiğim heyecan nedeniyle. Yeni türler keşfetmekten keyif aldığım için. FR: J'aime observer les oiseaux. Pour le plaisir que je ressens lorsque j'observe les oiseaux. J'aime découvrir de nouvelles espèces d'oiseaux. EN: I enjoy birdwatching. For the pleasure I feel when I observe birds. I like to discover new species of birds.	5-point Likert scale
Birdwatching integrated motivation	Integrated regulation type of motivation for birdwatching in accordance	TR: Kuş gözlemi yapmak kimliğimin önemli bir parçasını oluşturduğu için. Çünkü kuş gözlemi yapmak hayatımın ayrılmaz bir parçası haline geldi. Çünkü kuş gözlemi yapmak benim için bir yaşam biçimi. FR: Observer les oiseaux constitue une part importante de mon identité. Cela fait partie intégrante de ma vie.	5-point Likert scale for factor analysis. Transformed to continuous for

	with SDT	<p>C'est un mode de vie pour moi.</p> <p>EN: Birdwatching is an important part of my identity. Birdwatching is an integral part of my life. Birdwatching is a way of life for me.</p>	regression analysis by taking the average
Birdwatching identified motivation	Identified regulation type of motivation for birdwatching in accordance with SDT	<p>TR: Çünkü kuş gözlemlemek boş zamanlarımı değerlendirmek için faydalı bir hobi. Kuş gözlemi sayesinde kendime zaman ayırdığım için. Çünkü kuş gözlemlemek doğada vakit geçirmek için iyi bir aktivite.</p> <p>FR: C'est une activité utile à laquelle consacrer mon temps libre. Grâce à l'observation des oiseaux, j'ai du temps pour moi. Cela me permet de passer du temps dans la nature.</p> <p>EN: It's a useful activity to spend my free time. Through bird watching, I spare time for myself. Birdwatching allows me to spend time in nature.</p>	5-point Likert scale
Birdwatching introjected motivation	Introjected regulation type of motivation for birdwatching in accordance with SDT	<p>TR: Çünkü kuş gözlemlemek faydalı bir aktivite ve yapmazsam kendimi suçlu hissederim. Çünkü kuş gözlemi yapmak yararlı bir aktivite ve kendimi iyi hissetmek için yapmam gerekiyor. Çünkü kuş gözlemi yapmazsam kendimi kötü hissederim.</p> <p>FR: C'est un passe-temps utile, je me sentirais coupable si je ne le faisais pas. C'est une activité utile, j'ai besoin de la pratiquer pour me sentir bien. Je me sentirais mal dans ma peau si je n'observais pas les oiseaux.</p> <p>EN: It's a useful pastime; I would feel guilty if I didn't do it. It's a useful activity; I need to do it to feel good. I would feel bad about myself if I didn't do birdwatching.</p>	5-point Likert scale
Birdwatching external motivation	External regulation type of motivation for birdwatching in accordance with SDT	<p>TR: Çünkü kuş gözlemi sayesinde tanınırlık kazanıyorum. Çünkü kuş gözlemi yaptığım için takdir ediliyorum. Kuş gözlemi yapmak bana diğer gözlemcilerle rekabet etme fırsatı verdiği için.</p> <p>FR: Je gagne en reconnaissance sociale grâce à l'observation des oiseaux. Je suis apprécié.e pour mon activité d'observation d'oiseaux. L'observation d'oiseaux me donne l'opportunité de rivaliser avec d'autres ornithologues.</p>	5-point Likert scale

		<p>EN: I gain social recognition through birdwatching. I am appreciated for my birdwatching activity. Birdwatching gives me the opportunity to compete with other birdwatchers.</p>	
Platform engagement intrinsic motivation	Intrinsic regulation type of motivation for platform engagement in accordance with SDT	<p>TR: Kuşlarla ilgili yazılanları okumaktan heyecan duyduğum için. Gözlem verilerimi paylaşmaktan keyif aldığım için. Bu platformları kullanarak kuşlarla ilgili bilgi edinmek zevkli olduğu için.</p> <p>FR: Lire sur les oiseaux me procure beaucoup de bonheur. C'est très agréable de partager mes observations. C'est amusant d'apprendre à connaître les oiseaux via ces plateformes.</p> <p>EN: Reading about birds gives me a lot of pleasure. It's very nice to share my observations. It's fun to learn about birds through these platforms.</p>	5-point Likert scale
Platform engagement integrated motivation	Integrated regulation type of motivation for platform engagement in accordance with SDT	<p>TR: Bu platformları kullanmak kimliğimin önemli bir parçası haline geldiği için. Çünkü gözlem verilerimi paylaşmak benim için bir yaşam biçimi. Bu platformlarda paylaşım yapmak hayatımın önemli bir parçası olduğu için.</p> <p>FR: Utiliser ces plateformes fait partie de mon identité. Partager mes données d'observation fait partie de mon mode de vie. Partager mes données via ces plateformes est important dans ma vie.</p> <p>EN: Using these platforms is part of my identity. Sharing my observation data is part of my lifestyle. Sharing my data via these platforms is important in my life.</p>	5-point Likert scale for factor analysis. Transformed to continuous for regression analysis by taking the average
Platform engagement identified motivation	Identified regulation type of motivation for platform engagement in accordance with SDT	<p>TR: Bu platformları kullanarak bilimsel çalışmalara destek vermek önemli olduğu için. Çünkü bu platformları kullanmak kuşların korunmasına katkı sağlamak için iyi bir yöntem. Çünkü gözlem verilerimi paylaşarak biyoçeşitliliğin korunmasına yardımcı olmam önemli.</p> <p>FR: Il est important de soutenir la science en utilisant ces plateformes. Ces plateformes sont un bon moyen de contribuer à la protection des oiseaux. C'est important pour moi de protéger la biodiversité en partageant mes observations.</p>	5-point Likert scale

		<p>EN: It's important to support science by using these platforms. These platforms are a good way to contribute to the protection of birds. It's important for me to protect biodiversity by sharing my observations.</p>	
Platform engagement introjected motivation	Introjected regulation type of motivation for platform engagement in accordance with SDT	<p>TR: Gözlem verilerimi paylaşarak bilime katkı sağlıyorum, bu nedenle paylaşmazsam suçlu hissederim. Kuşlarla ilgili bilgi edinmek için bu platformlar önemli, bu nedenle bilgi edinmek için bu platformları kullanmak zorunda hissediyorum. Bence bu platformlarda gözlem verilerini paylaşmak önemli ve paylaşmazsam pişman olurum. FR: Je contribue à la science en partageant mes observations, je me sentirais coupable de ne pas le faire. On ne peut pas se passer de ces plateformes pour obtenir des informations sur les oiseaux, je suis contraint.e de les utiliser. C'est important de partager des données d'observation via ces plateformes, je regretterais de ne pas pouvoir le faire. EN: I contribute to science by sharing my observation data, so I feel guilty if I do not. These platforms are important to learn about birds, so I feel obliged to use these platforms to learn about birds. It's important to share observation data on these platforms, I would regret it if I didn't.</p>	5-point Likert scale
Platform engagement external motivation	External regulation type of motivation for platform engagement in accordance with SDT	<p>TR: Çünkü bu platformları kullanarak tanınırlık kazanıyorum. Çünkü en fazla tür gözlemleyen kuşçular listesine girmek istiyorum (kertik, ilk 100 kuşçu vb.). Çünkü gözlemlerimi paylaştığım zaman takdir ediliyorum. FR: Je gagne en reconnaissance en utilisant ces plateformes. Je veux faire partie des observateurs/observatrices diffusant le plus d'observations sur la plateforme (les plus actifs/actives). Je suis apprécié.e quand je partage mes observations. EN: I gain recognition by using these platforms. I want to be among the most active observers on the platform.</p>	5-point Likert scale

		I am appreciated when I share my observations.	
Platform Variables (Independent Variables)			
Protection	Perceived importance of protecting sensitive data about birds by not sharing it publicly	TR: Benim için bu platformun nadir türlerle ilgili verileri kapalı tutması ve paylaşmaması en önemli özellikleri arasında. FR: L'une des fonctions les plus importantes de Faune-France est qu'elle garde confidentielles les données sur les espèces rares et ne les partage pas. EN: One of the most important functions of Faune-France is that it keeps data on rare species confidential and does not share them.	5-point Likert scale
Competition	Perceived importance of the competitions in the platform	TR: Benim için bu platformun en önemli işlevlerinden biri, kurtik yarışı, ilk 100 kuşçu vb., rekabeti destekleyen aktivitelere katılmam için olanak sağlaması. FR: L'une des fonctions les plus importantes de Faune-France est de me permettre de participer à des activités compétitives, comme le classement des membres les plus actifs. EN: One of the most important functions of Faune-France is to allow me to participate in competitive activities, such as ranking the most active members.	5-point Likert scale
Demographic Variables (Control Variables)			
Age <18, 19-24, 25-34, 35-44, 45-54, 55-64, >65	The age of the respondent	TR: Yaşınız? FR: Quel âge avez-vous ? EN: How old are you?	Ordinal
Male Others (female, non-binary, not shared)	The gender of the respondent	TR: Cinsiyetiniz? FR: À quel genre vous identifiez-vous ? EN: Which gender do you identify with?	Nominal, categorical
Turkey France	The country of the platform		Nominal, categorical

5.3.3 DATA ANALYSIS

Data analysis consists of two steps²⁵. The first step is the Confirmatory Factor Analysis (CFA), which was conducted for the motivation constructs. The objective of the CFA was to determine the latent motivation variables to be used. In the second step, multinomial logistic regression was used to determine the correlations between the dependent variables and independent variables.²⁶ Summary statistics are given in Table 15 below.

To test the hypothesis, I initially considered ordinal logistic regression because the dependent variables active and passive participation are in ordered nature. However, one of the main assumptions of ordinal logistic regression is proportional odds assumption (Long & Freese, 2014). A significant test statistic in Brant test indicates that the proportional odds assumption is violated (Long & Freese, 2014), which was the case for models 1, 2, 3, 4, 6, 8, and 9²⁷. In this case, one of the options is switching to multinomial logistic regression (Williams, 2016). Because both multinomial logistic regression and ordinal regression models yield similar results²⁸, I report the results of the former in the main text.

Multinomial logistic regression model can be used when modelling categorical response with more than two categories (Chatterjee & Simonoff, 2020), which allows for “simultaneously fitting binary logits for all comparisons among the alternatives” (Long & Freese, 2014, p. 386). In multinomial logistic regression, one of the response categories is chosen as a baseline or reference (Chatterjee & Simonoff, 2020). For both response variables, active and passive participation, I chose 0-3 hours per week as the reference category, as it was the middle category, and interpreting the remaining two categories would be more intuitive. Likelihood ratio (LR) test is used to test significance (Agresti, 2007). Because of non-linear models, I calculated the odds ratios and transferred them to relative risk ratios (RRR) by exponentiating them (Long & Freese, 2014) for easier interpretation.

The H1, H2, and H3 are concerned with understanding whether different levels of active and passive participation can be explained by the motivations of people (birdwatching and platform engagement). To test these hypotheses, I constructed four models using a single dataset

²⁵ The CFA analysis was done using R version 4.2.2. Multinomial Logistic Regression was done using R version 4.3.1.

²⁶ To test the hypotheses, I used nnet package (V. 7.3-19), multinom function of R for multinomial logistic regression.

²⁷ See Annex D

²⁸ See Annex C for the ordinal logistic regression, and Annex E for VIFs. R version 4.3.1, MASS package (V. 7.3-60), and polr function of R was used for ordinal logistic regression.

encompassing the data collected for all three platforms. For H4, my objective was to investigate the platform-specific effects on active and passive participation. Thus, for H4, I carried out regressions for each platform separately. Dependent variables in all models are active and passive participation variables. Independent variables are integrated birdwatching motivation, integrated platform engagement motivation, platform address to negative externality, and platform value offer. Control variables are the age and gender of the respondent and the country of the platform in the first four models. In what follows, I present the results of the CFA.

Table 15. Summary Statistics

	Models 1 to 4		Models 5 FR and 8 FR	Models 6 EB and 9 EB	Models 7 TK and 10 TK
No Obs. with NA's	1593		1111	241	241
Active participation	0 hours: 144 obs. 0-3 hours: 1046 obs. 4+ hours: 234 obs.	Active participation	0 hours: 39 obs. 0-3 hours: 832 obs. 4+ hours: 181 obs.	0 hours: 36 obs. 0-3 hours: 116 obs. 4+ hours: 30 obs.	0 hours: 65 obs. 0-3 hours: 96 obs. 4+ hours: 23 obs.
Passive participation	0 hours: 141 obs. 0-3 hours: 997 obs. 4+ hours: 286 obs.	Passive participation	0 hours: 68 obs. 0-3 hours: 773 obs. 4+ hours: 211 obs.	0 hours: 28 obs. 0-3 hours: 119 obs. 4+ hours: 35 obs.	0 hours: 41 obs. 0-3 hours: 103 obs. 4-6 hours: 40 obs.
Birdwatching integrated motivation	Min.: 1 1st Qu.: 3.667 Median: 4 Mean: 4.067 3rd Qu.: 4.667 Max.: 5	Protection	Min.: 1 1st Qu.: 3 Median: 4 Mean: 3.67 3rd Qu.: 5 Max.: 5	Min.: 1 1st Qu.: 3 Median: 4 Mean: 3.473 3rd Qu.: 4 Max.: 5	Min.: 1 1st Qu.: 3 Median: 3 Mean: 3.245 3rd Qu.: 4 Max.: 5
Platform engagement integrated motivation	Min.: 1 1st Qu.: 2.667 Median: 3.333 Mean: 3.270 3rd Qu.: 4 Max.: 5	Competition	Min.: 1 1st Qu.: 1 Median: 1 Mean: 1.843 3rd Qu.: 3 Max.: 5	Min.: 1 1st Qu.: 1 Median: 2 Mean: 2.038 3rd Qu.: 3 Max.: 5	Min.: 1 1st Qu.: 1 Median: 2 Mean: 2.25 3rd Qu.: 3 Max.: 5
Gender	Others: 326 Male: 1098	Gender	Others: 240 Male: 812	Others: 42 Male: 140	Others: 40 Male: 144

Age	Min.: 1 1st Qu.: 3 Median: 4 Mean: 4.398 3rd Qu.: 6 Max: 7		Age	Min.: 1 1st Qu.: 3 Median: 5 Mean: 4.548 3rd Qu.: 6 Max: 7	Min.: 1 1st Qu.: 3 Median: 4 Mean: 3.945 3rd Qu.: 5 Max: 7	Min.: 1 1st Qu.: 3 Median: 4 Mean: 3.962 3rd Qu.: 5 Max: 7
Country	Turkey: 371 France: 1053					

5.3.3.1 *Confirmatory Factor Analysis (CFA) of Motivational Constructs for Birdwatching and Platform Engagement*

I conducted CFA for the birdwatching and platform engagement motivation constructs to test the model fit and reliability of items in order to form latent independent variables to be used in the multinomial logistic regression analysis.^{29 30}

To evaluate the CFA models, I verified the goodness-of-fit statistics of the models, the factor loadings, and reliability measures. To assess the goodness-of-fit of the models, using several fit indices is recommended (Nye & Drasgow, 2011). These fit indices are the root mean square of approximation (RMSEA), the Tucker Lewis Index (TLI), the comparative fit index (CFI), and the standardised root mean squared residual (SRMR).

Factor loadings are defined as “the correlation of each variable with the factor” (Hair et al., 2013, p. 110). Hair et al. (2013) highlight that, as a rule of thumb, factor loadings of 0.30 to 0.40 are minimally acceptable, whereas values greater than 0.50 are considered to be practically significant (Hair et al., 2013).

Lastly, I reviewed the reliability measures of Cronbach’s alpha and McDonald’s omega.³¹ Reliability “refers to the accuracy or precision of a measurement procedure” (Thorndike & Thorndike-Christ, 2014, p. 75).

5.3.3.2 *CFA Results of Motivation Variables for the Birdwatching Community in France*

The dataset of Faune-France platform respondents consists of 1111 responses. For the CFA for birdwatching motivation and platform engagement, R took 1079 and 1064 observations, respectively, because of missing values. The 5-point Likert scale variables from strongly disagree to strongly agree were coded as numeric values from 1 to 5.

Table 16 provides the goodness-of-fit statistics of France's CFA models for birdwatching and

²⁹ For CFA, I used diagonally weighted least squares (DWLS) estimator in lavaan package (V 0.6-13) cfa function considering that the data consisted of ordinal observed variables. Because it is highlighted that DWLS perform better than maximum likelihood with robust standard errors (MLR) in models with ordinal observed variables in terms of resulting in more accurate factor loading estimates, interfactor correlation estimates, and structural correlation estimates (C.-H. Li, 2016).

³⁰ See appendices H, I, J, and K for correlation matrices.

³¹ The construct reliability was measured using compRelSEM function of semTools package (V 0.5-6) (Jorgensen et al., 2022) in R to calculate Cronbach’s alpha and McDonald’s omega values.

platform engagement motivation constructs. Both models show a good fit when CFI, TLI, RMSEA, and SRMR values are considered.

Table 16. Goodness-of-fit statistics of CFA models (France)

	Birdwatching motivation	Platform engagement motivation
P-value (Chi-square)	0.000	0.000
Degrees of freedom	83	83
Robust Comparative Fit Index (CFI)	0.979	0.982
Robust Tucker-Lewis Index (TLI)	0.973	0.977
Robust RMSEA	0.043	0.040
90 Percent confidence interval - lower	0.039	0.036
90 Percent confidence interval - upper	0.047	0.044
P-value H ₀ : RMSEA ≤ 0.050	0.998	1.000
P-value H ₀ : RMSEA ≥ 0.080	0.000	0.000
SRMR	0.045	0.043

Note: The rules of thumb for determining the goodness-of-fit for these indices are highlighted as RMSEA ≤ 0.6, TLI ≥ 0.95, CFI ≥ 0.95 and SRMR ≤ 0.8 (Hu & Bentler, 1999).

Table 17 shows the standardised factor loadings of latent motivation constructs for birdwatching motivations. All loadings appear to be in the acceptable range above 0.4. For the integrated motivation, all factor loadings seem to be higher (above 0.70) when compared to other regulation types.

Table 17. Standardised factor loadings of latent motivation constructs for birdwatching (France)

	Factors				
	1	2	3	4	5
Intrinsic motivation					
I enjoy birdwatching.	0.630				
For the pleasure I feel when I observe birds.	0.718				
I like to discover new species of birds.	0.596				
Integrated motivation					
Birdwatching is an important part of my identity.		0.784			
Birdwatching is an integral part of my life.		0.761			
Birdwatching is a way of life for me.		0.811			
Identified motivation					
It's a useful activity to spend my free time.				0.652	

Through bird watching, I spare time for myself.	0.587
Birdwatching allows me to spend time in nature.	0.571
Introjected motivation	
It's a useful pastime; I would feel guilty if I didn't do it.	0.487
It's a useful activity, I need to do it to feel good.	0.767
I would feel bad about myself if I didn't do birdwatching.	0.732
External motivation	
I gain social recognition through birdwatching.	0.649
I am appreciated for my birdwatching activity.	0.793
Birdwatching gives me the opportunity to compete with other birdwatchers.	0.483

Table 18 displays the standardised factor loadings of latent motivation constructs for platform engagement motivations. The standardised loadings for all latent variables are in the acceptable range of above 0.4. The loadings of integrated motivation appear to be higher, above 0.70, when compared to other regulation styles.

Table 18. Standardised factor loadings of latent motivation constructs for platform engagement (France)

	Factors				
	1	2	3	4	5
Intrinsic motivation					
Reading about birds gives me a lot of pleasure.	0.448				
It's very nice to share my observations.	0.806				
It is fun to learn about birds through these platforms.	0.350				
Integrated motivation					
Using these platforms is part of my identity.		0.769			
Sharing my observation data is part of my lifestyle.		0.762			
Sharing my data via these platforms is important in my life.		0.828			
Identified motivation					
It is important to support science by using these platforms.			0.722		
These platforms are a good way to contribute to the protection of birds.			0.678		
It's important for me to protect biodiversity by sharing my observations.			0.753		
Introjected motivation					
I contribute to science by sharing my observation data, so I feel guilty if I don't.				0.605	
These platforms are important to learn about birds, so I feel obliged to use these platforms to learn about birds.				0.269	
It is important to share observation data on these platforms; I				0.667	

would regret it if I didn't.	
External motivation	
I gain recognition by using these platforms.	0.688
I want to be among the most active observers on the platform.	0.686
I am appreciated when I share my observations.	0.715

Table 19 displays the reliability measures of Cronbach's alpha and McDonald's omega for the CFA models of birdwatching and platform engagement motivation constructs. The results appear to be in the acceptable ranges to be meaningfully interpreted.

Table 19. Factor reliability of CFA models (France)

	Birdwatching motivation		Platform engagement motivation	
	Cronbach's α	McDonald's Ω	Cronbach's α	McDonald's Ω
Regulation Type				
Intrinsic	0.658	0.682	0.531	0.522
Integrated	0.816	0.839	0.832	0.822
Identified	0.598	0.634	0.764	0.759
Introjected	0.696	0.686	0.540	0.461
External	0.675	0.673	0.739	0.732

5.3.3.3 CFA Results of Motivation Variables for the Birdwatching Community in Turkey

The dataset in Turkey includes 241 valid responses. The number of observations for birdwatching constructs and for platform engagement constructs that R took into consideration were 214 and 200, respectively, because of missing values.

Table 20 displays the goodness-of-fit statistics of the CFA models for birdwatching motivation constructs and platform engagement motivation constructs for the data collected in Turkey. Both models show a good fit when CFI, TLI, RMSEA, and SRMR values are considered.

Table 20. Goodness-of-fit statistics of CFA models (Turkey)

	Birdwatching motivation	Platform engagement motivation
P-value (Chi-square)	0.005	0.002
Degrees of freedom	83	83
Robust Comparative Fit Index (CFI)	0.985	1.000
Robust Tucker-Lewis Index (TLI)	0.981	1.012
Robust RMSEA	0.038	0.039

90 Percent confidence interval - lower	0.022	0.024
90 Percent confidence interval - upper	0.052	0.052
P-value H_0: RMSEA <= 0.050	0.917	0.923
P-value H_0: RMSEA >= 0.080	0.000	0.000
SRMR	0.055	0.052

Table 21 shows the standardised factor loadings of latent motivation constructs for birdwatching motivations. All factor loadings are in the acceptable range of above 0.4. Loadings for integrated regulation are higher, above 0.70, compared to the loadings of other regulation types.

Table 21. Standardised factor loadings of latent motivation constructs for birdwatching (Turkey)

	Factors				
	1	2	3	4	5
Intrinsic motivation					
I enjoy birdwatching.	0.488				
For the pleasure I feel when I observe birds.	0.655				
I like to discover new species of birds.	0.561				
Integrated motivation					
Birdwatching is an important part of my identity.		0.772			
Birdwatching is an integral part of my life.		0.731			
Birdwatching is a way of life for me.		0.824			
Identified motivation					
It is a useful activity to spend my free time.			0.590		
Through bird watching, I spare time for myself.			0.575		
Birdwatching allows me to spend time in nature.			0.404		
Introjected motivation					
It's a useful pastime; I would feel guilty if I didn't do it.				0.560	
It's a useful activity, I need to do it to feel good.				0.561	
I would feel bad about myself if I didn't do birdwatching.				0.768	
External motivation					
I gain social recognition through birdwatching.					0.781
I am appreciated for my birdwatching activity.					0.753
Birdwatching gives me the opportunity to compete with other birdwatchers.					0.635

Table 22 displays the standardised factor loadings of latent motivation constructs for platform engagement motivations. The standardised loadings for all latent variables are in the acceptable range of above 0.4. As also observed in the other models, the loadings of integrated motivation

appear to be higher, above 0.70, when compared to other regulation styles.

Table 22. Standardised factor loadings of latent motivation constructs for engagement with the platform (Turkey)

	Factors				
	1	2	3	4	5
Intrinsic motivation					
Reading about birds gives me a lot of pleasure.	0.406				
It's very nice to share my observations.	0.651				
It's fun to learn about birds through these platforms.	0.433				
Integrated motivation					
Using these platforms is part of my identity.		0.857			
Sharing my observation data is part of my lifestyle.		0.846			
Sharing my data via these platforms is important in my life.		0.846			
Identified motivation					
It is important to support science by using these platforms.			0.789		
These platforms are a good way to contribute to the protection of birds.			0.767		
It's important for me to protect biodiversity by sharing my observations.			0.866		
Introjected motivation					
I contribute to science by sharing my observation data, so I feel guilty if I don't.				0.675	
These platforms are important to learn about birds, so I feel obliged to use these platforms to learn about birds.				0.453	
It is important to share observation data on these platforms; I would regret it if I didn't.				0.777	
External motivation					
I gain recognition by using these platforms.					0.745
I want to be among the most active observers on the platform.					0.633
I am appreciated when I share my observations.					0.887

In Table 23, reliability measures of Cronbach's alpha and McDonald's omega for the model of birdwatching and platform motivation constructs are shown. Reliability measures for the integrated regulation type are again above 0.80, displaying the highest value compared to others.

For platform engagement motivation constructs, integrated and identified regulation types show higher Cronbach's alpha values with values higher than 0.80. McDonald's omega values of integrated, identified, and external regulation types are above 0.80.

Table 23. Factor reliability of CFA models (Turkey)

	Birdwatching motivation		Platform engagement motivation	
	Cronbach's α	McDonald's Ω	Cronbach's α	McDonald's Ω
Regulation Type				
Intrinsic	0.591	0.585	0.495	0.518
Integrated	0.817	0.820	0.890	0.881
Identified	0.536	0.526	0.846	0.848
Introjected	0.677	0.651	0.697	0.669
External	0.766	0.773	0.797	0.800

The objective of this analysis was to derive the latent motivation variables that can be used in the multinomial logistic regression analysis in the next part of the study. It can be seen that the regulation type which is the most consistent and has the highest Cronbach's alpha and McDonald's omega values between the different models was the integrated regulation type. Bearing in mind that integrated motivation is defined as the most integrated version of extrinsic motivation, the one closest to intrinsic motivation (Deci & Ryan, 2015), I decided to use integrated regulation in the first three sets of hypotheses.

Consequently, I modified the hypotheses related to intrinsic motivation by using integrated regulation. A behaviour is a result of integrated motivation when it is completely integrated and internalised into the self, values, and needs of a person (Deci & Ryan, 2015). "Internalization is the process of taking in a value or regulation, and integration is the process by which individuals more fully transform the regulation into their own so that it will emanate from their sense of self" (Ryan & Deci, 2000a, p. 60). Integrated regulation "share many qualities with intrinsic motivation", such as both being autonomous (Ryan & Deci, 2000a, p. 62), which means "acting with a full sense of willingness and volition, wholly endorsing that which they are doing because they find it either interesting and enjoyable, consistent with their deeply held, integrated values" (Deci & Ryan, 2015, p. 486).

Based on these, I hypothesise that if someone has strong integrated motivation for engaging with the platform, then they would passively and actively participate more. Because if someone has integrated platform engagement with their self, values, and needs due to finding it enjoyable, then they would use the platform to share their observations and follow others' observations or to learn about different species. I similarly deduced that if someone has strongly integrated the act of birdwatching with their self, values, and needs due to finding it interesting and enjoyable, then learning about bird species, being informed about the updates in the birdwatching world, or

following the sightings shared by others would be addressing their values and needs, parallel to their sense of self. Thus, the first set of hypotheses are modified as follows:

H1a) People with stronger integrated motivation for platform engagement are more likely to devote more time to passive participation.

H1b) People with stronger integrated motivation for platform engagement are more likely to devote more time to active participation.

H1c) People with stronger integrated motivation for birdwatching are more likely to devote more time to passive participation.

The second hypothesis is modified in a similar manner as well. I hypothesise that if someone has a stronger integrated motivation for birdwatching, then they are less likely to participate actively by sharing data. Because if birdwatching is highly integrated into the self, values, and needs of a person, then being in the field and observing birds would be interesting and enjoyable and they won't be willing to engage with their phones or computers to share data. This is very similar to the above argument that I explained concerning intrinsic motivation. Therefore, I modified H2 as follows:

H2) People with stronger integrated motivation for birdwatching are less likely to spend more time on active participation.

For the third set of hypotheses, we expect an interaction effect, which is parallel with the explanation above concerning H3a. Thus, I modified H3a as follows:

H3a) The interaction effect between the integrated motivation for platform engagement and intrinsic motivation for birdwatching is positive for active participation.

And lastly, we expect to see an interaction effect of two types of motivations as far as passive participation is concerned parallel to explanation of H3b above. Based on these, I modified H3b as follows:

H3b) The interaction effect between the integrated motivation for platform engagement and intrinsic motivation for birdwatching is positive for passive participation.

5.4 RESULTS AND DISCUSSION

The first three hypotheses (H1, H2, and H3) are concerned with motivations and participation. These hypotheses address the first two research questions above (RQ1 and RQ2). The results of

the regressions addressing these questions are presented in Table 24.

Hypotheses of H4 are concerned with the relationship between participation and platform features. They address the research questions, RQ3 and RQ4. The results of this analysis are presented in Table 26.

Tables 25 and 27 displays the variance inflation factors (VIF). Variance inflation factor is a diagnostic tool to check the multicollinearity between the variables. Multicollinearity represents a high intercorrelation between explanatory variables leading to incorrect results (Kim, 2019). When the VIF is higher than 5, multicollinearity is present (Kim, 2019).

Table 24. Multinomial Logistic Regression Models for the Associations Between Motivations and Active and Passive Participation

	Dependent variable: Active Participation				Dependent variable: Passive Participation			
	Model 1 (H1b, H2)		Model 2 (H3a)		Model 3 (H1a, H1c)		Model 4 (H3b)	
Coefficients and Std. Errors								
	Ref: 0-3h.		Ref: 0-3h.		Ref: 0-3h.		Ref: 0-3h.	
	None	4+h.	None	4+h.	None	4+h.	None	4+h.
Birdwatching integrated motivation	-0.03 (0.12)	0.30* (0.13)	-0.06 (0.22)	0.10 (0.37)	-0.28* (0.12)	0.48*** (0.12)	-0.17 (0.23)	-0.02 (0.27)
Platform engagement integrated motivation	-0.45 (0.11)***	0.56*** (0.11)	-0.51 (0.43)	0.29 (0.49)	-0.17 (0.11)	0.26** (0.09)	0.07 (0.38)	-0.50 (0.39)
Birdwatching integ. motiv. * platform engagement integ. motiv.			0.02 (0.10)	0.06 (0.11)			-0.06 (0.09)	0.17* (0.09)
Age	-0.05 (0.07)	0.08 . (0.05)	-0.05 (0.07)	0.08 . (0.05)	-0.10 . (0.06)	-0.07 (0.04)	-0.10 . (0.06)	-0.06 (0.04)
Male (ref: others)	-0.15 (0.22)	0.95*** (0.23)	-0.15 (0.22)	0.95*** (0.23)	-0.25 (0.21)	0.61** (0.19)	-0.24 (0.21)	0.61** (0.19)
France (ref: Turkey)	-1.93*** (0.22)	-0.36 . (0.19)	-1.93*** (0.22)	-0.35 . (0.19)	-1.00*** (0.21)	-0.35* (0.16)	-1.03*** (0.21)	-0.30 . (0.17)
Intercept	0.80 (0.51)	-5.60 (0.61)	0.93 (0.90)	-4.76 (1.58)	0.90 (0.48)	-4.09 (0.53)	0.47 (0.89)	-2.00 (1.12)
Log-likelihood	-925.982		-925.818		-1063.308		-1061.056	
LR stat.	298.4994***		298.8289***		154.5015***		159.0063***	
Pseudo R2 (CoxSnell, Nagelkerke, McFadden tests)	(0.1891, 0.2427, 0.1388)		(0.1893, 0.2430, 0.1390)		(0.1028, 0.1288, 0.0677)		(0.1057, 0.1323, 0.0697)	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

	RRR							
	Ref: 0-3h.		Ref: 0-3h.		Ref: 0-3h.		Ref: 0-3h.	
	Non	4+h.	Non	4+h.	Non	4+h.	Non	4+h.
Birdwatching integrated motivation	0.97	1.34	0.94	1.10	0.75	1.61	0.85	0.98
Platform engagement integrated motivation	0.64	1.76	0.60	1.33	0.85	1.29	1.07	0.61
Birdwatching integ. motiv. * platform engagement integ. motiv.			1.02	1.07			0.94	1.19
Age	0.95	1.08	0.95	1.08	0.90	0.94	0.90	0.94
Male (ref: others)	0.86	2.59	0.86	2.58	0.78	1.85	0.78	1.84
France (ref: Turkey)	0.14	0.70	0.15	0.71	0.37	0.70	0.36	0.74

Table 25. Variance Inflation Factor for Models 1-4

	VIF Model 1	VIF Model 2	VIF Model 3	VIF Model 4
Birdwatching integrated motivation	1.4589	6.0145	1.4364	6.2786
Platform engagement integrated motivation	1.5951	24.6083	1.5618	24.2780
Birdwatching integ. motiv. * platform engagement integ. motiv.		39.4943		39.5702
Age	1.0547	1.0579	1.0397	1.0421
Gender	1.0082	1.0093	1.0073	1.0084
Country	1.1485	1.1953	1.1239	1.1794

Table 26. Multinomial Logistic Regression Models for the Associations Between Platform Offer and Negative Externality Solution with Active and Passive Participation

	Dependent variable: Active Participation						Dependent variable: Passive Participation					
	H4a, H4b						H4c					
	Model 5 FR		Model 6 EB		Model 7 TK		Model 8 FR		Model 9 EB		Model 10 TK	
	<i>Coefficients and Std. Errors</i>											
	Ref: 0-3h.		Ref: 0-3h.		Ref: 0-3h.		Ref: 0-3h.		Ref: 0-3h.		Ref: 0-3h.	
	None	4+h.	None	4+h.	None	4+h.	None	4+h.	None	4+h.	None	4+h.
Protection	-0.11 (0.13)	-0.08 (0.07)	-0.50** (0.17)	0.04 (0.18)	-0.25 . (0.15)	0.07 (0.21)	-0.10 (0.10)	-0.17** (0.06)	-0.85*** (0.21)	-0.03 (0.17)	-0.50** (0.18)	0.07 (0.17)
Competition	-0.02 (0.17)	0.36*** (0.08)	0.09 (0.20)	-0.25 (0.21)	0.20 (0.15)	0.15 (0.23)	-0.22 (0.14)	0.17* (0.08)	0.15 (0.23)	-0.20 (0.20)	0.49** (0.18)	0.02 (0.19)
Age	-0.06 (0.09)	0.04 (0.05)	0.40** (0.15)	0.06 (0.15)	-0.32** (0.13)	0.50* (0.19)	-0.19* (0.07)	-0.12** (0.04)	0.40* (0.18)	-0.13 (0.14)	-0.07 (0.15)	0.27 . (0.14)
Male (ref: others)	-0.19 (0.37)	0.86*** (0.25)	-0.41 (0.48)	1.18 . (0.66)	-0.43 (0.39)	1.32 (1.07)	-0.61* (0.27)	0.44* (0.21)	0.33 (0.63)	0.92 . (0.54)	-0.26 (0.44)	1.24 . (0.65)
Intercept	-2.20 (0.75)	-2.84 (0.44)	-1.05 (0.92)	-2.23 (1.07)	1.48 (0.77)	-5.43 (1.48)	-0.46 (0.57)	-0.85 (0.38)	-1.03 (1.06)	-0.97 (0.96)	-0.05 (0.87)	-3.43 (0.99)
Log likelihood	-621.881		-153.720		-162.164		-743.074		-144.776		-168.472	
LR stat.	40.7432***		21.9013**		31.5100***		40.7597***		31.7971***		27.7752***	
Pseudo R2 (CoxSnell, Nagelkerke, McFadden tests)	(0.0380, 0.0539, 0.0317)		(0.1134, 0.1356, 0.0665)		(0.1574, 0.1840, 0.0886)		(0.0380, 0.0496, 0.0267)		(0.1603, 0.1934, 0.0989)		(0.1401, 0.1625, 0.0762)	
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1												

	RRR											
	Ref: 0-3h.		Ref: 0-3h.		Ref: 0-3h.		Ref: 0-3h.		Ref: 0-3h.		Ref: 0-3h.	
	Non	4+h.	Non	4+h.	Non	4+h.	Non	4+h.	Non	4+h.	Non	4+h.
Protection	0.90	0.92	0.60	1.05	0.78	1.07	0.91	0.85	0.43	0.97	0.61	1.07
Competition	0.98	1.43	1.10	0.78	1.22	1.16	0.81	1.19	1.16	0.82	1.63	1.02
Age	0.94	1.05	1.49	1.06	0.73	1.64	0.83	0.89	1.49	0.88	0.93	1.32
Male (ref: others)	0.83	2.36	0.66	3.27	0.65	3.76	0.54	1.55	1.38	2.51	0.77	3.46

Table 27. Variance Inflation Factor for Models 5-10

	VIF Model 5 FR	VIF Model 6 EB	VIF Model 7 TK	VIF Model 8 FR	VIF Model 9 EB	VIF Model 10 TK
Protection	1.016385	1.09948	1.109985	1.017311	1.144942	1.190535
Competition	1.013593	1.08432	1.107147	1.013766	1.112768	1.202376
Age	1.000898	1.09044	1.017426	1.000787	1.100294	1.031499
Gender	1.019806	1.097951	1.035965	1.020099	1.043143	1.040175

5.4.1 MOTIVATIONS AND PARTICIPATION

5.4.1.1 *Role of Motivations in Active Participation (Models 1 and 2)*

In Model 1, integrated motivation for birdwatching and integrated motivation for platform engagement were found to be significant predictors of active participation. In Model 1, the gender variable male was found to be a significant predictor of active participation. The age variable is not significant at the 0.05 level in Model 1. The country variable was found to be significant.

The results of Model 1 indicate that we don't find support for H2. In other words, while I hypothesised that integrated motivation for birdwatching would be negatively associated with sharing data (active participation), the results reveal a positive and significant association between the two. In other words, people with higher integrated motivation for birdwatching are more likely to actively participate 4 hours or more per week compared to the ones who spend less time actively participating.

Model 1 suggests support for H1b, as platform engagement motivation is significantly correlated with active participation, considering that higher integrated platform engagement motivation is less likely to result in not participating compared to 0 to 3 hours per week for active participation. And it is more likely to result in participating 4 hours or more compared to 0 to 3 hours of active participation.

Interpreting model 2 is difficult because of the high multicollinearity between the interaction term and main effects (Table 25). This is because high multicollinearity leads to incorrect results (Kim, 2019). Therefore we don't have sufficient results to conclude if there is support for H3a or not.

5.4.1.2 *Role of Motivations in Passive Participation (Models 3 and 4)*

Integrated motivation for birdwatching and for platform engagement were found to be significant predictors of passive participation in Model 3. The gender variable male was found to be a predictor of passive participation in Model 3. The age variable is not significant at the 0.05 level. Country variable is significant in Model 3.

The results of Model 3 indicate support for H1a and H1c. Therefore, stronger integrated birdwatching motivation is likely to be positively associated with passive participation. Higher motivation for platform engagement is more likely to be associated with 0 to 3 hours of passive participation per week compared to not participating passively. Moreover it is more likely to be associated with passive participation of 4 hours or more per week compared to 0 to 3 hours of passive participation per week. Similarly, people with stronger integrated motivation for platform

engagement are likely to display more passive participation. As integrated motivation for platform engagement increases, passive participation of 4 hours or more per week is more likely compared to 0 to 3 hours per week.

Similar to Model 2, the interpretation of Model 4 is difficult due to the high multicollinearity between the interaction term and the main effects (Table 25). Thus, we don't have sufficient results to indicate if there is support for H3b or not.

5.4.1.3 Discussion of Results for Motivations and Participation

The results highlight that the effect of platform engagement motivation is higher for active participation than it is for passive participation (the relative risk ratios for the 4+h. category for the two variables are 1.76 and 1.29, respectively, as shown in Table 24, Models 1 and 3). This implies that higher platform engagement motivation is more likely to manifest itself in active participation than in passive participation. On the other hand, when it comes to the birdwatching motivation, the effect is higher for passive participation than it is for active participation (the relative risk ratios for the 4+h. category for the two variables are 1.34 and 1.61, respectively, as shown in Table 24, Models 1 and 3). This indicates a rather opposite relationship compared to the effect of platform engagement motivation.

Even though I hypothesised a negative association between integrated birdwatching motivation and active participation, the results of Model 1 showed support for the opposite. I think this result provides evidence for the tendencies of the data provider roles in general. And in this analysis, I might not be able to capture the nuances that I have found in the interviews in Chapter 4 that led me to formulate H2. Capturing these nuances might be possible through a further detailed analysis focused on the data provider roles.

Considering that we could not obtain reliable results from the Models 2 and 4, we could not actually test the Hypothesis 3a and 3b concerning the interaction effects. However, even if the results were not reliable because of multicollinearity, in Model 4, interaction effect appears to be positive and significant. In future studies, different analysis methods might be used to better test this potential interaction effect.

Our results in Models 1 and 3 show that males are more likely to actively and passively participate as opposed to others, including females and non-binary. In previous studies conducted in different fields of citizen science, such as astronomy and health, the participation of males was also found to be dominant (Curtis, 2015; Price & Paxson, 2012; Raddick et al., 2013). By referring to science-

related attitude research conducted in the United Kingdom (Research Councils UK, 2008), Curtis (2015) highlights that men may be more interested in science-related activities than women (Curtis, 2015). Curtis further underlines by referring to previous studies (Helsper, 2010; Joiner et al., 2012; S. Jones et al., 2009) that men were found to be spending more time on the internet (Curtis, 2015). Furthermore, it was highlighted that the average participation of women decreased in online citizen science as opposed to outdoor projects (National Academies of Sciences et al., 2018). Even though women become members of organisations related to bird protection, it is underlined that they are less likely to participate, possibly due to competition or required authority (National Academies of Sciences et al., 2018). These might explain the male dominance when it comes to online citizen science participation.

Concerning the age variable, the results were not significant at the 0.05 level in the analysis. They show weak evidence of significance at the 0.1 level for Models 1 and 3, indicating that as age increase, active participation is likely to increase; and for passive participation, as age increase participating 0-3 hours is more likely compared to none. In the literature, there are different findings concerning the age of participants in citizen science. In 2020, a survey conducted on Flemish citizen scientists showed that the majority of the citizen scientists who participated in the survey were older than 56 (Duerinckx, Annelies et al., 2021). In the study by Curtis (2015), most participants were reported to be over 40 years old (Curtis, 2015). Martellos et al. (2022) highlighted that older people (65 years old and higher) are underrepresented in citizen science (Martellos et al., 2022). As these different findings in the literature suggest, age of the participants might differ depending on the citizen science project, considering that there are many different citizen science projects in variety of fields, as shown in Chapters 1 and 2.

The results of the country variable indicates that participants in France are more likely to spend time participating in the platform 0-3 hours compared to not participating and participating more than 4 hours, both actively and passively, compared to the participants in Turkey.

5.4.2 THE ROLE OF PLATFORM OFFER AND NEGATIVE EXTERNALITY SOLUTION OF PLATFORMS IN PARTICIPATION

Models 5-10, in Table 24, present the results H4a, H4b, and H4c. These models address the research questions RQ3 and RQ4, which are concerned with how people differ from each other in active and passive participation, depending on the importance they give to platform offers and mechanisms of platforms to address negative externalities. In particular, we focus on the extent to

which a platform puts in place the features that show its dedication to protecting birds by protecting sensitive information (H4a) and the extent to which the platform organises competitions (H4b and H4c). Because these are platform-specific, they were analysed for each platform separately in the two countries.

The dependent variable in Models 5, 6, and 7 is active participation for the models of Faune-France, eKuşbank (eBird Turkey), and Trakuş, respectively. The dependent variable in Models 8, 9, and 10 is passive participation for the models concerning Faune France, eKuşbank (eBird Turkey), and Trakuş, respectively.

5.4.2.1 The Relation Between Platform Offer and Negative Externality Solution with Active Participation (Models 5, 6 and 7)

Model 5 FR tests H4a and H4b for Faune-France. The importance given to competitions was found to be a significant predictor of active participation in Faune-France. As the importance given to it increases, actively participating 4 hours or more per week is more likely compared to 0 to 3 hours of active participation per week. Protection variable is not significant.

Model 6 EB tests H4a and H4b for eKuşbank (eBird Turkey). The importance given to the protection of sensitive data by the platform was found to be a significant predictor of active participation, suggesting that active participation of 0 to 3 hours per week is more likely compared to not participating actively. Competition variable is not significant.

Model 7 TK tests H4a and H4b for Trakuş. Protection variable is not significant at 0.05 level, but it shows weak evidence of positive significance at 0.1 level. The importance given to the protection of sensitive data by the platform appears as a weak predictor of active participation in Trakuş, as shown that actively participating 0 to 3 hours per week is more likely compared to non-participation. This finding displays a similarity to the finding concerning eKuşbank (eBird Turkey) (Model 6 EB), especially interesting compared to non-significance of protection and significance of competition variables in the case of Faune-France (Model 5 FR).

The gender variable male was found to be a significant predictor of active participation in Model 5 FR, meaning that male participants are more likely to actively participate in Faune-France. Gender variable in Model 6 EB is not significant at 0.05 level, but shows weak evidence of significance at 0.1 level. The age variable is significant in Models 6 EB and 7 TK. The result of Model 6 EB indicate that the active participation of younger participants is more likely than older participants in the case of eKuşbank (eBird Turkey). In Trakuş, older participants seem to be more likely to actively

participate (Model 7 TK).

5.4.2.2 The Relation Between Platform Offer and Negative Externality Solution with Passive Participation (Models 8, 9 and 10)

Models 8 FR, 9 EB, and 10 TK investigate the role of platform features as the value offer and mechanism to address negative externalities in passive participation. In Model 8 FR, the importance given to competitions in the platform and the importance given to the protection of sensitive data by the platform were found to be significant predictors of passive participation in the case of France. The results demonstrate that as the importance given to the protection of sensitive data in the platform increases, passive participation of 4 hours or more per week is less likely than 0 to 3 hours per week. So, passive participation is likely to decrease. As the importance given to competitions in the platform increases, active participation of 4 hours or more is more likely compared to spending less time on it.

In Model 9 EB, the importance given to the protection of sensitive data by the platform was found to be a significant predictor of passive participation. So, in eKuşbank (eBird Turkey), passive participation of 0 to 3 hours per week is more likely compared to not participating as the importance of protection of sensitive data increases. And lastly, in Model 10 TK, both the importance given to competitions in the platform and the importance given to the protection of sensitive data by the platform were found to be significant predictors of passive participation. As the importance given to the protection of sensitive data by the platform increases, passive participation of 0 to 3 hours is more likely than no participation. Conversely, as the importance given to competitions increases, passive participation is likely to decrease. This is the opposite of the results of Model 5 FR suggests.

Gender is significant in Model 8 FR, indicating that male participants are more likely to passively participate 4 hours or more per week compared to 0 to 3 hours in Faune-France. Male variable is not significant at 0.05 level for the Models 9 EB and 10 TK, the two models concerning passive participation in the platforms in Turkey. But it shows a weak evidence of positive significance at 0.1 level. Age is a predictor of passive participation in Models 8 FR and 9 EB. The results show that in Faune-France, passively participating 0-3 hours seem to be more likely as age increase, compared to not participating and participating more than 4 hours (Model 8 FR). And in the case of eKuşbank (eBird Turkey), active participation of younger participants is more likely than older participants (Model 9 EB).

5.4.2.3 Discussion of Results for Platform Offer, Negative Externality Solution, and Participation

To interpret the results in what follows, I also use some insights from interview results in Chapter 4. Considering the results of Model 5 FR, we cannot find support for H4a, but H4b is supported. The models highlight that in the two countries examined, the role of platform features elicits different responses in terms of participation; while competitions organised in the platform seem to drive both active and passive participation in the French case (confirming H4b and H4c), competitions are at best insignificant, and at worst has a negative effect on passive participation in the Turkish platforms. On the other hand, while the importance given to the protection of sensitive data by the platform (addressing a negative externality) seems to be negatively associated with passive participation in France, it has a strong positive effect on the two Turkish platforms, both in terms of active and passive participation.

Even though all three platforms share the features of competitions and protection of sensitive data, how these value offers and mechanisms to address negative externalities are perceived and reflected in the participation behaviour in the two countries are different. Previously, in research concerning social media usage in different country settings, differences between the preferences of users of social media platforms were found (Schulz et al., 2022; Singh et al., 2012). In the context of using social media to follow the news, country differences regarding the users included the importance given to the picture or the heading of the article (Schulz et al., 2022), which can be interpreted as users having different expectations from the platform content or platform feature depending on the context. Regarding the reasons for using social media platforms in different regions of the world, again, differences were found between the users in terms of business and personal use of social media (Singh et al., 2012), meaning that contextual differences do exist when it comes to online platform use. Considering these previous studies in social media research, I expected to find some country-specific differences regarding citizen science platforms, as mentioned above.

To better explain the roots of the differences that we have found, I would like to return to the Citizen Science Platform Interactions Model (Figure 14) developed in Chapter 4. In this model, these value offers are related to the expectations and motivations of participants. The Citizen Science Platform Interactions Model is applied to the examples of competition and protection, as shown in Figure 16.

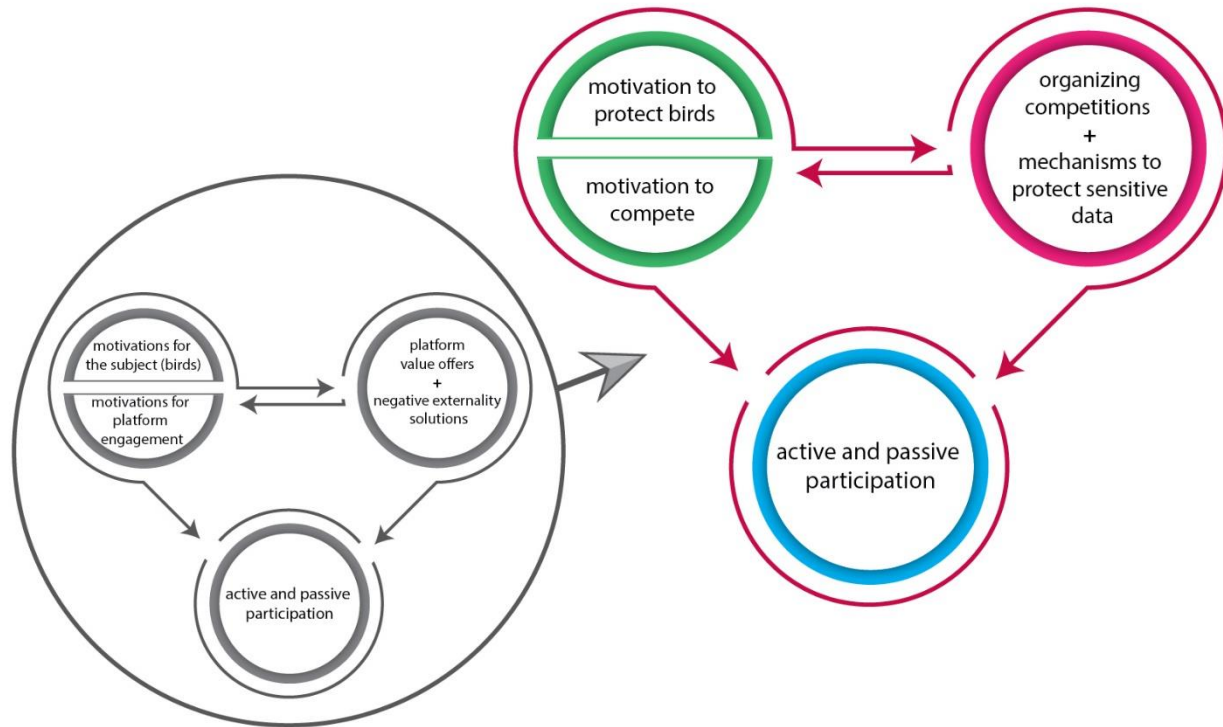


Figure 16. The Citizen Science Platform Interactions Model Applied to the Examples of Competition and Protection

The use of the regression model in this chapter does not permit the demonstration of the two-way relationships in this model, but it can provide insights into the explanation of these differences.

The observed differences might be due to the differences between the drivers or motivations of people in communities who use these three platforms. Previous research on environmental volunteering motivations in Austria and Great Britain showed differences in the degree of relevance given to different motivations in different countries and cultural settings (Sloane & Pröbstl-Haider, 2019). Moreover, in an investigation of the incentives for participation in citizen science research in five countries (Czechia, Germany, Italy, Spain, Sweden, and the UK), some country-specific differences were found (Lakomý et al., 2020). Thus, some drivers might be more relevant in France and others in Turkey. As mentioned before, the impact of platform design on participation was previously highlighted as a determining factor for increasing participation (Shirk et al., 2012) and high-quality participation (Rotman et al., 2012). Also, understanding the needs and motivations of participants is a crucial factor in increasing the amount of information shared by participants, as well as increasing the number of participants (Sullivan et al., 2014). The findings

of this study permit a detailed snapshot of the role of the platform of design in terms of value offers and participant motivations in both active and passive participation.

For example, people in the community in Turkey using Trakuş seem to give less importance to the competitions that the platform organises, resulting in a negative correlation with their passive participation, as seen through Model 10 TK. Adversely, the community using Faune-France seems to be more motivated by the competitions, which positively correlates with their active and passive participation demonstrated through Models 5 FR and 8 FR. And, the community of Faune-France seems to be less motivated about the protection of sensitive data by the platform. In other words, the users whose passive participation is higher give less importance to protection of sensitive data by the platform in the case of Faune-France (Model 8 FR). An alternative explanation might be less concern about revealing sensitive data when participating in Faune-France, because passive participation includes following others' observations, reading information about species, following statistics, or following news sections. Or, when participating passively, users in France might be less concerned about the risk of divulgation of sensitive data that might lead some bird photographers or hunters to harm the birds.

Another point of view to explain the results regarding the eKuşbank (eBird Turkey) and Trakuş models is that people might be forming a connection between bird conservation and the protection of sensitive data. In the interviews, I saw that a common motto used in the community in Turkey to raise awareness about birdwatching was "You can protect the birds by sharing your observations." Interviews in Chapter 4 exemplified this point as follows:

"It is emphasised, for example, during the Atlas project that the data shared is used for a good cause and that this data creates a base for the conservation efforts."

"The reason for creating Kuşbank was beyond "I saw this bird, 'Ahmet' can also see if I share it", but it was more for nature conservation."

As a result of this widespread awareness raising about bird conservation in the community in Turkey, participants who put strong importance on the protection of sensitive data might be more likely to increase their active and passive participation, with the perception of contributing to the conservation of birds. Putting emphasis on bird conservation is also a communication strategy of the Faune-France platform, but during the interviews, participants did not mention it like the participants in Turkey did. So, in both countries, the importance of sharing observation data for bird conservation was emphasised by the platforms, but how participants perceive it seems to have

differed. This might be because of the smaller size of the community in Turkey, which would allow for more direct contact between the members of the community, leading to more direct conversations in which the conservation objective is reinforced. This shows the power of communication in increasing the amount of data shared (Chu et al., 2017; MacPhail & Colla, 2020). The importance of communication was also previously highlighted in the literature by having feedback channels for different actors on the platform (Parra et al., 2020).

Our results about the gender variable suggest that males are more likely to participate in Faune-France actively and passively. They can be also considered to more passively participate in eKuşbank (eBird Turkey) and Trakuş, even though the evidence were weak in Models 6 EB, 9 EB and 10 TK. Overall, male dominance in online citizen science participation was prominent in the findings of previous studies (Curtis, 2015; National Academies of Sciences et al., 2018; Price & Paxson, 2012; Raddick et al., 2013).

Regarding the findings about the age, there is an interesting dynamic between the Turkish platforms. In eBird (eKuşbank), active and passive participation seem to be more likely to increase when the participant is younger (Models 6 EB and 9 EB). In Trakuş, active participation -and passive participation with weak evidence- seem to be more likely when the participant is older. This difference can be due to the differences in audiences of the two platforms related to their experiences using the platforms. As previous studies argue, platforms' user interface or technical features are determinant factors when it comes to non-participation (Benyei et al., 2021; Gharesifard & Wehn, 2016; Martin et al., 2016). In the interviews, an interviewee who is younger than 45 years old highlighted that:

"Trakuş is nice, but the website looks old, like it's from the first days of the internet. On the one hand, it's nice, like a historical artefact. But I don't feel like using it so much, to be honest."

Conversely, an interviewee who is older than 45 years old mentioned that:

"It was easier to enter data to Trakuş. The interface of eBird was more scientific and more difficult to use".

The user interface might be a reason for the results concerning the difference in age in the platforms in Turkey.

5.5 CONCLUSION

In this chapter, I explored why people differ in their participation in citizen science platforms. In

particular, I investigated the role of their motivations related to the subject of observation (birds) and platform engagement. More specifically, I examined the roles of integrated birdwatching motivation and integrated platform engagement motivation in active and passive participation. I also investigated the role of the importance users give to value offers of the platform and the platforms' mechanism for addressing negative externalities. In other words, I examined how the perceived importance of competitions and the protection of sensitive data as a mechanism to address negative externalities are related to active and passive participation.

I demonstrated that both motivations, motivations for the subject and motivations for platform engagement, are positively associated with active and passive participation. Thus, I show the importance of taking into consideration motivations for the subject of the platform and motivations for engaging with the platform separately. Previously, various drivers of participation were identified, such as joy, learning, and social interactions (Gharesifard & Wehn, 2016; Raddick et al., 2010). Even if interest in the subject was identified as motivation before (Mankowski et al., 2011; Marshall et al., 2015; Tinati et al., 2016, 2017), I went a step further and grouped motivations for the subject as a comprehensive category of motivations, which is also demonstrated in Chapter 4 from a qualitative point of view. Furthermore, while the previous research on motivations in citizen science took into consideration extrinsic and intrinsic motivations (Ellis, 2020; Jakositz et al., 2020; Lakomý et al., 2020), I adopted a different approach by examining the relationship between participation and integrated regulation of these two motivation types as referred in SDT. This provided a deeper understanding of the nature of motivations in citizen science.

By considering the role of different motivations regarding the subject and for platform engagement, I built on the previous literature, which highlighted the importance of understanding the needs and motivations of citizen scientists (Raddick et al., 2013) to ensure that the participation is sustainable (Rotman et al., 2012) and of high quality (Shirk et al., 2012). This way, founders and managers of citizen science platforms can design the platforms in a more informed manner concerning the diverse motivations of users and different participation types.

I also showed that the value offers of the platforms, such as the competitions, have an important role in active and passive participation. Even though the subject of the platforms is the same, which is birds in our case, how people behave in terms of their participation differed in the two countries. This suggests the importance of taking into consideration the context and the messages given by the platforms to their participants, knowing their direct impact on active and passive participation. The differing results concerning active and passive participation were previously shown in social

media literature and virtual communities literature (Horng, 2016; Pagani et al., 2011).

In this chapter, I approached participation as active and passive participation. I describe active participation as contributing observations, whereas passive participation encompasses other methods of interacting with the platforms.. Thus, this thesis contributed to the literature on online platform studies demonstrating the different associations between active and passive participation and the roles of motivations and perceptions regarding the importance of different platform features. In other words, while designing and managing online platforms, one of the crucial factors to take into account is the distinction between active and passive participation types. Because similar user-related factors can have different roles in both, and should be considered to ensure accurate targeting for the corresponding participation type. This thesis exemplified this in the case of online citizen science platforms.

The different effects of such platform features on user preferences in different country settings were previously shown in social media studies (Schulz et al., 2022) and in business literature (Singh et al., 2012). I also contributed to the literature in this aspect. In other words, I demonstrated that the ways in which active and passive participation occurs will likely depend on users' perceptions of the platform features in different contextual settings, even if the platform subject is the same.

In this study, I examined only one platform offer and one mechanism of the platforms to address negative externalities. Further investigation of the impact of other value offers of platforms in different contexts will provide further insights about how to ensure productive participation in citizen science, and consequently have more and higher quality data collection to use in scientific knowledge creation. A similar approach can also be emphasised in a more general sense of online platform participation.

In the next chapter, I provide a conclusion for the PhD project by summarising the study, presenting the application of the IAD framework following the findings of the two studies, highlighting managerial implications of the project and sharing the limitations and areas for future work.

6 CONCLUSION

In this PhD thesis, I investigate the participation dynamics in online citizen science platforms in Turkey and France by focusing on the roles and interaction patterns in the platforms and motivations of users together with what citizen science platforms provide to them. This chapter is organised as follows. First, I provide a summary of the research. Second, I present the summary of the findings inside the *action arena*, interactions, and outcomes of the IAD framework, following examination of the platforms in Chapters 4 and 5. Third, I provide managerial implications and conclude with potential limitations and future research.

6.1 SUMMARY OF THE PHD PROJECT

Citizen science provides various benefits, such as data collection beyond the capacity of small teams of researchers (Adler et al., 2020; Dickinson et al., 2010; Jarvis et al., 2015), consequently increasing the capacity of data collection in many fields of science (Larson et al., 2016), leading to scientific publications in various fields with the involvement of people who are not scientists. Hence, citizen science provides environmental, societal, and collaborative benefits. In terms of the environment, it creates opportunities to monitor pollution, climate change, land use, and ecosystems (Adler et al., 2020; Dickinson & Bonney, 2012), as well as wildlife and biodiversity conservation (Deguines et al., 2020; Larson et al., 2016). Society and individuals also benefit from citizen science as it leads to local empowerment and learning opportunities (Adler et al., 2020; Larson et al., 2016). It further enhances international research collaboration and fosters stronger partnerships between scientists and the public (Dickinson & Bonney, 2012). The initial motivation behind this study was to contribute to our knowledge of citizen science for better leveraging its potential, given its widespread benefits from the individual, to scientific, and to the ecosystems levels.

For this purpose, I first conducted a literature review focusing on the challenges and success factors in citizen science, participation in citizen science, and user motivations to map the current literature and identify the gaps. In the first part of the literature review, I conducted a bibliographic coupling analysis to understand the evolution of the field and to identify the common themes in different research areas. This analysis focused on only motivations and participation. Secondly, I extended the literature survey to cover other resources not included.

I observed that, participants (in other words, citizen scientists) occupied a common central theme in studies, either directly or indirectly. The common themes include issues related to data, such as

data quality, validity, verification, and privacy (Acorn, 2017; Bonney et al., 2016; Fox et al., 2019), organisational issues such as design (Chesser et al., 2020; Killion et al., 2018) and inclusiveness (Fiske et al., 2019; Walker et al., 2021), and factors related to the participants such as motivations (Bonney et al., 2016; Earp & Liconti, 2020) and ways of increasing participation (Sullivan et al., 2014; West & Pateman, 2016).

I found that the research related to data, organisation and design, and participants shed light on the best practices and suggested ways of ameliorating citizen science projects for better results. The common subject of these themes stands out as citizen scientists. For example, when data validity, verification, and quality are concerned, the focus is on understanding the degree of validity and quality of data shared by citizen scientists (Gibson et al., 2019; Safford & Peters, 2018) and ways of ameliorating it, such as through education and training (Parrish et al., 2018; Pinto et al., 2020). In the case of organisational and design-related issues, I observed that there is an emphasis on the needs and outcomes regarding participation (Chesser et al., 2020; Shirk et al., 2012) and ways of increasing participation (Rotman et al., 2012) such as learning, inclusion, and motivations, as well as emphases on the needs and outcomes for scientists (Golumbic et al., 2020; Walker et al., 2021), for local communities (Johnson et al., 2020), and regarding communication and collaboration (Krželj et al., 2020; Parra et al., 2020). Thus, citizen scientists stand out as one of the focus points of organisational issues.

Additionally, user-related studies in citizen science occupy a separate line of research by investigating the motivations of participants (Gharesifard & Wehn, 2016; Raddick et al., 2013) and how they change and affect participation (Crowston & Fagnot, 2008; West & Pateman, 2016). Based on the review of the literature, I saw that participants have a central place in citizen science, and even though there is a body of research concerning the motivations of participants, there is still a need for a further understanding of the motivational dynamics (Wehn & Almomani, 2019). Overall, this chapter showed that data issues, participation dynamics, and user motivations are important factors to take into account, especially in addressing the challenges that citizen science faces.

Following the literature review, I presented the theoretical background of the thesis. The main framework is the Institutional Analysis and Development (IAD) framework. Together with the IAD framework, I drew upon the theory of knowledge commons, Multi Sided Platforms (MSPs), and Self-Determination Theory (SDT). I approached citizen science platforms as knowledge commons, defined as “a resource which is shared by a group of people” (Hess & Ostrom, 2007, p. 4), as well

as “a form of community management” (Strandburg et al., 2017, p. 10). The IAD framework is used to analyse commons (Hess & Ostrom, 2007). I also drew upon MSPs approach, because the platforms under study are digital infrastructures with various types of participants for which MSPs provides useful insights. Because the IAD framework acts as an umbrella for the analysis, I focused on different parts of the framework as the project progressed. Taking the IAD framework as a multi-tier conceptual map, I dissected into the different levels of the framework by using appropriate theories at those levels (Ostrom, 2005). For the presentation of the platforms in Chapter 3, I used the guiding questions that the IAD framework provides. And later, for the analysis of the inside workings of the *action arena*, I used knowledge commons together with MSPs in Chapter 4 and built on the findings from Chapter 4 by also utilising SDT in Chapter 5.

Given that environmental sciences and ecology, particularly ornithology, are prominent in citizen science - with ornithology being one of the oldest and most widespread fields (Kullenberg & Kasperowski, 2016; Pelacho et al., 2021), I selected the case platforms accordingly and presented them in Chapter 3. The platforms examined in this study are Faune-France from France, eKuşbank (eBird Turkey) and Trakuş from Turkey. France and Turkey have different institutional, social, and economic dynamics, and analysing them regarding the citizen science platforms they host, has demonstrated similarities and differences in terms of online citizen science participation in different contextual settings.

In the fourth chapter, I presented the results of a preliminary qualitative analysis, which was conducted through semi-structured in-depth interviews, in which I examined the motivations/drivers of participants in three citizen science platforms in two countries by focusing on: actors’ roles in the platforms, their motivations, the types of participation, interactions and the negative externalities in the platforms.

To examine the roles of the actors and the network effects arising from their interactions, I focused on the *action arena* of the IAD framework, and I used the MSPs approach together with the understanding of knowledge commons. To investigate the motivations and participation types, I distinguished between motivations for the subject and motivations for engagement with the project/platform. I believe this distinction is important, considering that two different behaviours, namely, subject-related behaviours and platform-related behaviours, originate from these two kinds of motivations.

Emphasising this point of view further allowed us to see the negative externalities resulting from different motivation and behaviour bases, such as drivers of behaviours concerning birds which

cause people to avoid sharing their observations. An example from the interviews is, being content in the field, busy with birds, and because of enjoying themselves, not willing to *play* with their phone to share their observation data. I took interruptions in sharing data as negative externalities because these platforms are knowledge commons; they are knowledge and data resources. The data in the platform is both shared and used by the participants (Frischmann et al., 2014). Therefore, when data is shared in the platform, every role is better off.

I also found that behaviours that are potentially harmful for birds cause some participants to conceal data. For instance, interviews showed that photographers may act in ways that are harmful for birds, such as throwing objects at them to capture a unique photograph. Consequently, people who give importance to the protection of birds become reluctant to share the location data of the birds. This also shows that, birds constitute the source of the data collected and shared in the platform. Therefore their well being is sometimes at the centre for various roles. Another example is, when hunters are present in the field, birdwatchers are sometimes reluctant to go to the field to make observations. This in turn results in having less observations and sharing less data in the platform.

In that chapter, I identified two participation modes: active and passive participation. This distinction was previously highlighted in social media participation (Gainous et al., 2021; Pagani et al., 2011). In this work, I defined active participation as sharing observations and passive participation as other means of engaging with the platform. I also identified four different roles that actors of the platform play: birdwatcher, bird photographer, hunter, and scientist. These are considered as “roles” and not as individuals. Meaning that the same individual could be acting in different roles at different times. For instance, someone would be in the role of scientist when retrieving the observation data for scientific publication; the same person would be in the role of birdwatcher when making observations and sharing them on the platform.

Moreover, I examined the motivations behind not participating as a form of negative externality. I investigated the methods that platforms use to promote active and passive participation. I found that platforms make value deals with each role to promote the flow of data and information (Figure 13). Value deals refer to what is provided to different roles by the platform and what different roles provide to the platform. I also found that these value deals are shaped in accordance with the motivations of the participants, as well as with how platforms address the behaviours that cause negative externalities first-hand, such as not sharing, sharing faulty data/information, sharing incomplete data/information, or sharing late (Table 13). These behaviours can potentially result in

negative externalities for the knowledge resource. Also, certain behaviours can potentially harm the birds and result in negative externalities regarding birds. Thus, the findings suggest that platforms make value deals with each role by taking into consideration the ways of addressing these negative externalities, as well as responding to the needs, expectations, and motivations of participants. I demonstrated this process on the Citizen Science Platform Interactions Model (Figure 14) that were devised in Chapter 4.

Following the qualitative study in Chapter 4, I conducted quantitative empirical research aiming to explain the roles of motivations and the perceptions of platform features in active and passive participation. This study used the insights obtained in the qualitative part, in addition to the previous literature. In this analysis, I conducted a large-scale survey targeting the participants of the three platforms examined in this project.

I examined the motivations using the SDT, a widely used motivation theory (Ryan & Deci, 2000b, 2017), by distinguishing between motivation for the subject (birds) and motivations for platform engagement. My investigation regarding the platform features corresponded with the MSPs approach, as used in the qualitative part. Based on the different regulation types of motivations in the SDT, as intrinsic, integrated, identified, introjected, and extrinsic regulations, I conducted a confirmatory factor analysis to determine the latent motivation variables to be used in regression models.

I examined the roles of integrated motivation for birdwatching and for platform engagement and the roles of their interaction on active and passive participation types. I also examined whether differences in active and passive participation can be explained by the differences in how people give importance to various platform value offers and how platforms address negative externalities. The findings of this study suggest that integrated motivation for birdwatching and integrated motivation for platform engagement are associated with higher active and passive participation; with platform engagement motivation having a stronger association for active participation, and birdwatching motivation having a stronger association with passive participation.

An interesting finding is related to the contextual factors observed through platform features. I found differences between the platforms in Turkey and the platform in France. The importance given to competitions is likely to have a positive association with active and passive participation in Faune-France, but it is either insignificant or likely to have a negative association with participation in the platforms in Turkey. In addition, the importance given to the protection of sensitive data by the platforms is likely to have a negative association with passive participation in

France, but it is likely to have a positive relationship with both participation types in the case of the platforms in Turkey.

Previously, differences in different countries were found in social media participation (Schulz et al., 2022; Singh et al., 2012). The underlying reasons for these differences in the case of the citizen science platforms are demonstrated in the Citizen Science Platforms Interactions Model (Figure 14) developed in Chapter 4. This model demonstrates the relationships between the design and governance strategies of the platform, the motivations of participants, and the role of these factors in participation. Motivations are shaped by the platform to a degree, and what the platform offers can also be shaped by the motivations to a degree. Finding a balance between the participant motivations and the values provided by the platform, in turn, has implications for active and passive participation.

6.2 REVISITING THE CASE ANALYSIS USING THE IAD FRAMEWORK ACCORDING TO THE FINDINGS

In Chapter 3, I briefly analysed the platforms by using the guiding questions from the IAD framework. Here, I would like to present a summary of the action arena, interactions, and outcomes as displayed on the IAD framework following the analyses conducted in Chapters 4 and 5. The analyses conducted in Chapters 4 and 5 focused on the examination of the action arena, interactions and outcomes. Here, I included these in the analysis of the platforms. Ostrom et al. (1994) highlight that different theories are compatible with the IAD framework (Ostrom et al., 1994) to make analysis at different tiers of the IAD framework (Ostrom, 2005); thus, I used knowledge commons, Multi-Sided Platforms (MSPs) and Self-Determination Theory (SDT) to analyse the patterns of interactions and motivations of actors in the action arena.

Figure 17 demonstrates the IAD framework by detailing the topics examined in each box in the framework. Points in red in Figure 17 show the summary results derived from Chapters 4 and 5. I used insights from the explanations of Hess and Ostrom (2007) and Frischman et al. (2014) and adapted those to the citizen science cases in this study. Thus, this study contributes to the application of the IAD framework in the case of online citizen science platforms, which we approached as a form of knowledge commons. The cases in this study fit the description of knowledge commons as a resource that participants both share and take part in its creation (Frischmann et al., 2014). I believe that including “What are the motivations and potential interactions between them?” among the guiding questions of the IAD framework (see Chapter 2)

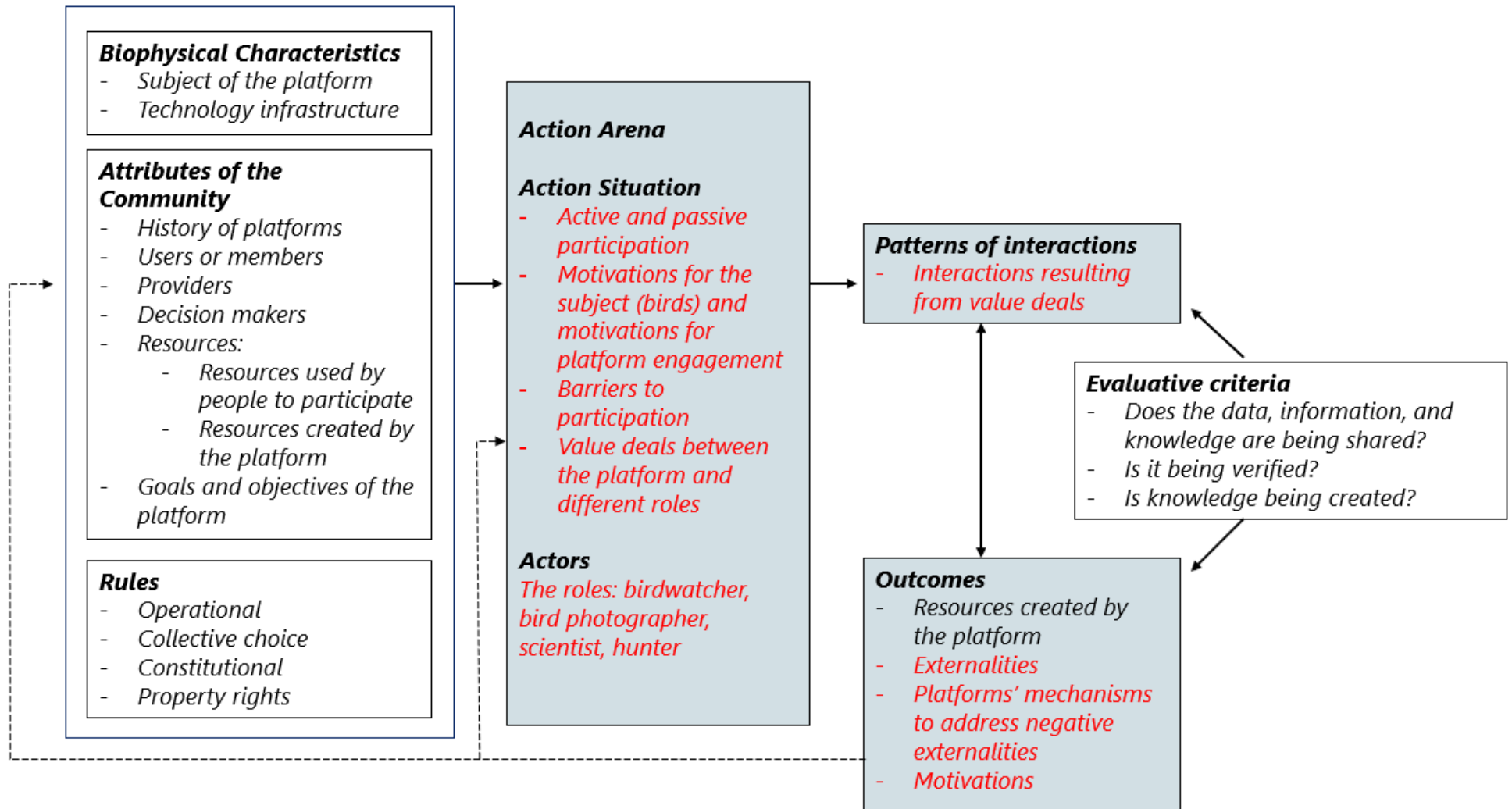
would be useful for the analysis of the action arena because motivations are not separate from the roles that participants take, negative externalities that platforms address, the goals of the platform, and the goals of platform participants.

I believe the IAD framework proved useful in analysing the platforms in this study in a detailed manner. Given that detailed analyses were presented in the previous chapters and at the beginning of this conclusion chapter, I included summary points in Figure 17. In the action arena, I took into account active and passive participation, the roles of birdwatcher, bird photographer as users and providers of data, hunter and scientist as users of data, motivations for platform engagement, motivations for birdwatching, the barriers for participation, and the value deals between the platform and different roles. Patterns of interactions are resulting from the value deals. The outcomes are highlighted as the negative externalities, platforms' methods to address negative externalities, motivations for platform engagement and for birdwatching, and knowledge, information and publications created with the contributions.

Evaluative criteria concerns the outcomes and the process of achieving those outcomes (Ostrom, 2011). For the evaluative criteria, I included the questions "does the data, information, and knowledge are being shared?", "is it being verified?", "is knowledge being created?", considering the citizen science platform cases that were examined in this thesis. These questions lead us to see the well being of the knowledge and data resource of the platform.

The Citizen Science Platform Interactions Model can be useful to explain the elements in the boxes of action arena, patterns of interactions, and outcomes because it includes the two categories of motivations, platform value offers and negative externality solutions, and active and passive participation types. Although the IAD framework is valuable in the examination of the platforms as a whole, the Citizen Science Interactions Model allows for a detailed analysis of the workings inside the action arena, interactions, and outcomes in citizen science platforms.

Figure 17. The IAD Framework Adapted to the Online Citizen Science Cases in This Study
Source: Adapted from (Frischmann et al., 2014; Hess & Ostrom, 2007)



6.3 MANAGERIAL IMPLICATIONS

It is evident that taking into consideration the needs and motivations of participants leads to higher quality participation (Shirk et al., 2012), retaining the participants, and overall increasing participation (Rotman et al., 2012). The necessity to take into account the benefits and experiences of participants is also evident in the success of the citizen science platforms/projects (Chesser et al., 2020; Golumbic et al., 2020; Killion et al., 2018). Thus, I further delved into the relationship between the participants and the platforms, and the findings demonstrate both the central role of the participants in shaping the design and governance processes of these platforms, as well as the role of the platforms in shaping the motivations of participants. Motivations of participants and what platforms provide to their participants influence the two modes of participation, active and passive, as demonstrated through the Citizen Science Platform Interactions Model (Figure 14).

These findings are beneficial for the platform managers as well as policymakers, considering the increasing role of citizen science as a tool to support policy (Fraisl et al., 2020; Quinlivan et al., 2020b; Schleicher & Schmidt, 2020; Shulla et al., 2020; Wamsler et al., 2020; Wuebben et al., 2020). Distinguishing between the active and passive participation types would be useful for accurate targeting of the participants by sending different messages. This is not necessarily about choosing one type of participation to target but rather developing strategies by taking into consideration these different participation types. In other words, platform managers can develop strategies regarding which type of participation (active and/or passive) they desire to promote based on the needs of the platform/project, given that different motivations and expectations of participants can potentially influence these.

The distinction between the motivations for the subject and motivations for platform engagement is also critical for better targeting the users and encouraging their active and/or passive participation. Platform managers and/or policymakers can decide which group of motivations to target with the awareness of such distinction. In other words, they can decide if they will encourage motivations related to the subject or platform engagement. In the case of online citizen science platforms, if the desired participation type is active participation, then strategies for influencing platform engagement motivations will likely reflect as more active participation, such as awareness-raising campaigns about scientific contributions and learning opportunities. They might also prefer to encourage passive participation. Then, they can use strategies that will likely influence motivations about birds, such as organising activities in nature to ignite fun and curiosity about birds.

What platforms/projects communicate to their communities (Chu et al., 2017; MacPhail & Colla,

2020) and what they provide to their participants also influence participation and motivations. However, even if what is communicated and provided by different platforms are similar, how they are perceived by the citizen science communities might be different in different country settings. For example, all three platforms emphasise bird conservation by sharing observation data. However, participants of the platforms in Turkey are more likely to actively and passively participate when they perceive the protection of sensitive data to be important, as opposed to the participants of the platform in France. I mentioned in Chapter 5 that this difference might be due to participants of platforms in Turkey forming a connection between bird conservation and the protection of sensitive data, as also exemplified in the interviews. Thus, the context should also be considered when designing and managing such platforms/projects. For example, the same feature can result in more active participation in one platform but not in another. Understanding the community well is key. Further country-specific and platform-specific investigations, such as in this study, will provide insights for understanding the communities. These findings have implications for the development of communication strategies and their potential to lead to active or passive participation. The platform features and value offers should be designed according to the mutual interactions between the motivations, platform offers, and their reflections on the two participation types.

It is further possible to better understand the community by identifying the roles on the platform, as shown in Chapter 4. Identification of the roles is the first step to understanding the motivations of different roles and their potential effects in the form of externalities causing implications for platform engagement or for other motivations. Understanding the different roles might lead platform managers to develop appropriate communication strategies according to the motivations and expectations of different roles. For example, by identifying the bird photographer role in Chapter 4 and examining the motivations of this role, I saw that the motivations of some bird photographers may sometimes cause negative externalities, for instance, by chasing or disturbing the birds to capture unique photographs. This is a negative externality for the roles which share the motivation for the conservation of birds, and might cause interruptions in their data sharing. A strategy for the platform managers and communities might be to use the changing nature of motivations as a leverage and lead a change in the role of bird photographer to the role of the birdwatcher. A similar change of roles is also shown in the case of hunters, when the hunter role is sometimes converted to the bird photographer or birdwatcher roles. Platform managers can also balance the conflicting expectations of different roles by identifying and understanding each role.

6.4 LIMITATIONS AND FUTURE WORK

Given the best efforts to ensure a comprehensive coverage of the topic by using both qualitative and quantitative methods, there are potential limitations. One limitation might be related to possible biases in sample selection. For the qualitative part of the study, in Turkey, I approached people either with references or invitations posted on the platform websites for the interviews. In France, due to concerns about the privacy of personal data, I had to approach people through invitations posted on the website for the interviews. For the quantitative part, one limitation might be self-selection bias, because participation to survey was open to the platform users who wanted to participate.

Another potential limitation might be the extent to which results can be generalised to other fields of citizen science. Even though I used qualitative and quantitative methods in this research, given that the qualitative part of the study provided detailed insights, which then led to the quantitative part of the study, further research on other platforms in diverse citizen science fields will be of interest and potentially provide further insights related to the findings of this study. For instance, observation of other taxons like plants and/or mammals.

The fields in which citizen science is conducted completely through online tools might include other types of interactions of motivations, which needs to be tested and which is another avenue of future research. For instance, spending time in nature does not apply in the case of astronomy citizen science platforms. They often require the use of digital tools for both the subject of interest and platform engagement. However, motivations concerning astronomy might still exist together with the motivations for engaging with the citizen science platform, as well as their likely influence on active and/or passive participation. People who are highly motivated with astronomy might not be willing to engage with the citizen science aspect. Thus, investigating potential interactions between motivations for subject and platform engagement is a topic for future research.

While this study contributed to understanding the participation dynamics, motivations, actors, and interactions in general in citizen science platforms, other areas for future work could be further investigation of the role of hunters in ornithology citizen science platforms, as well as identifying similar roles which have the potential to harm the subject of the project in other citizen science platforms. Research would be valuable to understand how the use of data and information, as in the use of these by bird photographer or hunter roles in our cases, potentially threatens knowledge creation by affecting motivations in other fields of citizen science and online creation platforms in general.

Given that the motivations change over time for citizen scientists (Crowston & Fagnot, 2008; Curtis, 2018; Jackson et al., 2015), the change in motivations for the subject and for platform engagement and the relationship between these two types of motivations over the course of such change would be another topic of future research related to this study. An investigation of these two kinds of motivations in other fields of citizen science, especially different applications of motivations for the subject, is of interest for future research as well. Similarly, investigating these two kinds of motivations in different country settings would contribute to further understanding of the impact of contextual differences.



Investigation of the precedence of different drivers or motivations in Turkey and France will potentially provide further insights into the explanation of the country differences by considering the Citizen Science Platform Interactions Model (Figure 14). For instance, the case of Turkey might provide insights into the countries in which the community of the citizen science field in question is relatively smaller and younger. And the case of France might be insightful for other similar countries with larger and older communities in the field of citizen science in question. Thus, the Citizen Science Platform Interactions Model can further be tested as a future research avenue.



Another future research area is the investigation of the implications of motivations for bird photography regarding active and passive participation types, similar to what I did in Chapter 5. Such analysis would provide further insights into the relationship between motivations for the subject of the platform and active and passive participation. Similarly, investigating the relationships between other value offers and mechanisms of platforms to address negative externalities, besides competitions and protection of sensitive data, would provide further insights into the implications of value deals concerning active and passive participation.

As a final reflection, citizen science is a powerful tool to address the environmental and societal challenges that we face. Understanding the workings of citizen science platforms, their participants, specifically the needs and motivations of participants, as well as supporting these initiatives, are important steps for improving the existing fields and discovering promising areas of citizen science applications.

7 APPENDICES

Appendix A. Faune-France News Section, Invitation to Participate in Research Project

**LES NOUVELLES**


 Consulter

Les nouvelles

- Cartes de synthèse
- Les observations récentes
- Les dernières données rares
- Carte oiseaux rares
- Mon coin de nature
- Toutes mes données
- Consultation des données
- Les galeries sons et images
- Les cartes du moment
 - Aurore 2023
 - Bombyx versicolore 21-23
 - Cigogne blanche 2023

Vous souhaitez contribuer à une thèse ?

posté par Philippe Jourde 🕒 jeudi 14 octobre 2021, 14:20



Dans le cadre de sa thèse, Hazal Baytok souhaiterait échanger avec des utilisateurs de Faune-France. Pas besoin d'être dans le top ten des meilleurs contributeurs, au contraire. Que vous soyez un utilisateur occasionnel ou plus régulier, n'hésitez pas à [la contacter](#) pour contribuer à ses recherches sur les sciences participatives.

Les entretiens seront menés soit en anglais, soit en français, avec l'assistance de Nicolas Julien, son Directeur de thèse de l'IMT Atlantique.

Merci pour votre soutien.

Contact : hazal.baytok@imtbs-tsp.eu

Appendix B. News section of eKuşbank (eBird Turkey)

eKuşbank is a collaborative project between the Turkish Rare Birds Committee and Doğa Derneği.

COLLABORATORS



POWERED BY eBird TheCornellLab

SON HABERLER Hepsini Görüntüle



Kuş Gözlemcileri ve Fotoğrafçıları Motivasyon Araştırması

Tarafından Hazal Baytok | November 23, 2022

Paris-Saclay Üniversitesi'nde yürütülen bir doktora çalışmasına katkı sağlamak ister misiniz? Çalışmanın amacı, Türkiye'deki ve Fransa'daki kuş gözlemcilerinin ve fotoğrafçılarının motivasyonlarını ve kullandıkları platformları araştırmak.

Appendix C. The landing page of Trakuş displays the banner written "Ankete destek vermenizi dileriz" (We hope you will contribute to the survey)

Anasayfa | İletişim

TRAKUŞ

TÜRKİYE NİN AKADEMİKLERİ

KONYA

Kullanıcı Adınız: Enter

Beni unutma

Yeni Üyelik Sifremini Unuttum

Türkiye'nin Kuşları Forum FotoGaleri TürGaleri FotoForum Kuş Forum Sergi Gözlemler Haberler

Haberler

The Nature Conservancy 2022 Fotoğraf Yarışması'nın...

Gözlemler

İgökbulut, İSTANBUL » Ormanlı gözlemi

Ormanlı Gözlemidir....

Önceki Gözlemler

15.11, KOCAELİ gözlemi	12.11, ÇANAKKALE gözlemi	03.11, KONYA gözlemi
15.11, AYDIN gözlemi	10.11, ŞANLIURFA gözlemi	03.11, İSTANBUL gözlemi
12.11, BURDUR gözlemi	10.11, TRABZON gözlemi	30.10, ZONGULDAK gözlemi
12.11, İZMİR gözlemi	05.11, İSTANBUL gözlemi	30.10, İZMİR gözlemi

Gözlemler Günün gözlemi

ANKETE DESTEK VERMENİZİ DİLERİZ

Appendix D. The analytics of the tweet concerning the Turkish survey

× **Tweet Analytics**

paylaşırsanız harika olur❤️: telecombs.fra1.qualtrics.com/jfe/form/SV_6K...
[Show this thread](#)

❤️ 102	↻ 37	💬 30
-----------	---------	---------

Impressions ⓘ 30,792	Engagements ⓘ 1,018	Detail expands ⓘ 190
	New followers ⓘ 3	Profile visits ⓘ 412
	Link clicks ⓘ 244	

Appendix E. Faune-France news section showing the information about the survey

Soutenez la thèse d'Hazal en contribuant à une enquête sur Faune-France !

posté par Philippe Jourde 🌐 samedi 19 novembre 2022, 07:00



Dans le cadre de sa thèse de doctorat à l'Université Paris-Saclay, Hazal Baytok étudie les motivations des utilisateurs de plateformes de science citoyenne (en l'occurrence Faune-France et eBird-Turquie). Il s'agit d'analyser comment les portails d'observation des oiseaux sont utilisées, ainsi que les liens entre ces usages et les motivations des utilisateurs.

Faune-France vous invite donc chaleureusement à soutenir de nouveau le travail d'Hazal en remplissant [ce questionnaire](#).

Nous vous remercions de consacrer quelques minutes pour y répondre afin que les résultats intègrent au mieux votre perception des choses. Merci aussi de vous faire l'écho de cette enquête auprès des autres utilisateurs des outils VisioNature de votre connaissance.

IMPORTANT : vos réponses sont totalement confidentielles, anonymes, et seront exclusivement analysées par les chercheurs du projet. Elles seront uniquement traitées à des fins scientifiques, et les résultats de notre étude seront utiles à Faune-France et d'autres acteurs des sciences citoyennes et seront partagés avec la communauté Faune-France.

N'hésitez pas à contacter [Hazal](#) pour tout éventuel complément d'information.

Équipe du projet : Hazal BAYTOK (Université Paris-Saclay), Muge OZMAN (Institut Mines-Télécom Business School), Nicolas JULLIEN (IMT Atlantique).

Légende de la photo : Hazal vous remercie chaleureusement de contribuer à sa thèse et se réjouit déjà d'analyser toutes vos réponses à son enquête !

Appendix F. Faune-France news section displaying a reminder for the survey

Plus que quelques jours pour contribuer à une thèse

posté par Philippe Jourde 🕒 mardi 20 décembre 2022, 12:57



Dans le cadre de sa thèse de doctorat à l'Université Paris-Saclay, Hazal Baytok étudie les motivations des utilisateurs de plateformes de science citoyenne (en l'occurrence Faune-France et eBird-Turquie). Il s'agit d'analyser comment les portails d'observation des oiseaux sont utilisées, ainsi que les liens entre ces usages et les motivations des utilisateurs.

Faune-France vous invite donc chaleureusement à soutenir de nouveau le travail d'Hazal en remplissant [ce questionnaire](#).

Nous vous remercions de consacrer quelques minutes pour y répondre afin que les résultats intègrent au mieux votre perception des choses. Merci aussi de vous faire l'écho de cette enquête auprès des autres utilisateurs des outils VisioNature de votre connaissance.

IMPORTANT : vos réponses sont totalement confidentielles, anonymes, et seront exclusivement analysées par les chercheurs du projet. Elles seront uniquement traitées à des fins scientifiques, et les résultats de notre étude seront utiles à Faune-France et d'autres acteurs des sciences citoyennes et seront partagés avec la communauté Faune-France.

N'hésitez pas à contacter [Hazal](#) pour tout éventuel complément d'information.

Équipe du projet : Hazal BAYTOK (Université Paris-Saclay), Muge OZMAN (Institut Mines-Télécom Business School), Nicolas JULLIEN (IMT Atlantique).

Appendix G. Correlation matrix of 15 latent motivation variables for birdwatching (Faune-France)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	0.53	0.37	0.36	0.37	0.33	0.31	0.15	0.4	0.1	0.33	0.29	0.1	0.2	0.03
2	0.53	1	0.4	0.37	0.4	0.38	0.32	0.26	0.38	0.11	0.37	0.37	0.12	0.18	0.06
3	0.37	0.4	1	0.27	0.25	0.26	0.3	0.23	0.37	0.11	0.27	0.24	0.13	0.19	0.19
4	0.36	0.37	0.27	1	0.62	0.56	0.36	0.28	0.29	0.25	0.46	0.53	0.23	0.35	0.18
5	0.37	0.4	0.25	0.62	1	0.64	0.35	0.25	0.3	0.21	0.47	0.51	0.18	0.33	0.15
6	0.33	0.38	0.26	0.56	0.64	1	0.4	0.31	0.31	0.27	0.53	0.53	0.23	0.3	0.21
7	0.31	0.32	0.3	0.36	0.35	0.4	1	0.33	0.36	0.3	0.45	0.34	0.22	0.27	0.16
8	0.15	0.26	0.23	0.28	0.25	0.31	0.33	1	0.35	0.26	0.38	0.34	0.22	0.24	0.18
9	0.4	0.38	0.37	0.29	0.3	0.31	0.36	0.35	1	0.13	0.33	0.24	0.14	0.2	0.12
10	0.1	0.11	0.11	0.25	0.21	0.27	0.3	0.26	0.13	1	0.37	0.38	0.28	0.26	0.23
11	0.33	0.37	0.27	0.46	0.47	0.53	0.45	0.38	0.33	0.37	1	0.54	0.27	0.34	0.15
12	0.29	0.37	0.24	0.53	0.51	0.53	0.34	0.34	0.24	0.38	0.54	1	0.23	0.31	0.19
13	0.1	0.12	0.13	0.23	0.18	0.23	0.22	0.22	0.14	0.28	0.27	0.23	1	0.49	0.38
14	0.2	0.18	0.19	0.35	0.33	0.3	0.27	0.24	0.2	0.26	0.34	0.31	0.49	1	0.32
15	0.03	0.06	0.19	0.18	0.15	0.21	0.16	0.18	0.12	0.23	0.15	0.19	0.38	0.32	1

Appendix H. Correlation matrix of 15 latent motivation variables for engagement with the platform (Faune-France)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	0.29	0.25	0.21	0.24	0.31	0.23	0.22	0.24	0.16	0.13	0.26	0.09	0.12	0.13
2	0.29	1	0.29	0.41	0.44	0.45	0.34	0.33	0.38	0.3	0.07	0.44	0.26	0.27	0.29
3	0.25	0.29	1	0.15	0.1	0.15	0.19	0.19	0.12	0.06	0.06	0.15	0.08	0.08	0.07
4	0.21	0.41	0.15	1	0.61	0.58	0.26	0.28	0.28	0.41	0.22	0.38	0.41	0.38	0.39
5	0.24	0.44	0.1	0.61	1	0.63	0.31	0.32	0.39	0.37	0.09	0.45	0.27	0.32	0.32
6	0.31	0.45	0.15	0.58	0.63	1	0.36	0.35	0.41	0.44	0.14	0.48	0.34	0.36	0.36
7	0.23	0.34	0.19	0.26	0.31	0.36	1	0.49	0.54	0.37	0.08	0.44	0.14	0.18	0.15
8	0.22	0.33	0.19	0.28	0.32	0.35	0.49	1	0.55	0.3	0.09	0.39	0.14	0.15	0.17
9	0.24	0.38	0.12	0.28	0.39	0.41	0.54	0.55	1	0.37	0.09	0.47	0.18	0.20	0.19
10	0.16	0.3	0.06	0.41	0.37	0.44	0.37	0.3	0.37	1	0.27	0.45	0.25	0.31	0.27
11	0.13	0.07	0.06	0.22	0.09	0.14	0.08	0.09	0.09	0.27	1	0.12	0.23	0.20	0.18
12	0.26	0.44	0.15	0.38	0.45	0.48	0.44	0.39	0.47	0.45	0.12	1	0.2	0.28	0.23
13	0.09	0.26	0.08	0.41	0.27	0.34	0.14	0.14	0.18	0.25	0.23	0.2	1	0.41	0.61
14	0.12	0.27	0.08	0.38	0.32	0.36	0.18	0.15	0.2	0.31	0.2	0.28	0.41	1	0.39
15	0.13	0.29	0.07	0.39	0.32	0.36	0.15	0.17	0.19	0.27	0.18	0.23	0.61	0.39	1

Appendix I. Correlation matrix of 15 latent motivation variables for birdwatching (Turkey)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	0.41	0.41	0.13	0.25	0.32	0.31	0.27	0.18	0.17	0.27	0.25	0.01	0.02	0.03
2	0.41	1	0.37	0.37	0.35	0.34	0.31	0.31	0.19	0.15	0.29	0.31	0.16	0.15	0.17
3	0.41	0.37	1	0.16	0.25	0.21	0.24	0.23	0.24	0.06	0.24	0.19	0.20	0.14	0.19
4	0.13	0.37	0.16	1	0.53	0.62	0.28	0.25	0.21	0.33	0.34	0.48	0.45	0.40	0.31
5	0.25	0.35	0.25	0.53	1	0.68	0.33	0.28	0.16	0.26	0.39	0.50	0.35	0.27	0.30
6	0.32	0.34	0.21	0.62	0.68	1	0.38	0.41	0.20	0.33	0.41	0.60	0.40	0.27	0.19
7	0.31	0.31	0.24	0.28	0.33	0.38	1	0.35	0.20	0.20	0.36	0.31	0.24	0.28	0.23
8	0.27	0.31	0.23	0.25	0.28	0.41	0.35	1	0.26	0.20	0.31	0.29	0.25	0.12	0.11
9	0.18	0.19	0.24	0.21	0.16	0.20	0.20	0.26	1	0.14	0.29	0.21	0.26	0.13	0.14
10	0.17	0.15	0.06	0.33	0.26	0.33	0.20	0.20	0.14	1	0.34	0.50	0.26	0.37	0.24
11	0.27	0.29	0.24	0.34	0.39	0.41	0.36	0.31	0.29	0.34	1	0.37	0.24	0.23	0.20
12	0.25	0.31	0.19	0.48	0.50	0.60	0.31	0.29	0.21	0.50	0.37	1	0.30	0.30	0.26
13	0.01	0.16	0.20	0.45	0.35	0.40	0.24	0.25	0.26	0.26	0.24	0.30	1	0.59	0.45
14	0.02	0.15	0.14	0.40	0.27	0.27	0.28	0.12	0.13	0.37	0.23	0.30	0.59	1	0.48
15	0.03	0.17	0.19	0.31	0.30	0.19	0.23	0.11	0.14	0.24	0.20	0.26	0.45	0.48	1

Appendix J. Correlation matrix of 15 latent motivation variables for engagement with the platform (Faune-France)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	0.19	0.48	0.25	0.26	0.27	0.27	0.30	0.32	0.19	0.32	0.29	0.02	0.07	0.16
2	0.19	1	0.25	0.43	0.52	0.41	0.47	0.37	0.42	0.35	0.21	0.52	0.37	0.36	0.43
3	0.48	0.25	1	0.29	0.24	0.24	0.45	0.42	0.50	0.26	0.38	0.29	0.14	0.10	0.21
4	0.25	0.43	0.29	1	0.69	0.74	0.36	0.33	0.37	0.52	0.47	0.59	0.48	0.49	0.56
5	0.26	0.52	0.24	0.69	1	0.75	0.39	0.33	0.39	0.55	0.32	0.61	0.50	0.43	0.54
6	0.27	0.41	0.24	0.74	0.75	1	0.34	0.36	0.38	0.53	0.37	0.64	0.45	0.40	0.49
7	0.27	0.47	0.45	0.36	0.39	0.34	1	0.60	0.72	0.55	0.33	0.46	0.14	0.12	0.26
8	0.30	0.37	0.42	0.33	0.33	0.36	0.60	1	0.65	0.44	0.31	0.42	0.20	0.11	0.25
9	0.32	0.42	0.50	0.37	0.39	0.38	0.72	0.65	1	0.52	0.38	0.51	0.19	0.15	0.29
10	0.19	0.35	0.26	0.52	0.55	0.53	0.55	0.44	0.52	1	0.33	0.62	0.36	0.29	0.39
11	0.32	0.21	0.38	0.47	0.32	0.37	0.33	0.31	0.38	0.33	1	0.42	0.22	0.20	0.29
12	0.29	0.52	0.29	0.59	0.61	0.64	0.46	0.42	0.51	0.62	0.42	1	0.40	0.32	0.51
13	0.02	0.37	0.14	0.48	0.50	0.45	0.14	0.20	0.19	0.36	0.22	0.40	1	0.53	0.67
14	0.07	0.36	0.10	0.49	0.43	0.40	0.12	0.11	0.15	0.29	0.20	0.32	0.53	1	0.48
15	0.16	0.43	0.21	0.56	0.54	0.49	0.26	0.25	0.29	0.39	0.29	0.51	0.67	0.48	1

8 ANNEXES

ANNEX A. Interview Guide

1) Could you briefly introduce yourself?	
2) Could you tell me about your history with this platform?	
3) How did you discover this platform?	
4) How long have you been observing or photographing birds and other species? What does it mean for you?	
5) In your opinion, what are the reasons of people for observing and taking photographs of birds? What motivates you? What motivates them?	<ul style="list-style-type: none"> a) Do you observe any differences in these motivations between France/Turkey and other countries? (if you had a chance to observe) b) Do you think people who observe birds and people who observe other species have different reasons, motivations? c) Why do you think birds are more popular?
6) In your opinion, is there a difference between a birdwatcher and a bird photographer?	<ul style="list-style-type: none"> a) If yes, what is the difference? b) Is there a difference in their motivations?
7) Why, do you think, people share their observations and the photos they take on this platform? Why do you share?	<ul style="list-style-type: none"> a) Do you know people who choose not to share their observations on this platform? b) If yes, do you know the reasons?
8) Do you use other different platforms to share observations and photographs?	a) How would you describe the difference between faune-france and others?
9) Do you think the political environment in France/Turkey and political issues have an impact on nature observers?	a) Do you think of any examples?

10) Do you or other people in the community check and correct the observations entered which are suspicious?	a) If yes, how do you report?
11) What are your future plans about birdwatching and photographing?	
Additional Questions for People in Coordinator Positions	
1) Could you tell me about the governance and management of this platform? How does it work?	a) Are there volunteers? b) Are there people working full time?
2) Are there different membership types?	
3) Do members have different roles and responsibilities?	
4) What can you tell us about the platform from the beginning until today? How did it start? What changed?	
5) What is the business model of this platform?	

ANNEX B. Codebook of Interview Analysis

Context / Platforms

Platform general
Interaction through the platform
Interaction inside the community
Interface design of the website/app
Other platforms used
eBird in FR
Economic factors
Collaborations
Event
Governance, rules
Platform response
Technological features of the platform app or website
Filters
Non-scientific publication
Trust in the community
Trust in the platform
Forecast for bird migration
Volunteers – skilled
Faune-france
Ornitho family
Checklists
Connected platforms
Data
Future
Governance
History
Participants

Faune-France usage in FR
Use of datasets
LPO
NaturaList app
national museum of natural history
oiseaux des jardins
SHOC STOC
Biolovision
Data verification – volunteer validators
eKuşbank (eBird Turkey)
Birdlife international
eBird TR history
Merlin app
Turkish Bird Records Committee
Data verification in eBird
Trakuş
Species Identification Committee
Trakus founder
Trakus governance
Trakus history
Need of info resource in Turkey
Platform comparisons
Difference between Trakus eBird
eBird Faune-France comparison
Rivalry Trakus eBird
Similarity between trakus ebird
Country
Birdwatching in Europe
Birdwatching in FR

Birdwatching in TR
Data entry in Europe
Data entry in Turkey
Difference – FR other countries

Roles / Actors

Roles
Birdwatchers
Photographers
Hunter similarity
Hunter
Hunting
Similarity photographer – birdwatcher
Similarity fishing
Switching from hunting
Switching to birdwatching
Switching to observing animals/species
Switching to photography
Difference – naturalists birdwatchers
Difference photographer – birdwatcher
Only birds

Motivations / Drivers / Negative Externalities

Motivations – Photograph
Aesthetic concerns
Best photo

Exhibition
Learn about photography
For documentation
Capturing a uniqueness
Photographing the highest number of species
Sell photo
Taking photo – rare species
Taking photo as a memory
Trophy
Show best photos / portfolio
Photo spontaneous
Motivations – Birdwatching
Parents' interest
Beauty of nature and birds
Being occupied with a living being
Curiosity about birds
Escape from city
Seeing different species
Seeing rare species
Seeing the highest number of species
Travel
Family activity/kids
Feeling of joy
Motivations – Platform engagement
Sharing for reciprocity
Asking the species
Co-creation of knowledge
Following entries of others
Help the people who work on environment

Record keeping
Record keeping for myself
Record keeping for others
Scientific contribution
Scientific reasons
See results of their contribution
Share their knowledge
Show off
Socialising
Taking photo for defining – proof
Learn about birds
Learn about locations of different species
Learn about locations to observe birds
Learn about species
Educating other people
Encouraging other people
Facilitate the lives of the birds
Sharing rare birds
Sharing the beauty of birds
Sharing with friends and family
Motivations – Common
Being appreciated
Being famous
Childhood
Competition
Getting recognition
Meeting with likeminded people
Protecting birds
Protection of nature

Protection of species
Spending time with kids
Negative externalities
Intentional false entry
Unintentional false entry
Criticisms to birdwatchers
Criticisms to bird photographers
Not sharing
Being too busy
Interpersonal dispute
To limit screen time
Banned due to ethical reasons
Desire to disconnect from technology
Desire to keep specialisation
Enter data but hide
Exceeding satisfaction point
It's my victory
Political reasons
Not competent to identify birds
Interrupts birdwatching
Not want to be questioned
Plagiarism
Rare species
Share on another database
Technology illiteracy
To protect the species
Apathy/too lazy to enter data
Unawareness of the platform
Not sharing data

Not sharing photograph
Common species
Interrupts joy
Takes too much time
Unaware of the importance of data
Not taking photograph
Internet connection

ANNEX C. Ordinal Logistic Regression Models

Ordinal Logistic Regression Models for Models 1-4

	Dependent variable: Active Participation		Dependent variable: Passive Participation	
	Model 1 (H1b, H2)	Model 2 (H3a)	Model 3 (H1a, H1c)	Model 4 (H3b)
	z values and std. errors			
Birdwatching integrated motivation	2.00* (0.09)	0.24 (0.18)	5.06*** (0.09)	0.86 (0.18)
Platform engagement integrated motivation	8.21*** (0.08)	1.51 (0.28)	4.14*** (0.07)	-0.59 (0.27)
Birdwatching integrated motivation * platform engagement integrated motivation		0.85 (0.06)		1.76 . (0.06)
Age	1.89 . (0.04)	1.95. (0.04)	-0.42 (0.03)	-0.30 (0.03)
Male (ref: others)	3.85*** (0.15)	3.81*** (0.15)	3.46*** (0.14)	3.38*** (0.14)
France (ref: Turkey)	5.10*** (0.16)	5.16*** (0.16)	1.49 (0.14)	1.84 . (0.15)
Likelihood Ratio Chisq	229.99***	232.25***	120.37***	123.47***
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				
	odds ratios			
Birdwatching integrated motivation	1.19	1.04	1.54	1.17
Platform engagement integrated motivation	1.91	1.52	1.35	0.85
Birdwatching integrated motivation * platform engagement integrated motivation		1.05		1.11
Age	1.07	1.07	0.99	0.99
Male (ref: others)	1.77	1.76	1.63	1.61
France (ref: Turkey)	2.24	2.31	1.24	1.31

Ordinal Logistic Regression Models for Models 5-10

	Dependent variable: Active Participation			Dependent variable: Passive Participation		
	H4a, H4b			H4c		
	Model 5 FR	Model 6 EB	Model 7 TK	Model 8 FR	Model 9 EB	Model 10 TK
	z values and std. errors					
Protection	-0.79 (0.06)	2.70** (0.13)	2.02* (0.13)	-1.86 . (0.06)	3.21** (0.14)	2.81 (0.13)**
Competition	4.20*** (0.08)	-1.27 (0.15)	-1.01 (0.14)	2.86** (0.07)	-1.08 (0.15)	-2.35 (0.14)*
Age	1.14 (0.04)	-1.93 . (0.11)	4.08*** (0.11)	-0.99 (0.04)	-2.52* (0.12)	2.30 (0.11)*
Male	3.41*** (0.20)	2.05* (0.37)	1.90 . (0.36)	3.24*** (0.18)	1.05 (0.37)	2.01 (0.35)*
Likelihood Ratio Chisq	34.55***	12.586*	28.495***	25.335***	16.362**	21.198***
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1						
	odds ratios					
Protection	0.95	1.42	1.29	0.90	1.55	1.43
Competition	1.37	0.83	0.87	1.22	0.85	0.72
Age	1.05	0.80	1.59	0.96	0.75	1.29
Male	1.97	2.13	1.99	1.77	1.47	2.03

ANNEX D. Results of Brant Tests

Brant Test for Ordinal Logistic Regression Models 1-4

	Model 1			Model 2			Model 3			Model 4		
Test for	X2	df	probability	X2	df	probability	X2	df	probability	X2	df	probability
Omnibus	69.72	5	0	69.14	6	0	35.56	5	0	36.7	6	0
Birdwatching integ. motiv.	2.01	1	0.16	0.14	1	0.71	1.08	1	0.3	0.04	1	0.84
Platform engagement integ. motiv.	0.39	1	0.53	0	1	0.99	0.2	1	0.65	0.19	1	0.66
Birdwatching integ. motiv. * platform engagement integ. motiv.				0.02	1	0.88				0.22	1	0.64
Age	0.06	1	0.8	0.07	1	0.79	4.67	1	0.03	4.53	1	0.03
Male (ref: others)	5.45	1	0.02	5.45	1	0.02	1.21	1	0.27	1.29	1	0.26
France (ref: Turkey)	58.79	1	0	56.66	1	0	23.48	1	0	22.38	1	0

Brant Test for Ordinal Logistic Regression Models 5, 6, 7

Test for	Model 5 FR			Model 6 EB			Model 7 TK		
	X2	df	probability	X2	df	probability	X2	df	probability
Omnibus	5.93	4	0.2	9.5	4	0.05	3.09	4	0.54
Protection	1.54	1	0.22	2.69	1	0.1	0.29	1	0.59
Competition	2.18	1	0.14	0.25	1	0.62	1.23	1	0.27
Age	0.05	1	0.82	3.89	1	0.05	0.93	1	0.33
Male	1.74	1	0.19	0.8	1	0.37	0.73	1	0.39

Brant Test for Ordinal Logistic Regression Models 8, 9, 10

Test for	Model 8 FR			Model 9 EB			Model 10 TK		
	X2	df	probability	X2	df	probability	X2	df	probability
Omnibus	15.29	4	0	14.8	4	0.01	7.15	4	0.13
Protection	3.85	1	0.05	9.54	1	0	2.64	1	0.1
Competition	0.18	1	0.67	0.01	1	0.93	3.22	1	0.07
Age	10.96	1	0	1.44	1	0.23	0.75	1	0.38
Male	0.39	1	0.53	1.83	1	0.18	1.3	1	0.25

ANNEX E. Variance Inflation Factors

Variance Inflation Factor for Ordinal Logistic Regression Models 1-4

	VIF Model 1	VIF Model 2	VIF Model 3	VIF Model 4
Birdwatching integ. motiv.	1.359179	5.563331	1.379414	6.044878
Platform engagement integ. motiv.	1.439437	17.983343	1.480001	20.74686
Birdwatching integ. motiv. * platform engagement integ. motiv.		29.49652		33.9226
Age	1.035042	1.03979	1.047055	1.051226
Gender	1.003823	1.006379	1.005253	1.007129
Country	1.098776	1.157016	1.11159	1.16735

Variance Inflation Factors for Ordinal Logistic Regression Models 5-10

	VIF Model 5 FR	VIF Model 6 EB	VIF Model 7 TK	VIF Model 8 FR	VIF Model 9 EB	VIF Model 10 TK
Protection	1.01121	1.082281	1.120334	1.010449	1.052452	1.116348
Competition	1.007982	1.071172	1.119641	1.008109	1.045626	1.108791
Age	1.000309	1.040245	1.022876	1.000588	1.04296	1.03224
Gender	1.01095	1.075766	1.047811	1.011584	1.054771	1.052098

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