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KWR

REACHING NEW CITIZEN SCIENTISTS

A study on the influence of motives on participation in citizen science projects

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Abstract

Current environmental challenges form huge threats for conservation biology, natural resource management and environmental protection. Citizen science can be an effective tool for dealing with these threats. Citizen science is the participation of the public in the generation of new scientific knowledge. Through increasing scientific knowledge and better engaging the citizens in public action, citizen science can deal with these threats. By engaging more citizens, more data can be generated, and more options of solutions can be found. Motives to participate and not participate play a central role when wanting to attract more non-participants. By addressing the motives of the non-participants, through communication methods, as invitations, they will be faster inclined to participate. Moreover, recommendations are sought to enhance the participation. To uncover these motives and recommendations an explorative research is executed to propose an answer on the following questions: '*What motives determine the intention to participate or not participate in citizen science? And what recommendations enhance the intention to participate in citizen science?*'.

An explorative inductive qualitative research was carried out. 24 semi-structured interviews were conducted with citizens who were not involved with citizen science. Through NVivo the results were coded and analysed. Three relevant motives to participate and not participate emerged from the results which enhances the intention to participate. The first motive was *sense of urgency*, where more attention is to be given to the specific risks involved and a clearer understanding of the projects' goal. Emphasis on the sense of urgency is required for citizens to feel more addressed. The second motive that citizens are more likely to participate when the *information meeting* is nearby the citizens residential area or instead of a meeting an informative video can be used. Thirdly, people are more inclined to participate when the *activity* of the project is *organised close* to the citizens residential area. If these motives to participate and not participate are addressed this can enhance the intention to participate.

Based on these results and other gathered data recommendations were formulated, which enhances the intention to participate. These are organised in six components. The first two recommendations are on how to make the project more *accessible* and to provide *feedback of results* to the respondents when the project is completed. The following four recommendations are composed of four main themes: *improvin*g of *the content of invitation, increasing the fun factor, increasing triggers* and *improving the visibility and promotion.*

Executive summary

This research identifies what motives enhances the intention to participate and not participate in citizen science and provides recommendations which increases the chances of participating. Citizen science refers to the participation of the public in the generation of new scientific knowledge. It functions as an effective tool to deal with environmental challenges as; the degradation of earth's biological and physical systems by the hand of men, urbanization, deforestation, land conversion to agriculture and climate change which threatens the existence of many species. Citizen science established this through two manners. The first one is that citizen science allows for data generation which otherwise could not be generated because for example of scale. More scientific knowledge can be obtained for science in general. The second manner is that citizen science involves people in forming policies and stimulating public action. By involving more citizens, more data is generated, more public action is established, which encourages better and more problem solving in environmental challenges. However, to reach more participants the motives of the non-participants/potential participants is researched. The motives which increases the intention to participate can be used in such a way to attract more citizens, through communication methods, as invitations. If citizen motives and needs are considered and addressed, they are more likely to participate.

The respondents mentioned several motives which enhances the intention to participate and not participate. The three most frequent mentioned motives are presented here. The first mentioned motive was *sense of urgency*. More emphasis on the sense of urgency is to be given and particularly more attention to the specific risks involved of the citizens science project and a clear goal is advised. An example of a risk is a citizen science project about lead. This project states that children up to six years old and unborn babies were the most sensitive for lead, but no mention of the exact risks were given and what this meant for people who were not in this target group. More emphasis on the sense of urgency is required for citizens to feel addressed. The second motive is about the desire of the *information meeting* to be in the neighbourhood of citizens or instead of a meeting the use of an informative video is advised. Thirdly, citizens were more inclined to participate when the activity of the project is organised closer to the citizens residential area. Another suggestion was to make it more tempting to gather in different neighbourhoods and then travel together to the location of the activity. Addressing these motives to participate and not participate can enhance the intention to participate.

Based on the results and other gathered data, recommendations were formulated which enhances the intention to participate. These are organised in six components. The first two recommendations are making the project more *accessible* and providing *feedback of results* to the respondents when the project is completed. The following four are composed of four main themes. The first main theme is improving *the content of invitation,* with four sub recommendations: *Continuation steps, know your target group, explanation of organisations, terms and abbreviations involved* and *more emphasis on urgency.* The recommendations of the second main theme are based on *increasing the fun factor*, consisting of: *Making it a group activity, making it a competition, organising an event* and *giving a reward in the form of a free walk or discount.* Recommendations on *increasing triggers* is the third main theme, which includes more emphasis on *enthusiasm* and *visualisation*. The last main theme is more focused on how to make citizen science projects *more visible and better promotion.* The fourth main theme consists of difference sub recommendations: *Promotion during the activity, promoting at schools and universities, involve companies* and *large scale approach promotion (Facebook).* Which motives and recommendations are applied to a project, depends on the type of citizen science project.

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1. Introduction

The complicatedness of current environmental issues form a considerable threat in the fields of conservation biology, natural resource management and environmental protection (McKinley et al., 2017). Threats such as the degradation of earth's biological and physical systems by the hand of men, urbanisation, deforestation, land conversion to agriculture and climate change endangers the existence of many species (McKinley et al., 2017). An effective tool to deal with these threats is citizen science (McKinley et al., 2017). Citizen science is the participation of the public in the generation of new scientific knowledge (Buytaert et al., 2014) and citizen science can attack these environmental challenges through two manners. The first manner (1) allows the people to practice science which otherwise was not possible to execute because of scale and for other practical reasons and (2) better engaging the public in helping to make decisions (McKinley et al., 2017). The first manner focuses on obtaining scientific knowledge by volunteers for conservation scientists, natural resource and environmental managers, and other decisionmakers. The second way encourages public input and engagement in natural resource and environmental management and policymaking. So, volunteers can directly contribute input into decisions. Citizen science projects can use one manner or both simultaneously to obtain results. To summarise, citizen science can identify problems and produce data through these manners and can help to improve the current challenges through; public policy formulation; strengthen public input into policymaking; help government agencies and other organisations implement policies; and help in enforcing laws and regulations pertaining to conservation, natural resources, and the environment (McKinley et al., 2017). Hence, by engaging more people, citizen science can play a prevalent role in the search towards viable solutions for tackling environmental challenges.

One of the first citizen science projects was the Christmas Bird Count project. Since 1900 this project has been executed yearly by the National Audubon Society in the USA, which involves currently about 60,000 to 80,0000 volunteers counting birds on a yearly base (Silvertown, 2009; Cohn, 2008). Disciplines and domains where the involvement of citizen science can have a positive influence are among others: invasive species, ecological restoration, water quality monitoring, population ecology and monitoring of all kinds (Silvertown, 2009). Citizen science can have a positive influence since it '*allows scientists to gather data on a larger geographic scale and over a longer time period than is possible in more traditional scientific research*' (Cohn, 2008, p.193).

The last ten years citizen science underwent a tremendous growth (McKinley et al., 2017), induced by four causes of which three were mentioned by Silvertown (2009) and one by Tweddle, Robinson, Pocock and Roy (2012). The first one is the development of information and communication technologies (ICT) to benefit from the disperse of information about possible projects and new methods to obtain data from participants (Silvertown, 2009)(Buytaert et al., 2014). Secondly, nowadays experienced scientists are increasingly aware that challenges in the aforementioned problems are large-scale environmental challenges that can benefit from citizen science. Among others, participants of citizen science (also known as citizen scientists) can offer a free source of labour, competences and calculation skills. The third cause is the fact that large research funders increasingly set new rules where each grant holder must initiate project-related science outreach. Hereby, involvement of the public is required, so they would better comprehend and accept science. The fourth cause is discussed by Tweddle et al. (2012), where he stated that '*technological developments are revolutionising citizen science*' (p. 16). Meaning that measurement tools, such as apps and sensors, support the development of citizen science.

Designing a citizen science project can take a lot of time and effort, and must be thought through well (Gura, 2013). When a citizen science project is clearly constructed, executed and evaluated, a project can contribute to science, produce high-quality data similar with conventional science, and support problem solving (McKinley et al., 2017). As said, numerous types of projects can benefit from citizen science, however it is important to match the need for science and public involvement with the right type of citizen science project and the right method of public participation (McKinley et al., 2017). Motives of citizen scientists to join projects should be taken into account when choosing the right communication method, as recruiting messages, to approach them (Lee, Crowston, Harandi, Østerlund, & Miller, 2018). Therefore, motives play a central role in this research. An understanding of the motives of citizen scientists is required for the proper execution and diffusion of citizen science projects (Wright, Underhill, Keene, & Knight, 2015).

Comprehensive research has already been executed identifying motives for enrolment and participation in different citizen science projects (e.g. Curtis, 2015; Kaufman, Flanagan, & Punjasthitkul, 2016; Raddick et al., 2013; Reed, Raddick, Lardner & Carney, 2013; Rotman et al., 2012). Discovered and frequently mentioned motives of citizens are for example; contributing to scientific research (Raddick et al., 2013), communication with their community (network) and an interest in science (Curtis, 2015). This research also takes the motives to participate in account to see if they are all covered and to obtain a complete overview of the motives.

However, very little research has been done on uncovering the motives for non-participants (citizens who are not involved in citizen science projects). Two studies were found. The first one is the article of Glynn, Brickman, Armstrong, & Taasoobshirazi (2011), who identified several motives for why people who were asked to participate did not engage in the projects, some said that they: 'did not have time', 'had a conflict', 'lost the announcement', or 'forgot'. Another study found that a motive of non-participants could be that they were 'survey fatigue', meaning that volunteers did not want to participate in any more projects of similar topics (Geoghegan, 2016). In addition to these previous scientific articles, this research will also focus on non-participants who are not yet approached and involved in citizen science, but potentially could be. Discovering the motives of non-participants can lead to an increase in citizen scientists, since future citizen science projects can be adjusted in a way that can meet the needs of these non-participants. In addition to the search of motives a search towards recommendations that will enhance the degree of participation in citizen science projects will be conducted. Therefore, taking these two research subjects into account, the aim of this research is to answer the following research questions:

What motives determine the intention to participate or not participate in citizen science? And what recommendations enhance the intention to participate in citizen science?

The scientific relevance is twofold. The first part of the research question will contribute to academic literature by providing insights on motives of non-participants of citizen science, because little prior literature addresses this concern. One exception is the article of Glynn et al. (2011), which mentioned a few motives for non-participants (see previous paragraph), but does not further elaborate them. Although much has been written about motives of participants (Nov, Arazy & Anderson, 2011, 2014; Phillips, Ballard, Lewenstein, & Bonney, 2019), motives of non-participants still remains a research gap in the literature. Therefore, this study will contribute to this research gap by uncovering motives of non-participants and therewith contributing to a complete overview of motives of both participants and non-participants. Secondly, the second part of the research question focuses on providing recommendations

on future citizen science projects to reach more potential participants. The scientific relevance is added because no prior research has been conducted on discovering this.

The social relevance encompasses of two components. Firstly, the discovered motives for non-participants can be used to better address the needs of non-participants. By addressing these needs better, more potential participants can be reached through communication methods. By involving more citizens, citizen science can offer solutions which can produce better environmental and social outcomes, helping to increase the impact of research and innovation (McKinley et al., 2017). Two important contributions can be identified when more participation of citizen scientists is realised. The first one is that they can add knowledge which other parties cannot add, namely the perspective of the citizen. Citizen scientists produce other knowledge, while they have other experiences compared to scientists. Thus, citizen science broadens the perspective and sheds other light on large issues and adds with this an important value to problem solving. The second contribution is that (potential) citizen scientists are present in large numbers. Since citizen science allows for a lot of people to collect or analyse data, the greater the chance that something relevant is found. Secondly, the social relevance is addressed as research parties (such as KWR) can get non-participants on board for their citizen science projects through this research.

The focus of this research will be on citizen science in the water sector. Monitoring water quality can be a complicated challenge (Muenich et al., 2016). Many water initiatives or organisations who face this challenge turn to citizen science to involve the public and obtain a large amount of input which tries to reduce the concerned problem (Muenich et al., 2016). An example of research conducted is detecting lead water pipes in houses (Brouwer & Hessels, 2019). KWR Water Cycle Research Institute is an organisation aimed to increase the water quality, which will be the organisation for which this research will be executed.

To answer the research questions, several steps were taken. In the following chapter the theory (chapter 2) is elaborated on, wherein the different concepts of citizen science, motives to participate and demographic characteristics are discussed. These concepts are combined into a conceptual model, which supports the process of answering the research questions. Then, the methodology (chapter 3) is introduced and this section explains how the research is conducted in practice. Data extracted from the steps from the methodology is explained in detail in the results chapter (chapter 4). Then, in the discussion chapter (chapter 5) theoretical implications and limitations are discussed. Ending with the conclusion (chapter 6) which gives a summarised answer on the research questions.

2. Theory

This chapter explains the theories and concepts used to answer the research questions. The first part (2.1) will elaborate on the theory of citizen science, the clarification of degree of participation and some challenges associated with citizen science. These concepts are discussed to get a better overview and a better understanding of them, which is useful for the rest of the research. The second part (2.2) presents an overview of the motives for participating in citizen science projects present in the current literature. At the end of this part, a motive framework is shown existing from the different motive frameworks, which will form the base of the conceptual model. In the third part (2.3), four demographic characteristics are presented, which are needed for structuring the data and to see if connections can be found between them and motives to participate or to not participate. In the fourth part (2.4) the theories and concepts will be connected into a conceptual model.

2.1 Citizen science

Citizen science is a democratizing form of science, because knowledge and experience are shared between scientists and non-scientists (Conrad & Hilchey, 2011). Citizen science strives towards two objectives: scientific output and scientific outreach (Bonney & Ballard et al., 2009). Scientific output addresses the output in the form of scientific articles on citizen science in peer-reviewed journals, which have increased significantly in the last decades (Bonney & Ballard et al., 2009). This shows that citizen science plays a larger role in scientific research nowadays (Catlin-Groves, 2012). At the same time, scientific outreach is focused on people and their interaction with science and the learning processes concerning science (educational function) (Bonney & Ballard et al., 2009). Moreover, citizen science accounts for multiple advantages for society, local ecosystems and scientists, including: increasing environmental democracy, social capital, advantages to government, and advantages to ecosystems being monitored (Conrad & Hilchey, 2011).

2.1.1 Degree of participation

The degree of participation is defined according to Shirk et al. (p. 4, 2012) as '*the extent to which individuals are involved in the process of scientific research*.' Degree of participation can be quantified in different measurements. Differences in degree of participation lead to distinct results when comparing studies. Degree of participation can be measured in terms of duration of involvement; research effort, number of participants and/or diversity of participants, the depth/intensity of involvement in the process, or the power that participants have over the processes in which they engage (Shirk et al., 2012). This research is focused on the number of participants, because it is studied on how to get more participants in citizen science projects and how the degree of participation can be increased through motives. Moreover, it is said that increases in degree of participation can lead to a broader range of possible results (Shirk et al., 2012).

Citizen science can have different project designs. Various relationships between different degree of participation and projects designs can be found in scientific literature. The projects design indicate different levels of engagement of the public in science. Bonney & Ballard et al. (2009) distinguish three types of citizen science projects designs: contributory, collaborative and co-created. They differ in degree of the involvement of the public. In contributory projects participants only help in the data collection part of the research. The second type of project are collaborative projects where the public contributes to the data collection, help refine the project design and analyse data. Co-created projects involve the public by letting them participate in almost every phase of the citizen science

project process. In this research the contributory project design is used, since this is the most accessible design for participants. This made it easier to find data (ask respondents), which increased the quality of the data.

2.1.2 General challenges citizen science

Although citizen science offers an alternative way of knowledge generation and multiple advantages, a number of challenges are implicated. Frequently mentioned challenges are data quality and recruitment (Irwin, 2018; McKinley et al., 2017; Gura, 2013). Citizen scientists can deviate from the standard protocol, which leads to differences in collected data compared to the collected data of the scientist. Moreover, two challenges arise from the recruitment phase: 1) more scientists should be involved with citizen science; 2) scientists should gather more participants to engage in citizen science projects. Irwin (2018) mentions that a great number of participants can be gathered for a short-term project, but only a few engaged participants for a long-term project. Martin Brocklehurst, an environmental consultant and citizen science advocate, claims that: '*Too much of citizen science is like a fireworks display: it's great science, but it's short-lived. We need to start embedding it into the routine way that we do science to support the policy-making process*' (Irwin, 2018, p. 482). Some claim that the ultimate goal of citizen science is to be embedded in science institutions and that it becomes common practice. However, this is not done overnight, and it will take time to engage more participants. The first steps towards this goal is to discover how the people can be persuaded to cooperate with citizen science projects. This will require certain incentives which might increase the degree of participation, these incentives can be in the form of certain motives, elaborated on in the following section.

2.2 Motives to participate

An important and much discussed aspect of citizen science is the motives of citizen scientists to participate. To be able to understand why a part of the public does not want to participate in citizen science projects, theory of motives of participants should be comprehended first. Therefore, this section presents a literature review on what scholars wrote concerning motives for the public to participate in projects. Some theories are particular focused on motives of people to join in volunteers projects in general and others are aimed on citizen science projects in specific. This will be indicated in the paragraphs. The order of the frameworks of motives to participate is based on increasing year of publication of the article from scholars.

2.2.1 Klandermans (1997)

The first theoretical framework that is discussed here is of Klandermans (1997), who came up with a framework which provides explanations of voluntary participation of social movements. He proposed four categories which elaborate on the motives of participating volunteers:
1) Collective motives (associated with the importance one attributes to the collective goals of the movement).
2) Norm-oriented motives (expectations regarding the reactions of important others, such as friends, family or colleagues).
3) Reward motives (benefits such as gaining reputation, or making new friends).
4) Identification (identification with the group, and following its norms).

2.2.2 Ryan and Deci (2000)

Ryan and Deci (2000) proposed a new theory in their article which is called: Self-Determination Theory (SDT). The main elements are two types of motives depended upon diverse reasons or aims that results into an action. The two types where they shine their light upon are: intrinsic and extrinsic motives. According to these scholars, intrinsic motivation refers to '*doing something because it is inherently interesting or enjoyable*' (p. 55) and extrinsic motivation refers to '*doing something because it leads to a separable outcome*' (p. 55). Within intrinsic stimulating activities it was said that the activity itself was found rewarding, such as participating for the enjoyment or out of interests. Research found that the quality of experience and performance can differ when a distinction is made between the two motives. Moreover, motives are relevant when people were to be moved to take part in a certain activity. They also came up with a taxonomy of human motives, where the two types were distinguished and elaborated on:

1) Intrinsic motive (Internal); a prototype of self-determined activity.
    a. Interest/enjoyment
    b. Inherent satisfaction
2) Extrinsic motive; integration occurs when identified regulations have been fully assimilated to the self. This occurs through self-examination and bringing new regulations into congruence with one's other values and needs.
    a. Integration (Internal)
        i. Hierarchal synthesis of goals
        ii. Congruence
    b. Identification (Somewhat internal); a person who has itself identified with the personal importance of a behaviour and has thus accepted its regulation as his or her own.
        i. Conscious valuing of activity
        ii. Self-endorsement of goals
    c. Introjection regulation (Somewhat external); describes a type of internal regulation that is still quite controlling because people perform such actions with the feeling of pressure in order to avoid guilt or anxiety or to attain ego-enhancements or pride.
        i. Ego involvement
        ii. Focus on approval from self or others
    d. External regulation (External); such behaviours are performed to satisfy an external demand or obtain an externally imposed reward contingency.
        i. Saliance of extrinsic rewards or publishments
        ii. Compliance/Reactance

2.2.3 Van Den Berg, Dann and Dirkx (2009)

A summary of multiple categories of motives for volunteers is given by Van Den Berg, Dann and Dirkx (2009). These categories arose from reviewing numerous studies about volunteerism. Categories found were:
- Altruism
- Ideological
- Egoistic
- Material/reward
- Status/reward
- Social relationship

- Leisure time
- Personal growth

This article also states that at first volunteers start participating because of the desire to help others, doing good for society or meeting new friends. In later phases the motives of more experienced volunteers shift from the initial desires to a more robust motive where the volunteers feel more committed towards the volunteering organisation.

2.2.4 Raddick et al. (2010)

A framework of motives for citizens scientists was found in this article. Raddick et al. (2010) propose twelve motives categories adjusted to their citizen science study on the Galaxy Zoo, where people were asked to join a citizen science research by classifying galaxies. At least 200,000 volunteers made more than 100 galaxy classifications. The identified motives together with their description were:
- Contribute: I am excited to contribute to original scientific research.
- Learning: I find the site and forums helpful in learning about astronomy.
- Discovery: I can look at galaxies that few people have seen before.
- Community: I can meet other people with similar interests.
- Teaching: I find Galaxy Zoo to be a useful resource for teaching other people.
- Beauty: I enjoy looking at the beautiful galaxy images.
- Fun: I had a lot of fun categorising the galaxies.
- Vastness: I am amazed by the vast scale of the universe.
- Helping: I am happy to help.
- Zoo: I am interested in the Galaxy Zoo project.
- Astronomy: I am interested in astronomy.
- Science: I am interested in science.

Several motivations are for this specific citizen science project, such as: beauty, vastness and astronomy. Other motives can be applied on citizen science projects in general.

2.2.5 Nov, Arazy and Anderson (2011, 2014)

The article of Nov, Arazy and Anderson (2011, 2014) used the framework of Klandermans of four categories with adjustments and additions of scholars from 2003 and 2009 (Hertel, Niedner, Herrmann, 2003; Schroer & Hertel, 2009), who proposed an addition of a fifth category. This led to the introduction of a hedonistic or intrinsic motive; operationalised as the enjoyment associated with participation in the project in studies of participation. Additionally, Nov et al. (2011) added suggestions of other authors from 2002 and 2006 (Butler et al., 2002; Roberts et al., 2006) who divided the reward motives in two sub-categories, because the reward motives encompassed a too wide range. These motives are referred to as community reputation benefits and social interaction benefits. Taking these adjustments into account an improved framework is proposed:
1) Collective motives (associated with the importance one attributes to the collective goals of the movement).
2) Norm-oriented motives (expectations regarding the reactions of important others, such as friends, family or colleagues).
3) Reward motives (benefits such as gaining reputation, or making new friends).
   a. Community reputation benefits
   b. Social interaction benefits
4) Identification (identification with the group, and following its norms).

5) A hedonistic or intrinsic motive (operationalised as the enjoyment associated with participation in the project in studies of participation).

This framework can be applied on different citizen science projects, as Nov et al. (2011) demonstrated in their article.

2.2.6 Rotman et al. (2012) and Batson et al. (2002)

The general framework used in this paragraph is based on Batson, Ahmad and Tsang (2002), who identified four motives as reasons for community involvement. Rotman et al. (2012) used this categories and applied it on a citizen science project. Her framework elaborated on motives factors which influences the degree of participation in citizen science projects. The four motives categories of participation, which Batson et al., (2002) used are:
1) Egoism; addresses the motives that refers to someone's own welfare.
2) Altruism; concerns the increase in welfare of others.
3) Collectivism; addresses to increase the welfare of a group.
4) Principlism; involves motives related to support a moral principle (e.g. justice, equality, caring for the environment).

Furthermore, two crucial moments in volunteer's participation are greatly influenced by motives: the initial motivation to participate and the motivation to stay involved (Mueller & Tippins, 2012; Rotman et al., 2012). Rotman et al. (2012) affirmed that egoism was the most important motivational category at the initial phases of participation, and to stay involved collectivism and altruism were the key. So, it is important to stimulate the citizen scientists with the focus on the right motives to keep them committed.

2.2.7 Tiago et al. (2017)

Another categorisation of motives is introduced by Tiago et al. (2017), which is called the Intrinsic Motivation Inventory (IMI). The IMI used in this article is an alteration of the IMI of McAuley, Duncan & Tammen (1989) with an adaption of Tiago et al. (2017) to better relate to citizen science projects. Seven categories are suggested:
1) Interest/Enjoyment
2) Perceived Competence
3) Effort/Importance
4) Perceived Choice
5) Value/Usefulness
6) Project Relatedness
7) Group Relatedness

The first six categories describe motivations based on individual motivations for executing an activity. Furthermore, Tiago et al. (2017) added another category, group relatedness, originated from Ryan & Deci (2008). Group relatedness is characterised by '*the degree to which a person feels connected to other persons that do the same activities*' (Tiago et al., 2017, p. 65).

2.2.8 Network and the role of opinion leaders

Multiple mentioned frameworks named network as a motive in different terms; social relationship (Van Den Berg et al., 2009), community (Raddick et al., 2013), reputation and social interaction (Nov et al., 2011) and group relatedness (Tiago et al., 2017). These articles do not elaborate in-depth on network as a motive, even though the network of a potential volunteer can be a large and complicated

motivational factor for the adoption of citizen science projects. Therefore, this part will elaborate on this motive.

A network exists of interconnected individuals and plays a connective role between communities and organisations (Davis, 1999). Individuals can play two roles; the first one is that they can diffuse information among their family, friends and acquaintances by communicating their experience through their network (McKinley et al., 2017). The second role is that these individuals are affected by the communicated experience of their network. For example when wanting to adopt something which they are not familiar with (Rogers, 2010). Both roles can be seen as a motivational factor in this research. Stepenuck & Green (2015) suggest that the influence of a citizen scientist and their believes can motivate others to join or to alter their own behaviour. Others are more likely to adjust their behaviour to an example set by a friend or family, than for example public information campaigns (McKinley et al., 2017). Communities where citizen science is regularly practiced are more likely to care about local concerns and are more engaged in the development of their community or their network (Conrad & Hilchey, 2011).

So, networks can have a positive influence on actors which are involved with them. Von Hippel (2005) mentions in his book that innovators are likely to unite together in network communities and diffuse an innovation. An advantage of being part of a network can be an improved reputation, because of positive network effects due to rapid diffusion of an innovation (Von Hippel, 2005). Citizen scientists are also a type of innovators, by practicing an enhanced way of collecting large amount of data in research areas.

Within the network, opinion leaders can have a dominant position as motivational factor. The emergence of the term opinion leader began last century. In 1943, Ryan and Gross established the fundamentals of the diffusion paradigm in a journal, which said that social contacts, social interaction and interpersonal communication were relevant factors on the adoption of new behaviour (Valente & Rogers, 1995). Stimulating new behaviour through close communication can be referred to as peer influence or peer networks (Davis, 1999). In peer networks there are people who look up to certain individuals as a role model, these role models can be seen as opinion leaders. Opinion leaders can speed up the diffusion process of innovation and sustain behaviour change (Davis, 1999). Hence, opinion leaders can be described by '*men who exert personal influence upon a certain number of other people in certain situations*' (Rogers & Cartano, 1962, p. 436). The motives of an opinion leader in a citizen science project might lead to an acceleration of the speed of adoption. In other words, the presence of an opinion leader in a citizen science project can accelerate the degree of participation. It can also be the other way around; thus, the absence of an opinion leader can make people less inclined to participate in citizen science projects.

2.2.9 Proposed motive framework as base for the conceptual model

To conclude, numerous frameworks regarding motives to participate can be distinguished in the literature. On the one hand, frameworks are proposed with a large amount of (detailed) categories. On the other hand, frameworks are described which had only a few categories and are more suitable as an overarching theme. For example, Van den Berg (2009) and Rotman et al. (2012) and Batson et al. (2002) were not or partly used because they focused on motives with too broad categories. Moreover, a few motives of Raddick et al. (2013) and Tiago et al. (2017) were not used because their motives were too focused on a specific type of citizen science project and therefore not applicable to this study.

Additionally, overlapping motives can be distinguished, which results in partly overlapping frameworks. The framework of Nov et al. (2011, 2014) is used as the base model, since this framework reflects the categories of motives the clearest for this study (Table 1). The motives of the other frameworks could be assigned to one of the five categories of Nov's framework and enriches this main model with their theories. As to build a complete model of motives, which can be used for this research. Two motives are added to Nov's framework: network and direct advantage. Firstly, Nov et al. (2011) emphasise in their framework different motives for including reputation (community reputation benefits) and social interaction (social interaction benefits). This is connected to network and opinion leaders and is therefore also important. For that reason, network and opinion leaders will become part of the reward motives. In Table 1 network is a standing alone motive to better compare it with the other frameworks but will become part of the reward motive in the rest of this research. Furthermore, direct advantage is added because Van Den Berg et al. (2009) mentioned a reward motive in material form and Ryan and Deci (2000) mentioned this motive as external regulation in extrinsic rewards. So, direct advantage is added to reward motives as a reward for participating, for example in material form.

Table 1: Motives with overlap with Nov's framework

Nov et al. (2011, 2014)	Ryan and Deci (2000)	Van den Berg (2009)	Raddick et al. (2010)	Tiago et al. (2017)
Collective motives			Contribute	Effort importance
Norm-oriented motives	Introjection regulation			
Reward motives	External regulation	Material/Status		
Identification	Identification			
Intrinsic motives	Intrinsic motivation	Personal growth	Fun/Interest	Interest/enjoyment
Network		Social relationship	Community	Group relatedness

2.3 Demographic characteristics

Standard demographic characteristics can be used to break down the data (Geoghegan, 2016). Church, Payne, Peel, & Prokopy (2018) wrote a scientific article about a citizen science project concerning water and chose amongst others the standard demographic characteristics of gender, education and age. However, this was only used to search for potential respondents (Church, Payne, Peel, & Prokopy 2018; Geoghegan, 2016; Raddick, 2010). Geoghegan (2016) demonstrated relationships between participation and demographic characteristics. He examined participants in an invasive species citizen science project and found that participation was high towards highly educated, middle-aged females. However, the connections between demographic characteristics and participation varies from each citizen science subject (Geoghegan, 2016). Furthermore, Land-Zandstra et al. (2016) stated that many citizen science report groups of participants are well-educated and mostly middle-aged. These are some examples of influences; however, it does not mean that these influences also apply to this research. So, to obtain a general representation of the population in this research, gender, education and age were chosen. These demographic characteristics are also used to study the influences between the motives and degree of participation.

Furthermore, as citizens science focuses mainly on conservative biology and environmental subjects, a fourth demographic characteristic can be identified in the form of environmentally active. It expresses how environmentally active a person is. No previous research is done on the relationship between environmentally active and motives to participate/not participate. However, since this is an explorative research it will be explored if and how the environmentally activeness of a person affects the motives to participate or not participate in citizen science.

2.4 The conceptual model

The literature from the theory chapter is used as the foundation for the conceptual model, which is used in finding an answer to the research questions. The conceptual model is shown in Figure 1 and is based on Nov et al. (2011, 2014). On the left (in blue) are the different motives illustrated with arrows and these are the independent variables. These motives are directed to the right, linking to intention to (orange). The intention to can result into two possible behaviours; participate (grey) and not participate (grey) (degree of participation). This is the dependent variable and the influence of the independent variables on the dependent variable is researched. Attention is given to participation for three specific reasons; The first reason is that when looking at both intentions, a better comparison can be made between these two. Motives to participate can also become motives to not participate but are not necessarily the same. For example, for some potential respondents enhancing their reputation can be a motive to participate, while for others this is not interesting and not a motive to participate. Secondly, to see if new motives arise from this explorative research from the intention to participate. Thirdly, motives that influence the intention to participate could help with composing the recommendations of future citizen science projects. A large focus of this research is on the grey rectangle to not participate, which will uncover motives which leads to the intention to not participate.

The first five motives in the blue oval are derived from the literature. Network is closely linked with social interaction and reputation. Therefore, network is part of reward motives. Opinion leaders present in the network can accelerate the process of participation. If actors fail to comply and satisfy the participants motives, this could lead to a low degree of enrolment or to a high level of people who quit a programme. Furthermore, direct advantage is also part of the reward motives and the presence of this motive can lead to the intention to participate.

Furthermore, the mentioned motives are focused on reasons why people do not *want* to participate, while there are also reasons why people *cannot* participate. The latter is focused on for example the fact that citizens are too busy and do not have time to be involved or just never heard of it. These types of reasons are amongst others represented in the lowest motive oval, 'other motives'. 'Other motives' also represent motives not mentioned in the literature and that is discovered during this research.

Then, the green rectangle shaped form represents the four demographic characteristic. Important to note is that the green arrow to the other motives applies for each motive. So, an influence is sought from the demographic characteristics of each motive on the intention to participate or not participate. Lastly, the influences in the form of + and – are absent at the arrows, considering this is an explorative research and the connections are not known in advance.
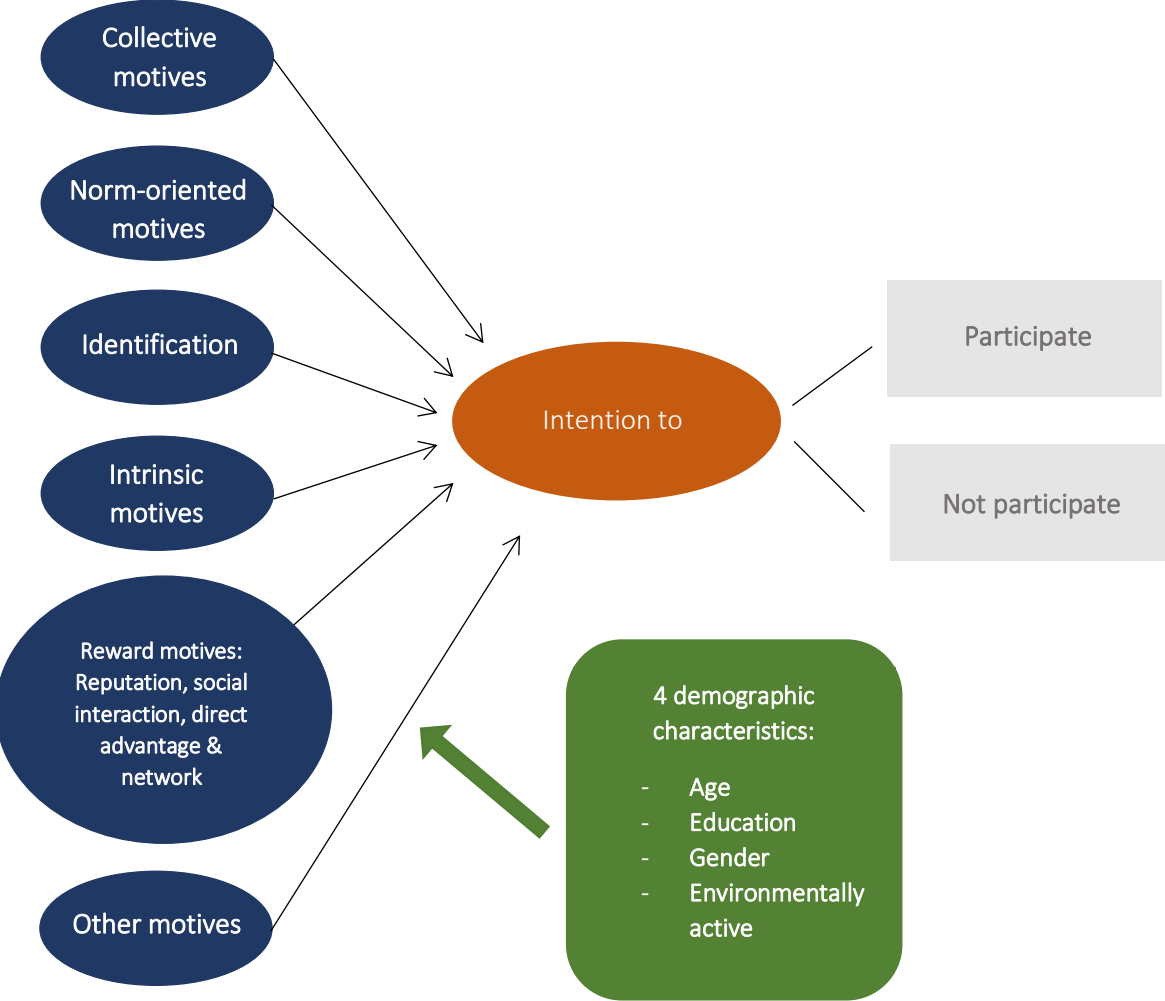

Figure 1: The conceptual model

3. Methodology

In this chapter an explanation is given of how the research was executed, consisting of five different steps. The first paragraph elaborates on the research design (3.1). Followed by a section which describes the case study (3.2). Then, it is explained how the data was collected (3.3) and operationalised (3.4). The methodology concludes with a paragraph on the data analysis, where an explanation is given on how the data is analysed (3.5) and on the research quality of this study (3.6).

3.1 Research design

According to Bryman (2016) a research design is a framework for the collection and analysis of data. The research design used in this research is focused on uncovering the motives of non-participants through explorative semi-inductive qualitative research. As little to no research was executed to uncover the motives of non-participants, it is mostly exploratory since this search leads to new discoveries. Moreover, inductive research is derived from data (Bryman, 2016). This approach is chosen, because motives for non-participants are discovered through collected data instead of theory.

Additionally, qualitative research in the form of semi-structured interviews was chosen, because multiple views were needed from non-participants. Semi-structured interviews were conducted to collect a variety of motives and to get an explanation on how these affect the participation of volunteers. Another reason for this interview method is that it allows the interviewer to get answers on important questions prepared in advance and spontaneous questions that might come up during the interview. For example, the questions regarding the motives from the literature were prepared in advance, but probing questions about motives to not participate that were mentioned were not prepared. The balance between prepared and spontaneous questions could be in the benefit of this explorative research. Furthermore, the semi-structured interview approach gives the respondent room for their own thoughts and ideas about the topic. It stimulates flexibility and allows for follow-up and probing questions. In-depth responses to problems are stimulated through this approach. According to Barriball & While (1994), the probing questions can assure reliability of data as it allows the interviewer to seek and stimulate for clear responses. Additionally, the format of semi-structured interviews eases the process of coding.

3.2 Case study: KWR

This research includes an internship for the organisation called KWR. KWR is involved with citizen science since 2015 and wants to gain more experience with self-measuring citizens (KWR, n.d.). The last couple of years KWR already executed five citizen science projects; The first citizen science project KWR introduced was concerned with the issue regarding the *freshness of the drinking water* in the Netherlands. Citizens of Amsterdam were asked to perform experiments at home to detect the microbiological stability of drinking water. A better understanding of the composition of the bacteria was established during the transportation process. The second project was also done in Amsterdam and was called *the clean water experiment,* focussing on the quality of the surface water. In 2017 a third project was set up, named *citizen science and lime*. Around 100 citizens participated in the south of the Netherlands. They measured lime quantities coming from their water pipes to be able to improve the hardness and the quality of the water. During that year the fourth citizen science project, *citizen science and lead,* was introduced in The Hague. Citizens were requested to test the presence of lead in their water pipes with simple experiments. The findings led to a better understanding of the lead levels in the water and if pipes should be replaced. Lastly, the project *citizen science and hardness* started also in

2017, but in comparison with the previously mentioned projects, this project had a longer time span. In this last project the lime quantities were measured in the region of Oss. The difference with the other lime project was that this project required measurements at multiple moments in times for seven months. The variations in the hardness of the water was adjusted a couple of times to see what the consequences were. During all the projects there was an emphasis on the increasing awareness about the substances in the water among the citizen scientists.

At KWR a recurring and unresolved question was why citizen scientists dropped out early from projects or did not participate at all. The answer to this question and this research can be used for enhancing future citizen science projects by using non-participants motives and by providing recommendations for KWR.

3.3 Data collection

The qualitative data was collected through semi-structured interviews with non-participants. The respondents were chosen and distinguished by differences in age, education and gender through the network of the researcher. While it is an explorative research these three main characteristics are chosen to have a concrete starting point. The (four) age groups, ranged from; 24 years and younger, 25-44, 45-64 and people who were 65 years and older. Moreover, three levels of education were chosen based on the Dutch educational system; MBO (secondary vocational education), HBO (higher professional education) and WO (university education) Ascending to study experience, from low educated to high educated. Potential participants were chosen on the basis of possession of a diploma. However, participants with a MBO background did not necessarily needed to be in possession of a diploma, but it was sufficient if they finished their VMBO and had work experience. These classifications are based on scientific articles where demographic characteristics are used to break down data from citizen science projects or to search for possible influences between the characteristics and degree of participation (Bolici & Colella, 2019; Forrester, Kays, Baker, Costello, & Kays, 2016; Raddick, Bracey & Gay, 2010). When putting these three demographic characteristics in a matrix, a total of 24 non-participants were calculated to interview in Table 2.

Furthermore, an environmental characteristic was considered as well, namely environmentally active. This characteristic is divided in three environmental types: environmentally active, semi-environmentally active and not environmentally active. The different environmental types were not categorised before conducting the interviews but have been exploratively defined. The respondents were categorised according to how environmentally active they were through the following process. Respondents were first asked about their environmental activities. Based on their answers, respondents were assigned an environmental type. This revealed that the largest part of the respondents, 19, were '*semi-environmentally active*' in Table 2. These respondents performed environmental activities which were accessible and with a low threshold within their houses. Frequently mentioned accessible activities were; separating waste in different bins and reducing electricity, gas (heating usage) and water consumption. Moreover, common outdoor activities as walking, cycling, working in the garden and running were frequently mentioned by this type of respondents. The type '*environmentally active*' has been assigned to four respondents who were also engaged with aforementioned activities within their houses, but additionally contributed towards the environment with at least two activities that required more effort. These activities concerned preventing producing waste, focusing on circular activities, cleaning the streets, contributing to a public garden (picking garden), growing up very environmentally conscious and isolating the house. Lastly, one of the respondents showed an attitude which could be ascribed to '*not environmentally active*'. Examples were that no waste was separated and no attention

towards the consumption of electricity and gas was given. The respondent said *'I do not know where to start',* which shows that this respondent is unwilling to change his behaviour. Moreover, as mentioned in the theory section (2.3) no literature was found on a relationship between environmentally active and motives to participate or not participate.

Table 2: Demographic characteristics and respondents

Age (years)	Education	Gender	Environmental types	Respondents
	MBO	Male	*	A
		Female	**	B
24 and younger	HBO	Male	***	C
		Female	***	D
	WO	Male	***	E
		Female	***	F
	MBO	Male	***	G
		Female	***	H
25-44	HBO	Male	***	I
		Female	***	J
	WO	Male	***	K
		Female	***	L
	MBO	Male	***	M
		Female	***	N
44-64	HBO	Male	***	O
		Female	**	P
	WO	Male	***	Q
		Female	***	R
	MBO	Male	***	S
		Female	**	T
65 and older	HBO	Male	**	U
		Female	***	V
	WO	Male	***	W
		Female	***	X

* Red stands for not environmentally active

**Green stands for environmentally active

***Yellow stands for semi-environmentally active

3.4 Operationalisation

In this part the operationalisation of the research is discussed. The interview design of the semi-structured interviews for the non-participants is shown in Appendix A. The motives from the theory were operationalised and defined in Table 3. These motives were the base for designing the interview questions.

Two invitations of citizen science projects were used in the interviews to provide the respondents with a better overview of what citizen science projects are. Furthermore, the invitations were also presented during the interviews, so the interviewer was able to ask questions about theoretical concepts (for example motives) in a more practical environment. The first citizen science project invitation is about the plastic soup. Citizens are asked to help counting waste, classify according to categories and clean it up. You can work in couples, there is no direct advantage present and the

indirect advantage focused on the collective motive is contributing to scientists who will use the data to do research and contributing to the general interest. This invitation is more specified for the general interest, as a cleaner environment.

The second citizen science project invitation is about detecting lead water pipes, only for citizens living in a house before 1960. When lead is detected, the citizen scientists can decide to replace the pipes in their house. This project is focused on working individually, the direct advantage present is improving your and other's health by removing the lead from your water. The indirect advantage focused on the collective motive is contributing to scientists who will use the data to do research. This invitation is more focused on personal benefits. The invitations themselves can be found in Appendix B. The type of citizen science project can also have an influence of the participation.

Table 3: Motives with their definitions

Motives	Definition
Collective motives	Participating because it feels important to contribute to a common/collective goal
Norm-oriented motives	The reaction of others to sharing information/activities
Identification	Participating because others expect you to follow their norms
Intrinsic motives	Participating because the project brings joy/is interesting/ brings satisfaction
Reward motives: Reputation	Sharing information/activities with others to show them what you are doing to feel better about yourself
Reward motives: Social interaction	Participating because you can work together with others (making new friends)
Reward motives: Direct advantage	Participating because of the presence of a direct advantage
Reward motives: Network	Sharing information/activities with others (possible opinion leaders) or being stimulated by your environment
Other motives	Motives not mentioned in the literature

3.5 Data analysis

The data obtained from the semi-structured interviews was transcribed and analysed with a qualitative data analysis software program NVivo. NVivo is known for understanding and discovering relations in the data (Saillard, 2011). For the search of relations between the influence of the different motives and degree of participation this was helpful. After this step, a coding framework was developed to organise the discovered data. The first step to construct this framework was by open coding all the interviews. Then, axial coding was performed to establish sub-categories and subsequently selective coding to establish core categories where necessary, see Figure 2 for the coding process. After selective coding a clear coding framework was formed. With this coding framework all the interviews were coded again, so the coding of the interviews was more consistent with each other and to verify if all the codes were relevant. Furthermore, the codes of the motives to participate and not participate were compared with each other and with the demographic characteristics to study if potential relationships could be found. Potential relationships would then be discussed in the result chapter (4).
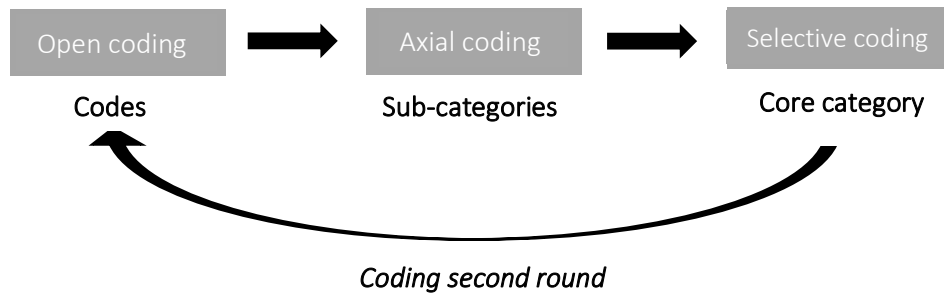
Figure 2: Coding process

3.6 Research quality

This paragraph elaborates on the general data quality of the research. The first is external reliability, which refers to the degree to which a study can be replicated (Bryman, 2016). It is difficult to address the external reliability with a qualitative research as the social context is continuously changing. The same applies for this research, where the environment and the home-situation of respondents are constantly changing. External reliability is therefore expected to be low. However, by precisely describing how this research is conducted, external reliability is addressed as good as possible. The interview design is described in Appendix A, the interviews are recorded, and detailed transcripts were written. Therefore, this research aims at providing the highest degree of transparency. Furthermore, the motives (section 2.2) are derived from the theory and tend to recur if this study is replicated.

Internal validity is the extent to which there is a good match between the researcher's observations and the developed theoretical ideas (Bryman, 2012). When semi-structured interviews are executed in the native language of the respondent, internal validity is improved. This way, the respondent can give their answers in their own manner without having to formulate their views in another language. The internal reliability is anticipated to be high, because in this research semi-inductive interviews are conducted in Dutch, the respondents' mother tongue.

External validity is absent, since external validity refers to the degree to which the results can be generalized (Bryman 2016; LeCompte & Goetz, 1982). Experience in research shows that studies with small samples have a low generalizability (Bryman, 2016). So, this result is also anticipated in this research with its small sample. Motives can differ in for example different areas, as urban and rural contexts and the different types of citizen science projects. However, the generalizability is addressed as best as possible by interviewing different groups of people within demographic characteristics. This is a small snapshot of society and that can make the generalizability a bit higher than normal. Finally, the internal reliability is also low, considering the researcher observed alone. Internal reliability is enhanced when there is more than one researcher present which can coincide on what they see and hear (Bryman, 2016).

4. Results

As mentioned in 3.4 two examples of citizen science projects were used to uncover motives. When asking the respondents about participating in the plastic soup and lead projects, nine respondents answered that they preferred participating in the plastic soup project and were less inclined to participate in the lead project. Almost similarly, ten other respondents favoured the lead project, and were hesitant when asked if they would join the plastic soup project. Moreover, four respondents indicated that they preferred both project equally and one respondent did not want to participate at all in any of the two citizen science projects. Questioning the respondents about the citizen science projects lead to multiple motives for participating and not participating for each project specifically.

In this chapter, the data is discussed which was found by conducting the interviews. The first section of the results (4.1) is structured in the same order as the conceptual model; the independent variables of collective motives (4.1.1), norm-oriented motives, identification and intrinsic motives, that were absent (4.1.2), intrinsic motives (4.1.3), reward motives (4.1.4) and other motives (4.1.5). First the motive to participate is discussed and then the same motive to not participate is explained. Where relevant the motives and the intention to participate and not to participate are analysed with the help of the demographic characteristics. In this way potential relationships were found between motives and demographic characteristics. In section 4.2, recommendations to enhance the increase of future citizen science projects are given.

4.1 Motives to participate and to not participate

4.1.1 Collective motives

Collective motives to participate

The first motive that was discussed with the respondents was the collective motive; whether the respondents wanted to participate because the subject was of collective important to them. In specific the collective motive was about making a contribution to the social interest or general interest and making a contribution to the data collection for scientists. Fourteen respondents mentioned this as a motive to participate (Table 4). An example of an answer was given by respondent B, who made the following statement on the plastic soup project: '*I think it is important that the data is passed on to organisations and scientists who can do something about it, so I do not care about the personal benefit*'. Moreover, respondent R mentioned the following about the plastic project: '*The activity (picking up plastic) itself is already satisfying. You do not achieve results immediately with this project. You will only reach it in 40 or 80 years and then I will not be alive anymore*'. Another example was given by respondent U: '*I think liveability is important in the general sense, it is also very important to take your children and grandchildren into account who have a great interest in it*'. Another respondent, respondent C, mentioned the following about the lead project: '*I find this more compelling, it sounds more like a real serious problem. It appeals to me more that human lives are involved*'. The presence of a collective motive was more notable and essential in the plastic soup project, than in the lead project. Considering that in the lead project the motive was more focused on improving the respondents' and others' health. Hence, the type of citizen science project also has an influence on the motive to participate.

Table 4 additionally demonstrates the collective motive plotted against the four demographic characteristics. It is striking that in the age classification of 24 and younger, 25-44 and 65 year and older, four or more respondents named this motive as relevant. Meaning that in the age classification of 45-64 there was only one respondent whom found this important.

So in general, collective motive is a popular motive, chosen by more than half of the respondents, and has an influence on the intention to participate. Adding from this research that the age from this motive has a potential influence on intention participate. It looks like the age classifications of 24 and younger, 25-44 and 65 and older have an possible influence on the intention to participate.

Table 4: Collective motives to participate and not participate with the four demographic characteristics

Demographic characteristics		Collective motives
		Participate
Gender	Female	8
	Male	6
Education	MBO	6
	HBO	5
	WO	3
Age	24 and younger	4
	25-44	4
	45-64	1
	65 and older	5
Environmental type	Environmental active	3
	Semi-environmental active	10
	Not environmental active	1
Total		14

Collective motives to not participate

There were two respondents who explained that the collective goal of the plastic soup project did not appeal to them. On a probing question why respondent C would not participate in the plastic soup project, he answered: '*I do volunteer work, but I do that for the art and culture session because I feel connected to that. I think this is a bit ironic because waste is of course for everyone, everyone should be connected to it but I am not*'. Respondent D emphasised the following, '*It is about the fact that it concerns your own house and your own health so that you are quicker triggered to participate than, for example, plastic for the earth. People do not feel that it is something for them directly. Then you are less inclined to participate, but health is here (lead project) the only reason for me to participate*'. This statement is also linked to another motive of the theory, namely direct advantage. Because of the two respondents no statements could be made about possible relationships with the demographic characteristics.

4.1.2 Norm-oriented motives, identification and intrinsic motive for not participating

Concerning the motives to participate, the following motives were absent. First, the norm-oriented motives, focused on expectations regarding the reactions of important others (such as friends, family or colleagues) on sharing information/activities were not explicitly mentioned by the respondents. The same applies for the motives regarding identification, defined as participating because others expect you to follow its norms.

Norm-oriented motives, identification and interest (intrinsic motives) were not named by any of the respondents for not participating in citizen science projects. Therefore, they are not included in the results and tables.

4.1.3 Intrinsic motives

Intrinsic motives to participate

Intrinsic motives is operationalised as the enjoyment associated with participation in the project. This motive was mentioned multiple times, as some found that the project brought them joy or found the project interest and gave them satisfaction simultaneously. The minority (one) found that the project was most attracting when the activity brought only enjoyment. Then, seven respondents found that enjoyment and interest were equally important as motives to participate. It would partly depend on the type of citizen science project if interest would outweigh enjoyment and the other way around. To be more specific, respondent B mentioned: *'That would really depend on the project, because with one project I would really do it for the activity and with the other for the goal. I think both projects are fine. Collecting a little waste along the water and if it is for charity then fine. And with the other (lead) I would rather do it for the results than the activity itself'*. It would also partly depend on the proper ratio between interest and enjoyment: *'It is linked to each other of course. The second, plastic soup problem, I find more interesting and important, but it does not sound fun, it is cleaning up waste. And if I notice that it is in a beautiful nature reserve and I can go there together with an acquaintance, then it is a pleasant walk through a beautiful place where I will also clean up waste. That is a nice combination. But if it was not nice, if the walk is along an old channel where there is nothing to see, it is less fun. Then I am also less inclined to participate'* (respondent E). The respondents emphasised that there should be a synergy between interest and enjoyment, so it can become a potential influence on the intention to participate. Furthermore, a remarkable insight was that more men (five) than women (two) agreed with this type of motives. Thus, it looks like more men have a potential influence on intention to participate than women regarding this motivation type.

Most respondents (14) indicated that interest was the main driver to enrol in one of the two citizen science projects. An equal number of men and women confirmed that interest was the most important factor, with each a total of seven (Table 5). As respondent G metaphorically stated concerning interest was: *'I would do it for the goal, so for its social relevance. I also like to go on a holiday, but I really have to work for it otherwise I cannot go on a holiday. I try to say with that: If you want to achieve something with a project then you should not look at what you have to do for it, but what you want to achieve with it.* Respondent K said: *'Then my interest outweighs the enjoyment. Suppose it really aroused my interest and it is useful, but no fun then fine... but if I do not know what I am doing it for, then the activity can be super fun but I would not really know if I would participate in it'*.

Other information obtained by this question was the intrinsic motive of satisfaction. Respondents indicated that they received satisfaction from their participation and this made it worth to join a citizen science project. For at least nine respondents satisfaction was a driver to join a project. Satisfaction was also seen as a direct advantage by six respondents. Cleaning up a beach where the

direct result was a waste free beach, gave respondents a feeling of immediate satisfaction. Respondent P answered: *'The plastic soup project gives you a good feeling when you make it a little cleaner. Then you are not only contributing to science, but also the animals, environment and the view'* and on the question if this would also be a direct advantage the same respondent said: '*Yes, I have a positive idea with that'*. So, satisfaction could have a potential influence on the intention to participate, which corresponds to the theory. Lastly, no striking numbers were discovered with the comparison of the demographic characteristics.

Moreover, one respondent mentioned that the choice of participating in a citizen science project was dependent on how much effort a project required, He was interested in the plastic soup project because this subject was about climate. The lead project also had his interest because of the benefits for his health, but not because he found lead an interesting object. He found the lead project more convincing because this project could be carried out in the comfort of his own home: *'Yes, but that is also because it is easier. It is at your home, it is not necessarily something difficult. You are finished within an hour and what I said we are all busy, and this is not such a big deal and you are doing something good'* (respondent E). So, if this respondent was looking at citizen science projects, the convenience in which he could carry out the project would have a potential influence on the intention to participate. The motives with one or two respondents are not shown in the table with the demographic characteristics, because no potential relationships can be discovered with this small number.

Intrinsic motives to not participate

The intrinsic motives also occurred a few times during the interviews for not participating. One respondent found that she did not want to participate because the activity of the plastic soup project did not brought her joy (respondent F). She preferred the lead project over the plastic soup project. Regarding the question what reasons she had to not participate in the plastic soup project she stated the following: *'It is not necessarily fun to do, because you have to search for waste. That is literally what it is. Sure, not everything in life is fun and it is for a good cause, but the day itself would probably not be fun either. It will certainly give me some satisfaction, but I would not really like it'.* On the follow-up question, if the lack of enjoyment would be a reason to not join the project she said: *'Yes. That sounds very blunt. You have to literally count and classify waste according to categories'.*

Another intrinsic motive, satisfaction, was named twice by the respondents. Satisfaction was not a reason for them to enlist. Regarding the question if the presence of a direct advantage was important respondent C said: *'Yes, I think so. I think for me I would be more stimulated by some sort of reward. Satisfaction is not really a reward for me, but you know it is for your own good. And that feels more like karma, and I am not looking for that'.* Participating was for him not a reward in itself. The other respondent mentioned that satisfaction was not sufficient as a decisive factor (respondent E). No striking data emerged from Table 5.

Thus, the lack of intrinsic motives of enjoyment and satisfaction by the respondents can have a potential influence on the intention to not participate. The motives with one or two respondents are not shown in the table with the demographic characteristics, because no potential relationships can be discovered with this small number.

Table 5: Intrinsic motives to participate and not participate with the four demographic characteristic

Demographic characteristics		Participate	
		Interest	Satisfaction
Gender	Female	7	5
	Male	7	4
Education	MBO	6	3
	HBO	5	3
	WO	3	3
Age	24 and younger	2	2
	25-44	4	1
	45-64	4	4
	65 or older	4	2
Environmental type	Environmental active	2	2
	Semi-environmental active	11	6
	Not environmental active	1	1
	Total	14	9

4.1.4 Reward motives: Reputation, social interaction, direct advantage and network

Reward motives to participate

In this section the reward motives are elaborated upon. Reward motives were defined as gaining benefits for the respondents. The first discussed topic was reputation. Respondents were first asked about the role of reputation in participating in a citizen science project (Table 7). Two of them replied during the interview that reputation was one of the reasons to participate: '*Yes and maybe also a hidden agenda. I think it is a bit of 'hey, look at how well I am working on the environment', but it is not the main reason. It is certainly one of the reasons to participate, I am also proud of it'* (respondent R about the plastic soup project). No striking numbers stood out from Table 7. So, beside the fact that it is a confirmation of the theory, no demographic differences were found.

Subsequently, respondents were asked if they would join the project to make new contacts (*social interaction*). Some agreed that this played a large part in participating and were curious about the motives of other citizens to participate. One person said: '*.. on the other hand, it is nice to meet others who also help with such a project and then you can also find out why people participate in such projects'* (respondent F) and another respondent mentioned: *'if you get coupled to another person you get to meet new people, get to learn different interests and why they would participate'* (respondent H). Five respondents stated that they did not had a preference with working with acquaintances or strangers and they were open for all possibilities. In total seven respondents mentioned answers which could be linked to social interaction.

A general finding presented, was that social interaction could been seen as a semi popular motive to participate by the respondents. Social interaction, as mentioned in the theory (section 2.2.5), has a positive influence on intention to participate. When zooming in on the social interaction with the demographic characteristics, a possible connection could be found with gender. More women (five) than men (two) mentioned connecting with new people as possible reasons to join a citizen science project. Thus, gender has a potential influence on intention to participate, when considering the social interaction motive.

Furthermore, half (twelve) of the respondents said that the chance to participate was larger when a *direct advantage* was offered. This could be in the form of positive effects on health, money or another form of reward. Eight of the twelve respondents considered the lead project to be positive for own or others' health and saw this as a direct advantage. As respondent D stated: *If my house were qualified for this, I would just participate for our own health'.* Moreover, this respondent made a comparison with the lead project and the plastic soup project and this statement was also used as a collective motive to not participate: *'It is about the fact that it concerns your own house and your own health so that you are quicker triggered to participate than, for example, plastic for the earth. People do not feel that it is something for them directly. Then you are less inclined to participate, but health is here (lead project) the only reason for me to participate'.* Just as respondent E who mentioned: *'The lead project is more personally focused. This is really in your own interest to participate and less for the general. Well indeed for the general interest, but it is more focused on you and on what you are going to get out of this personally? And that is very clear, you know whether you have healthy water from the tap or not. And that is the first priority for the people who participate and then it would be extra for them that researchers can do research that is much more important to them'.*

Another direct advantage mentioned by three respondents was payment. Money would be a large motivational factor, and it could turn some respondents' decision from a no to a yes: *'Money yes. I do almost everything for money ... I can always be persuaded if someone says that I would get paid for it, I would do it'* (respondent C). Also respondent E mentioned payment after reading the plastic soup project: *'Very hard, but money would probably work, because then I would do that instead of work ... I get something out of it for myself and that is not self-centred, but that is how it usually works'.*

Another suggestion of a direct advantage was given by respondent P: *'If they would send me an attractive letter that tempts me to watch an informative video with my neighbours in the community centre and drink a cup of coffee. You have to make it people attractive and then I will also get something for it if I participate. Then I would be encouraged, such as getting a nice water bottle'.* No striking numbers were found concerning the direct advantage with the demographic characteristics.

Respondents were also asked about their influences on their network and the influences from their network on themselves. Firstly, the results were discussed whether the network exerted influence on the respondents. The main influence from the network on the respondent was the influence exerted by a member of their family or friend. As respondent L mentioned: *'I think that my group of friends can pay a lot of attention to that (environmental activities). I notice that they find that important. So, this has also an influence on me. I started to eat meat more consciously and I think that is really good'.* Almost all respondents, 22, mentioned that they experienced influences through different channels from their network, as shown in Table 6. Also, the attitude of the environment or science of the respondents' partner provided a certain influence on the attitude or behaviour of the respondent. An example was given by respondent D, who said: *'Partly through my boyfriend I have become much more interested in science. He mainly finds NASA and the space, well actually, he finds everything interesting ... but actually the main trigger is my friend, because he likes it and talks a lot about it, so I hear it all'.* Moreover, social media was also seen as a driving factor, as LinkedIn and Facebook. Additionally, other influences were mentioned as: internet, news, podcasts and television.

Another interesting statement, made by the respondents was that the chances of participating in a citizen science project would increase if someone in their close environment asked them to join (*example set by friend or family member*). Nine of the respondents named this reason: *'The moment a*

friend of mine would ask me to join because she thinks it is really cool, then I would probably immediately say yes if I have the time. I think it is important, but apparently not important enough to just do that myself' (respondent L). Respondent F mentioned the following while talking about the plastic soup project: *'If I had a good friend who wanted to do that with me, I would certainly think about it'*. So, the network (*example set by friend and family member*) has a potential influence on the intention to behave, which corresponds to the theory.

To distinguish possible opinion leaders in the answers of the respondents, close attention was paid to relations of the respondents which triggered them to adopt new behaviour. Three cases were mentioned where an opinion leader could be distinguished in the environment of the respondent. First of all, the behaviour of the opinion leader caused the respondent to start thinking and subsequently joined an activity or project which the respondent would not have considered without that influence. Opinion leaders were the respondents' partner or a close friend. The focus was here namely on environmental activities. An example was given by respondent F who had a friend that was very environmentally active . Some examples of activities were that her friend did not travel with the airplane and did not want to wear leather, because it is all bad for the environment. Respondent L mentioned the following about the influence of that friend: *'Recently I ordered a coffee at the Spar (supermarket) and I do not know why but I like to put a plastic lid on it, that just drinks much better. And then my friend said 'sorry that I say so, but why do you do that? It is unnecessary, you grab a piece of plastic which you then throw back into the trash. Why do you take that?' I said I liked drinking with the lid on and she said she understood, but it was not necessary. I felt a little guilty at the time and thought that I had indeed packed a piece of plastic that was not necessary'*. On the question if this changed her behaviour she answered: *'I am now looking for such a nice durable mug. Now I take the plastic lid much less, but for example if I have to work in the library, you have to take it with you, but I am much more conscious about it now'*. Another example was given by respondent C whose partner has a scientific and sustainable innovative background. He mentioned: *'She says to me every time, 'have you turned off the light? And do you turn off the heating?' I get those kinds of questions. She is much more involved than me'*. On the question if this had any influence on his behaviour he stated: *'A bit anyway. It does not always succeed but I am doing a lot more. I now got the feeling that it is also very logical'*.

Notable is that there are similarities found between influences from the so-called opinion leaders and *example set by friend or family member*. Both codes could be assigned to the same sources; friends and family. Therefore, this specific part of data was given both codes, because these two were seen as relevant.

Observing Table 7 it is striking that only the semi-environmental types indicated that they would rather participate when a friend or family member asked them to join. Furthermore, no data stood out when comparing the networks' influences with the demographic characteristics.

Table 6: Influences network on respondents

Influences	Total
Friends or family member	11
Social media	9
Colleagues	6
Fellow students	2
Other influences	8

Secondly, the influence from the respondents on their network was discussed. All the 24 respondents said that they would share their activities concerning environment, science or participation in citizen science projects with the people to them. Sharing was expressed in the form of informing others about the subject or motivating others to join in the activity or citizen science project. Respondent L noted: *'I also try to stimulate (environmental awareness) a bit with my mother, who is not so aware of that now. But the moment I say that I think it is important, she thinks it is a good idea'.*

Two respondents identified themselves as opinion leaders, by saying they influence people around them, whereby respondent K mentioned that his activities came from intrinsic motivation and that he is the one who brings up subjects concerning for example science. Moreover, respondent Q stated: *'I am a beacon. I see those things. I have done so many different things in my life, so I look differently than many people who have had a straight career path in one type of work. I bring this together'.* For him, experience was a driver to inspire the people around him in the field of work.

Reward motives to not participate

Seven respondents claim that an improved reputation did not convince them to participate and would not be a reason if they were to participate. Respondent D favoured the plastic soup project and mentioned that she would share it with others, but reputation was not one of her reasons for participating: *'No in that respect, I do not think it is important that everyone knows what I am doing. I do not care that much. I do not have to show off that I participate in a volunteer project …. I do it because I want to do it myself and not because someone looks at me better'* (respondent D). Another respondent had the same thoughts as respondent D: *'No it is not self-interest, it is a social interest. So, I do not share because I am doing something good, I share it because I think the subject is good'* (respondent G). Respondent L emphasised: *'With collecting waste (plastic soup project) you are a good person, so to speak. You get satisfaction out of it, but I would not share it to show people what I am doing. However, It would make me feel better if I do something like that'* and on the follow-up question if she would share this for that reason she said: *'Not for that reason. The factor would be that I would like to do it with someone else, but not like 'look what cool things I do''.* The respondents indicated that they would feel good about themselves if they would share their participation of a project, but would only keep it for themselves and to not share it for a better reputation.

Additionally, six of the respondents agreed that making new contacts would not be a reason to participate in projects. Five respondents preferred working in couples, but with people they are already familiar with. Respondent K said '*it is not a network opportunity*' and respondent N mentioned '*I know enough people*'. Table 7 presents the social interaction compared to the four demographic characteristics. From this can be derived that more men (four) than women (two) found social interaction not a reason for participating. So, gender could have a potential influence on the intention to not participate. This motive might be more prominent for men than women. No further remarkable insights emerged from and the previous named motives.

Direct advantage and network are not discussed here, because they were both only mentioned as a motive to participate and not for not participating.

Table 7: Reward motives to participate and not participate with the four demographic characteristic

Demographic characteristics		Participate				Not participate	
		Reputation	Social interaction	Direct advantage	Network	Reputation	Social interaction
Gender	Female	2	5	6	5	3	2
	Male	0	2	6	4	4	4
Education	MBO	0	3	2	1	2	2
	HBO	1	1	6	5	1	1
	WO	1	3	4	3	4	3
Age	24 and younger	0	3	5	4	3	0
	25-44	0	1	3	3	3	2
	45-64	2	2	2	2	0	3
	65 and older	0	1	2	0	1	1
Environmental type	Environmental active	1	2	1	0	0	0
	Semi-environmental active	1	4	10	9	7	6
	Not environmental active	0	1	1	0	0	0
	Total	2	7	12	9	7	6

4.1.5 Other motives

Other motives to participate

In addition to the motives to participate which could be appointed to motives from the theory, other motives were given by the respondents. This was the last step of the conceptual model and these motives were focused on motives to increase the intention to participate.

Table 8 presents the different motives. The motive which was mentioned the most by the respondents was *sense of urgency*. This motive drawn respondents to the seriousness of the lead project problem and their risks when reading the project. To avoid more danger, they would participate in the project. This motive was expressed by a respondent with some prior knowledge about lead in drinking water through the following mentioning: *'I happen to have written a paper on high school about lead poisoning with the Romans. I read quite a lot about it then and it is pretty bad. So if I would live in such a house now and I would receive that invitation, then I will participate' (respondent I)*. Some respondents got the sense of urgency after reading the invitation: *'I find this touching, it comes across as a serious problem. It appeals to me more when human lives are involved. I would contribute to this anyway' (respondent C).* While others got the sense of urgency not for their selves but for others, like their grandchildren: '*I think if I had lived in the 60s, I would not have thought that it was important. But if you look now and have grandchildren or are expecting, I would be much more alert and productive now to avoid these things. So, now compared to the past, I would immediately say that it is important'* (respondent S). From this code and statements it is striking that *sense of urgency* has a potential influence on the intention to participate. Considering figure 3, more men (four) than women (two) tend to acknowledge *sense of urgency* as a motive to potentially participate. Gender can potentially affect the intention to participate when studying this motivation. The radar charts of the motives and the other demographic characteristics can be found in Appendix C and no relationships were discovered.

Alternative motives mentioned were amongst others *curiosity.* This was especially evident in the lead project, where respondents were curious if they also had lead pipes in their houses. When

respondents were asked if the invitation of this citizen science project was something for them they answered: *'If I knew that I lived in such a house from before 1960, then yes. For me it is of course also the question of do I have that too?'* (Respondent H) and *'yes. maybe. Only to see if the lead really is* present' (respondent X). Moreover, some respondents thought that if money would be offered in return for their participation it would not be a motivational factor: *'If you would put money in return, it is just a vacancy. It would not stimulate me more or less'* (respondent I). Two respondents indicated that if they could *bring their dog* during the plastic soup project activity this would be a great benefit. The combination of participating in the project while walking their dog, would increase the chance to join. Ending with the motive *approach in person*. Respondent F noted that she was sensitive for face to face approaches when asked to enrol in projects. She stated: '*I also think that personal addressing helps, because it always plays on my feelings. Then I find that these people tell me nice stories and I find it difficult to reject them. That works very well with me'*.

Table 8: Other motives

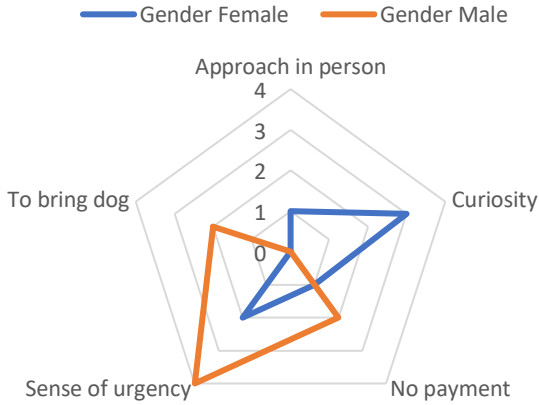| Other motives	Total
Sense of urgency	6
Curiosity	3
No payment	3
To bring dog	2
Approach in person	1

Figure 3: Other motives to participate and gender

Other motives to not participate

This section elaborates on motives with the intention to not participate. Respondents gave reasons why they would not participate in citizen science projects or why they were more hesitant, shown in Table 9. Some speak for themselves and others will receive more explanation. *Lack of time* and *lack of sense of urgency* were the most outstanding motives with each a total of ten or eleven respondents. *Lack of time* was associated with statements where respondents said they were too busy to participate in a citizen science project. A sub code of *lack of time* was *not expense of work or private* and mentioned by three respondents: *'A reason why I would not participate is if it goes at the expense of my work and*

*private life' (*respondent R*); 'Provided that I have enough time, but I would not let other things drop for it. I do a lot of things right now' (respondent S).* Noticeable was that *lack of time* for the age group of 24 and younger was the most mentioned (five) reason for not participating in comparison with the other age groups (Figure 4). It can be stated that lack of time has a potential influence on the intention to not participate and could be age dependent.

Secondly, the code *lack of sense of urgency* was divided amongst others in *low risk perception* and *no clear goal.* With *low risk perception* respondents did not realise the seriousness of the risks of the lead project. This code is therefore assigned to the lead project. It was said in this invitation that children up to six years old and unborn babies were the most sensitive for lead, but no mention was made of the specific risks involved for adults. Respondent B elaborated on this: *'I think that people with babies will indeed be a little more alert about this and perhaps will take part in this project. However, if it mainly concerns babies and small children, then I think I would skip it'* on the question that followed about if she would participate when the risks for adults were named she answered: *'I do not think I would do that either, because unborn babies and children must be protected, but at some point people think that everything has risks. You do not have to pay attention to every little detail. No I do not think this would work for me'.* Another respondent answered on the question if she felt addressed by the risks: *'To be honest, I think that it is not so bad. It is also not addressed to what extent it is relevant to me. I can tell that it is not good, but because I do not know how bad it can be for me, I think it will be better than expected. That would be good to indicate'* (respondent L). Respondent Q found the lead risks very exaggerated: *'I would not participate in this. I find the hassle about lead greatly exaggerated ... so when I read things about lead or lead water pipes I immediately put it aside ... It says it is for children up to 6 years old, that was a very long time ago. So, that should be the trigger, but that is not my trigger'.* *No clear goal* was, as well, only mentioned during the discussion of the lead project and by three respondents. Respondent D found: *'If a clear goal was mentioned on why it is so important to do that, then you can make the choice for yourself; do I find that goal important too? Then it would be more convincing and you would have the idea that they have thought it through well'.* Respondent P was hesitant to participate in the lead project considering the following: *'I find it incomplete ... There is indeed something missing: Where? To who? And how? No, it is incomplete. Also the goals are not clear. You become wiser and so do we; and then? This only makes it difficult for me'.* Too many information elements were lacking, so the *sense of urgency* was not stimulated.

There are no noteworthy links with the characteristics found for *lack of sense of urgency*. The only features which stood out were that more females (eight) than men (two) suggested that a reason to not partake in a citizen science project was the *lack of sense urgency* (Figure 5). Thus, in general the *lack of sense of urgency* has a potential influence on the intention to not participate. In addition, it looks like it is gender related, women could have a possible influence on the intention to not participate.

Furthermore, sense of urgency was mentioned both as a motive to participate and to not participate. More men (four) than women (two) found sense of urgency an important driver to participate, while a great number of women (eight) than men (two) said that the lack of sense of urgency prevented them from participating. The specific risks and goal were not clear enough mentioned in the invitation for the female reader, more emphasis needs to be placed on these aspects.

Other motives were *activity long distance.* The respondents found that the location of the plastic soup project was not close to their home, but long distance and were therefore less inclined to participate. They would be more willing to participate when the citizen science project would be in their own neighbourhood: *'For example, if it were just here in the forest, I would be more inclined to*

participate' (respondent E) and *'I would be more inclined to help if it was in my neighbourhood, because this is just too far away'* (respondent K).

Other interesting mentions were *presence of the information meeting or long distance* and *afraid of the consequences,* which were named a few times but not less interesting. *Presence of the information meeting or long distance* were mentioned at least by eight respondents. They indicated that they were not fond of going to an information meeting on their free day or to invest time in bridging the distant to go to the requested location. This statement is about the information meeting of the plastic soup project: *'Well if I understand correctly, the research consists of an information meeting. You should be there on the spot and therefore in Scheveningen, on a Saturday. I can imagine that there are enough people who do not want to spend their free Saturday there, including me. If by chance I already had plans that day and it should not even be special plans then I might think of 'gosh that is not necessary for me now'. It is not relevant to me now.'* (respondent L). Some respondents said that when the information meeting would be nearby they would consider to go: *'Then I would participate, unless the location of the information meeting is nearby, because it is now in Scheveningen. You should not have to drive for two hours to go to such a location'* (respondent M). Another observation is that the group of the age of 45-64 (five) implied that the presence of the information meeting and the distant were reason enough to be hesitant about enrolling in a citizen science project. This number was more than the other age groups, where each group included two respondents. Thus, it could be that this age classification has a potential influence on the intention to not participate.

Afraid of the consequences was mentioned by respondent P, who noticed after reading the invitation of the lead project that there was no mention of possible help or costs involved with the replacement when lead pipes were detected: *'I see costs coming. So it is self-interest, I am not happy about that. Then I prefer to just put my head in the sand, because it would not make me wiser'* (respondent P). So instead of tackling the problem, she preferred to remain unwilling.

In general, all the other motives for not participating have a potential influence on the intention to not participate. However, for each respondent there could be more than one reason and each reason weighs differently.

Table 9: Other motives for not participating

Other motives for not participating	Total
Lack of time	11
Lack of sense of urgency*	10
Activity long distance**	8
Presence of the information meeting or long distance***	8
Too lazy	5
Too much effort or steps	3
Lack of own initiative	2
Not physically mobile	2
Afraid of consequences	1
Forgetting	1
If it is not without an obligation	1
Stubbornness	1
Too old	1

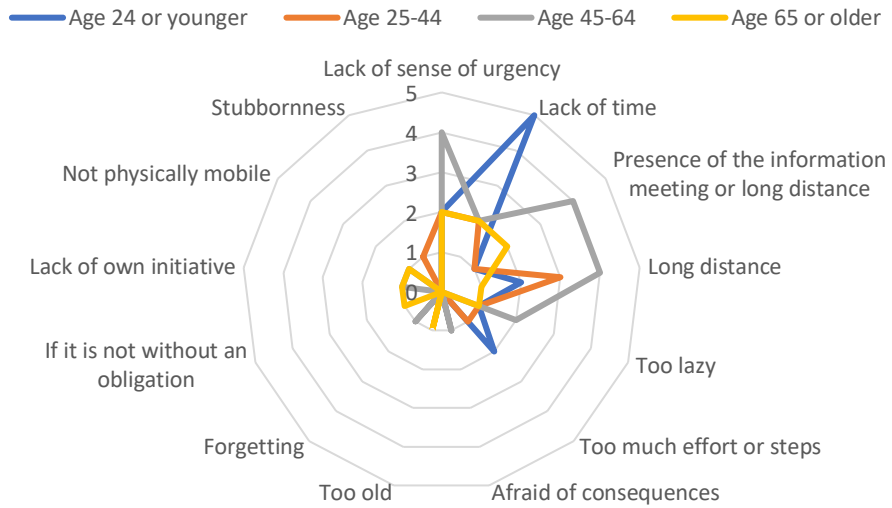*will be elaborated on with recommendations in section 4.2

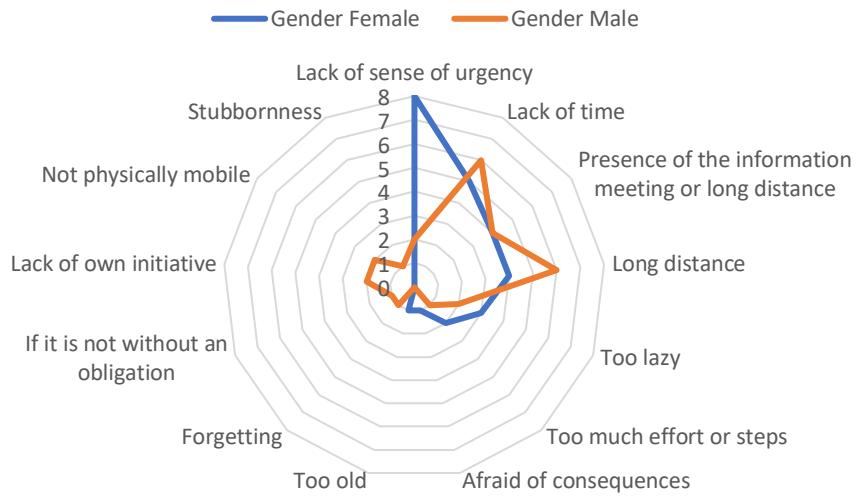*Figure 4: Motives to not participate and age classifications*

Figure 5: Motives to not participate and gender

4.1.6. Summary of motives which influence the intention to participate and not participate

Table 10 summarises the motives which influences the intention to participate and not participate. The first two columns show the motives to participate and the second two columns show the motives to not participate, both in order of popularity. The motives of sense of urgency, lack of sense of urgency, activity long distance and presence of information meeting or long distance are the most mentioned motives which influences the intention to participate or not participate. Lack of time is not further taken into account, because this is a motive which is difficult to change by people since it is about willingness.

Table 10: Summary of other motives which influence the intention to participate and not participate

Total	Motives to participate	Total	Motives to not participate
6	Sense of urgency	11	Lack of time
3	Curiosity	10	Lack of sense of urgency
3	No payment	8	Activity long distance
2	To bring dog	8	Presence of the information meeting or long distance
1	Approach in person	5	Too lazy
		3	Too much effort or steps
		2	Lack of own initiative
		2	Not physically mobile
		1	Afraid of consequences
		1	Forgetting
		1	If it is not without an obligation
		1	Stubbornness
		1	Too old

4.2 Recommendations for future citizen science projects

This section elaborates on the second part of the research question, where recommendations to enhance the participation of future citizen science projects are sought. The first section (4.2.1) is based on the recommendations of other motives to not participate (mentioned in section 4.1.5), and how these motives can be turned around so men can and want to participate.

Followed by a section which discusses specific recommendations for future citizen science projects. Recommendations which emerged from the answers of the respondents were given different codes. After finishing the coding, the codes were then organised in main themes or in individual codes if they did not belong to a main theme. Subsequently, two individual codes and four main themes were established concerning the recommendations. Therefore, section 4.2.2 begins with the two individual codes of *accessible project* and *feedback of end results*, followed by the four main themes of; *recommendations on the content of the invitation, recommendations on increasing the fun factor, recommendations of increasing triggers to participate and recommendations on making the citizen science projects more visible and promotion*.

4.2.1 Recommendations to alter the intention to not participate

In addition to the motives questions, the respondents were also asked on what could be improved to alter their decision from being hesitant to participate or not wanting to participate at all. To be more specific, what recommendations are needed to alter the motives to not participate from the respondents towards motives to participate.

As mentioned above, a motive to not participate was the presence of the *information meeting or that the location of the meeting* was *long distance****. This was mostly concerning the lead project. Six respondents came up with solutions to improve this or agreed to a viable option. An idea was to make an informative video instead of organising the information meeting on a distant location. So, the respondents could in the convenience of their own home learn more about the citizen science project: *'I think if there is an information meeting measuring would be complicated, then I would drop out. So they do not tempt me to participate. If they would say that the information meeting is in the neighbourhood or I would see a video, then they can also put it online. Then, I can watch a five-minute video and then I know exactly where I stand. I would rather want that with a link to it than having to go somewhere'* (respondent P). Another idea could be that more information meetings can be organised and on different locations, so that potential participants can go to a meeting nearby. An example was given by respondent P who answered the following on the question what she would like to read on a citizen science project invitation to be tempted to join: *'If they send me an attractive letter that tempts me to watch a movie with a cup of coffee with my neighbours in the neighbourhood centre'*.

The reason *activity long distance*** was also mentioned multiple times regarding the activity of the citizen science project of the plastic soup (at the Maas and Waal). A recommendation would be to organise the activity closer to the residentials of potential participants: *'Maybe if it is closer too ... if it were here in the forest, for example, I would be more inclined to participate'* (respondent E) and *'I would be more inclined to help if it was in my neighbourhood, because this is just too far away'* (respondent K). Another suggestion was to make it more tempting to gather in different neighbourhoods and then travel together to the location of the activity.

Improvements on *lack of sense of urgency is* discussed in the following section as part of *content of the invitation*.

4.2.2 Specific recommendations for future citizens science projects

Individual codes; accessible project/feedback of end results

Starting with the individual codes of *accessible project* (three) and *feedback of results* (seven). The first one refers to the fact that the project should be relatively easy to execute and not involve too many steps. The following example is from the lead project: *'I also think it should be easy to execute. Not that you have to be completely lifted into a suit or that you have to go to the middle of the lake'* (respondent J).

Moreover, *feedback of end results* was mentioned by seven respondents as an important suggestion to improve the invitation: *'The only drawback is that you have to guess or look up the outcome or never even get to hear it. Ultimately, you also want to know what was concluded and that you would then inform the respondents. For example, you can put a link at the bottom of the invitation on which you can click after three months to see what is concluded'* (respondent A). The respondents found it interesting to see how their gathered data would be used and how it made a contribution towards a larger goal: *'What will we do when we have studied this? What exactly are we doing it for? That would already motivate me 'okay so it is for a greater purpose that we do this'. I want to know if we have participated, investigated and saw how much waste there is, what they want to achieve with it. I always think that is important in a study'* (respondent D); *'You want to know what you did it for. Suppose you participate in a study of the plastic soup then I do not need to have your entire report, but of what is counted and what species, that is what we did it for. A summary. The feedback of results'* (respondent M). Thus, the lack of information about the end results was a shortcoming and a recommendation.

Recommendations on the content of the invitation

More ideas emerged from the interviews, where one main theme was focused on improvements on the *content of the invitation*. This was at least mentioned by 16 respondents and is together with recommendations of increasing triggers, also 16, the most mentioned recommendations. The invitation should be easily understood by readers with a different background. This improvement was the main theme, but was divided in four other improvements: *Continuation steps, know your target group, explanation of organisations, terms and abbreviations involved and more emphasis on urgency.* Firstly, the lack of *continuation steps* were seen as a great loss to the invitation of the lead project by at least nine respondents. Focused on what the consequences would be when lead would be detected in the respondents' house. No notifications were found on the invitation which said that respondents' would get support with and during the replacement process, whether part of the costs would be reimbursed or would receive a discount etc. As respondent D described: *'They talk all the time about detecting those pipes and the fact that they are there, but here 'this way you become wiser and we also know whether lead has been measured in drinking water'. So okay, if that is measured then you leave it that way? What will you do with it? It seems here that it is literally only if you have it or not, and you can sort out the rest yourself, I find that strange … Is it just becoming wiser or can you also help people with where you can replace it, how you can replace it, and how much money this would cost?'.* Also respondent O was asked about what she missed on the invitation*: 'Perhaps something as continuation steps. Suppose something is detected; what would then be advisable?'.*

Secondly, *Identifying your target group* and responding in a way that everyone feels involved was an essential improvement on the invitation by three respondents: *'You limit yourself to a very small target group and the danger with it. I am okay with that. I am not shocked of that sentence, but you do limit yourself with that. A target group is going to say that they no longer have unborn babies or children. They are then 60 or 70 years old and can say that they do not want to partake in the replacement, that*

way you would limit yourself. So, unborn babies and children up to 6 years of age are the most sensitive to lead, but I would add a sentence about what it does to older people' (respondent G).

The third sub improvement, *explanation of organisations, terms and abbreviations* involved were noted by six respondents. When every word in a citizen science project invitation is clear and understandable, the project would become more accessible for a potential participant, which can lead to a higher chance of participating. An example was given by respondent R on the lead project, where she also mentioned target group: *'I do not understand the first paragraph because I think; what is Dunea? Or who is Dunea? And what do they want from me? Do they invite me and do I have to be patient to read everything? I read it because you asked me, otherwise I would immediately stop reading at the first paragraph, because it is also incomprehensible. I have been instructed by you to read it and that is why I have continued reading, otherwise I would not do it. Because it is incomprehensible and it is not inviting'.* On the question of what could be improved about the invitation she stated: *'I would tell you what lead is, what it does to you and how many particles are in your water. And then they can further invite you for an investigation and explain what Dunea is. And who is KWR? I know it is a research institute, but what does the abbreviation stand for? What I think: look at your target group. To whom do you write that? Is it a text that is accessible to every person or is it aimed at a certain population of people? I can understand and investigate it, but if it ends up with someone who does not have the patience for it, they would not look at it'.*

The fourth specific improvement is *more emphasis on urgency** consisting of the sub code *more emphasis on the risks* and *clear goal* (see section 4.1.5). As in, what the specific risks and consequences are to your body when there is prolonged intake of lead. For many respondents (six) this was not clear, so they draw their own conclusions concerning the risks based on their ideas and experience. With experience is meant that respondents stated that if they would have had lead pipes in their houses, it would not have done them harm, because they still feel fine. Respondent B framed this about the lead project: *'If it is made more clear what exactly the consequences are of those lead particles in the water pipes. So, this makes the importance of the research also more clear... I think this would work better'.* Whereby respondent F emphasised this on the plastic soup project: *'We have a plastic problem, but suppose the plastic problem leads to animals dying in the sea, that kind of images. What kind of images you form in your head always makes an impression. Now it only says we have a plastic problem, of course we all know that. But what do we do with those problems? What are the consequences? And then they play a bit more on your feelings'.* Respondent O mentioned the following: *'If I knew better what the consequences of lead would be, it would appeal more to me. If there is something unhealthy for yourself then you want to know and then solve it'.*

Recommendations on increasing the fun factor

Another specific recommendation is focused on increasing the fun factor activity of the citizen science project. Eleven respondents indicated that they tend to participate when the activity would bring them enjoyment, which also stimulates the intrinsic motive. Ideas which were named were: *Make it a group activity, make it a competition, organise an event, give a reward in the form of a free walk or discount.* Make it a *group activity* indicates that there should be an option where you could sign up with a group of friends or family, people from their own environment which will give them a familiar feeling: *'What you could do is to let people make groups themselves. Then you could talk about this and say 'we will do it sometime' ... So you could let people with their own group participate, their own environment, friends and acquaintances. That you can register with each other ... it is often much more fun to register with*

acquaintances. Perhaps that would attract something more, entering your own group makes you feel much safer' (respondent R).

Adding a *competitive element* to the activity would trigger potential participants to join. Respondent L proposed a competitive element where the participant always wins: *'I mean it is always better to give something than to give nothing, I know that from research. The moment you can win something, that you are one of the 20 or 40, I would not participate. The moment you would always have a prize, that might just be a nice motivation'.* Respondent X suggested another idea: *'You know what is fun, when you make it into a competition. Who collects the most plastic'.*

Seven respondents proposed adding an event that is something more than just the activity itself can be a stimulant for potential participants. As respondent J openly stated: *'I think if you make the activity a bit more hip, more of an event around it, that you do attract more people .... That you get a lunch for example. If you try to involve young people, you will get a large part of people to participate'.* Respondent M proposed the following: *'If you take a part of the shore and put up some facilities there and sandwiches, coffee, tea, that kind of thing at lunchtime'.* Respondent N suggested a combination of a group activity and an event: *'That you can sign up with groups, make it a staff party for my part ... it is also fun to be busy with each other, for and in nature'.* Thus, organising events in the form of a lunch, a small party on the beach, a barbecue, facilities where you have a sandwich or tea and coffee were recommended.

The last improvement was mentioned by one respondent, who came up with the idea to give a reward in the form of a free walk or a walk with a discount with a ranger or forester: *'It is always nice if you can get something in return. It is an initiative of IVN. And that does not have to be something big, but just that you can walk along with a walk in the woods or a forester. If you are talking about nature, then you have that way of getting an incentive ... for free or something with a discount. There are plenty of IVN activities'.*

Recommendations on increasing triggers

As mentioned before, 16 respondents referred to recommendations on increasing triggers and is one of the two most popular recommendations. More improvements can be found under the main theme of *triggers: emphasis on enthusiasm* and *visualisation.*

Enthusiasm was an often heard term when asking respondents to improve the invitation. Seven respondents found that they should be enticed even before they start reading. It should catch the reader's attention immediately, but enthusiasm was lacking in both invitations. Respondent D gave a suggestion about the plastic soup project: *'It is not really an activating message. The paragraphs are simple, but it is not that I read and think 'wow, I will participate', because it does not activate for my idea'.* On the question how she would make the invitation more active she connected it to the upcoming code *visualisation: 'Use more exclamation marks, some nice colours, nice pictures. Make it a bit more attractive to read ... That makes it more fun to read. You want to look at it and think 'hey, I want to read this'.* Also the respondent C, M and R found that enthusiasm could be stimulated through visualisation. As respondent R stated: *'It is not really inviting to read. I had to read the first part twice. The intention is to motivate people more to participate in the project. I think that it should appeal to people with pictures that will make people think, I would like to contribute to clean water or a clean river. That would be more inviting. It is now more a project from A to Z and why and what'.* Moreover respondents O and R suggested that the writing style could be more inviting: *'I think it could be a bit more catchy in terms of writing style'* (respondent O).

Visualisation was recalled the most by 14 respondents. They were missing images of the situation of the projects' goal. Some said that a before and after picture of a beach full of trash and then a clean and waste free beach would really impress readers: *'Maybe something like a picture of a beach, that you are going to clean the beach from plastic. And that you have a picture of a beach with a lot of plastic and a picture of what it looks like after cleaning it up. That you think 'I can participate'' (*respondent H). The invitation should be eye catching for potential participants for them to even look at the invitation, before reading: *'I would make something beautiful with colours. Photography behind it ... It can be made a bit more catchy, that you notice it a bit more when you see it hanging'* (respondent C); *'If it hangs like this, I do not think I am even going to read it, like an empty A4 sheet. But if the layout is a bit nicer, why not? I often look at those things ... And a bit of layout in a house style. Here it is KWR, it will probably have a logo. Just put the logo on and then it will be more believable. If it is a bit credible, then you read it more carefully'* (respondent I). Respondent P was also not attracted to the invitation of the plastic soup project: *'It does not attract me now. It does not stand out, so I do not look at it. If you want to attract attention you should make a nice combination of a striking image with a good text. And that must become an experience and seduce me to look, that does not happen with this'.*

Recommendations on making the citizen science projects more visible and promotion

The last main theme is about improvements in making the citizen science project *more visible and promoting* it: *Promotion during the activity, promoting at schools and universities, involve companies, large scale approach promotion (Facebook).* The first one concerns that during the activity of for example cleaning plastic of beaches, the project is visible for bystanders: *'Make it visible. Make sure that somewhere along the side of the activity it says: 'We clean up here'. A big sign, because otherwise the barrier might be too high for some people, as they think that others would think they have community service ... You promote the activity and you make others think. You give people credit that they do this activity'* (respondent X). So, not only for the promotion of the project itself, but also as a promotion for bystanders.

Moreover, one respondent came up with the idea to promote plastic soup project at schools and universities: *'It actually seems like something which could be executed by schools. Whoever has the youth has the future, so why do you not let primary and secondary schools do this? They can clean it up right away. It is their own mess that they clean up, I do not throw anything in nature. Make it a student promotion'* (respondent Q). This way large young groups can be approach at once and get familiar with the current issues of the environment.

Concerning the involvement of companies as is mentioned by respondent X: *'So the Americans are not doing it wrong at all. They have signs along the highways that say 'this route is maintained by ...', but I believe this is only for cleaning. It is very often companies that build the crash barriers or cleaning it. And that is not wrong, because the names of those companies are written there. It is promotion for the company, which shows that they are socially involved ... It never hurts for the company to say that 'this is our social obligations that we do for society''.* So, this same way of promoting can be organised for citizen science projects like the plastic soup project.

Lastly, a way of large scale promoting can be done through social media platforms like Facebook, and was mentioned by two respondents: *'I think you might have to tackle this problem on social media nowadays ... to get as many people as possible involved' (*respondent J). Events can be made and shared through this medium, so more people can be reached.

4.2.3 Summary of recommendations which can enhance the intention to participate

To summarise the recommendations of 4.2.1, they all were focused on bringing the location of the information meeting and the activity itself closer to the potential participant. Three recommendations were derived from this: organise information meetings on different locations in neighbourhoods, make an informative video instead of the information meeting on long distance and organise the activity closer to the residentials of potential participants.

Then, to summarise 4.4.2, Table 11 shows the recommendations which can enhance the intention to participate in future citizen science projects in order of popularity by the respondents. The recommendations for future citizen science projects exists of two separate recommendations and four recommendations existing of main themes which are: *Content of invitation, increasing the fun factor activity, triggers and making the citizen science projects more visible and promotion.* The first individual recommendation is making the citizen science projects as *accessible* as possible by making it easy to execute and not involve too many steps. Secondly, include *feedback of results,* to show them what has happened with their gathered data and how it contributes to a larger goal when the data is processed.

Continuing to the first main theme*, the content of invitation*, which emphasis that the invitation should be easily understood by readers with a different background. Firstly, provide potential participants of citizen science projects where participants have to replace features in their house (like the water pipes in the lead project) support in any form. For example with the replacement, costs, or just recommend who can help them with the future steps (*continuation steps).* The citizen science projects invitations should have a clear *target group,* so potential participants are addressed as good as possible. When there are certain risks involved, make sure that your whole target group feels engaged. Then, a clear *explanation of organisations, terms and abbreviations* is important. When the invitation is clear and understandable, the project would become more appealing for potential participants. Moreover, more emphasis on the *sense of urgency* of the respondents through better explanation of the specific risks involved and a clear goal is advised.

The second main theme of the recommendations is *increasing the fun factor activity.* This can be done by making a citizen science project a *group activity,* potential participants could sign up with a group of friends or family. People from their own environment will give them a familiar feeling, which will lower the threshold to participate. Adding a c*ompetitive element* to the activity would stimulate potential participants to join. Similarly, with adding an *event,* something more than just the activity itself can be a stimulant for potential participants. The last one is to give a reward in th*e form of a free walk or a walk with a discount* with a ranger or forester, which could give an extra incentive to join.

Recommendations of *Triggers* is the third main theme. *Enthusiasm* is an important trigger for potential participants at the very first step: reading the invitation. *Enthusiasm* can become a greater trigger through improving the writing style, making it more active and emphasising the visualisation. The last one brings up the *visualisation* theme. By giving an impression of the projects' goal by adding images of the situation, for example a before and after picture when the citizen science project has something to do with collecting trash.

Lastly, the improvements on making the citizen science projects more visible and how to promote it. The first one is *promotion during the activity,* so the activity is visible for bystanders when they are cleaning plastic of beaches during the plastic soup project. It would not only be promotion for the participants, but also for potential participants as bystanders. Secondly, *promote citizen science projects at schools* and *universities,* larger groups can be approached and can get more familiar with the currents struggles of the environment. Thirdly, *involve companies,* every company can have their own part to clean, of for example a river bank or a part of the shore. Companies can show that they are

involved with the social interest and at the same time promote their company. The last one is *promoting citizen science on a large scale* through social media as Facebook.

Table 11: Summary of the recommendations in order of popularity

Respondents	Recommendations	Sub recommendations
16	Content of invitation	Provide continuation steps
		Know your target group
		Give an explanation of organisations, terms and abbreviations involved
		More emphasis on sense of urgency
16	Triggers	More emphasis on enthusiasm
		More emphasis on visualisation
11	Increasing the fun factor	Make it a group activity
		Adding a competitive element
		Organise an event
		Give a reward in the form of a free walk or discount
8	Give feedback on the end results	
4	Make the citizen science projects more visible and promotion	Promotion during the citizen science activity
		Promoting at schools and universities
		Involve companies
		Promote on large scale (Facebook)
3	Make citizen science project more accessible	

5. Discussion

This chapter provides an in-depth analysis of this research. Firstly, comparisons with previous research and literature are discussed (5.1), followed by the contributions to established knowledge and social benefits of this research (5.2). Then, this section continues with the relationships between motives, demographic characteristics and the degree of participation, which are used to formulate hypotheses for future research (5.3). The section concludes with discussing limitations and future research (5.4).

5.1 Comparison with previous research

The theory (2.2.9) provided an overview of different motives of current research, this is summarised in Table 1. Almost all these motives which influence the intention to participate corresponded with the data from the respondents except for identification and norm-oriented motives. Furthermore, the most popular motive to not participate was sense of urgency. It became clear that the respondents were not always aware of the specific risks involved and that a clear goal was absent. Therefore, it is important to emphasise the risks, consequences and goal as clear as possible, so the reader understands and it allows them to make a more conscious choice to participate in citizen science or not.

Reputation and social interaction were also seen as motives to not participate, which was in contrast to the theory in which these motives were presented as motives to participate (Nov et al., 2011). A reason for this can be that the difference in research design. Nov et al. (2011, 2014) research concern a deductive research studying the motives of volunteers' participation in online citizen science projects. This research is inductive and explorative, therefore allowing the respondents to give their opinion on why they do not want to participate instead of only why they do want to participate. Respondents admitted that, concerning reputation, they would feel proud when executing a citizen science project activity. However, they were not eager to share their proud for this reason and preferred to keep it for themselves. It is possible that the respondents gave socially desirable answers because it was a one-on-one interview and did not see a better reputation as an advantage. Moreover, some were not convinced of being total anonymous, even though it was emphasised that their names were not used. So, it could be that during possible future deductive research respondents are more likely to answer more truthful when being totally anonymous. Reputation was not seen as a motive to participate but looking at the role of network in participating most respondents were eager to share information about their preferred citizen science project. So, even though they indicated that they did not wanted to participate to improve their reputation, the first step towards improving your reputation is sharing information with your network. Concerning the social interaction motive, making new contact was not a welcome side effect or decisive factor for some of the respondents. However, for some people this is an advantage, while others found it a large barrier and they do not want to invest in new contacts if they are already busy with keeping contact with their current network. Hence, it can vary per potential participant whether it is a motive to participate or not.

Some popular motives to not participate were more focused on practical considerations and unwillingness, as the respondents found that they did not had the time and were too busy, or that the citizen science activity was long distance. Despite these motives, another motive to not participate was that respondents were missing the sense of urgency. Since sense of urgency is both seen as a motive to participate and not participate, it shows that this motive plays an important role in the increase of degree of participation. Another motive to not participate was more focused on the information meetings of the citizen science projects, because the respondents found this unnecessary or long distance. These motives also add new information to the literature.

5.2 Contribution to established knowledge and social benefits

This research contributes to established knowledge through discovering new motives to participate and to not participate through qualitative research. More insights on motives on citizen science in general have been obtained. Furthermore, the research gap is addressed since this research contributes to a clear overview of motives to participate and particularly not participate. The discovered recommendations on future citizen science projects to reach more potential participants are also a contribution to the literature, because this is the first research written on this subject.

The social benefits are twofold resulting from this research are that the motives to participate and not participate can be used in the communication methods to potential participants. For example, an invitation of a citizen science project should emphasise on the urgency, by better explaining the risk involved, to be able to really catch the attention of the potential participant. The chance of participating will increase when the potential participant feels addressed. This can lead to more citizen scientists, more different perspectives, more data generation, and possible to more solutions to environmental challenges. Secondly, this research contributes to established knowledge and social benefits through recommendations for future citizen science projects. These were formulated, which various institutions (e.g. KWR) that want to be or are involved with citizen science could use to recruit non-participants. The recommendations are focused on the first steps of dealing with a citizen science project. By using these recommendations for the foundation of citizen science projects, the base is better thought through; Resulting in fewer mistakes in recruiting participants, drawing up the invitation and in promotion.

5.3 Potential relationships and hypotheses

Potential relationships were found between the motives to participate or not and the demographic characteristics. No previous research studied these relationships and this study therefore offers the first explorative step. These potential relationships offer new possibilities for future research; to get a closer look on how gender, age, education and environmentally active influence the intention to participate. For example, the motive *sense of urgency* is frequently mentioned. More men than women tend to recognise *sense of urgency* as a reason to potentially participate. Therefore, gender is a variable that can potentially affect the intention to participate concerning the motive of *sense of urgency*, which proposes in Table 12 a hypothesis to be researched further. More potential relationships were found and are formulated in hypotheses.

Additional deductive research should be done to confirm the proposed hypotheses, in a large sample with the four demographic characteristics. Moreover, the sample should then comply with a good demographic spread of the respondents, concerning citizen science projects in an urban or rural context (depending on the project). These relationships should then be integrated in citizen science projects invitations when specific target groups need to be reached.

Table 12: Formulated hypotheses from relationships of demographic characteristics, motives and participation

Motives	Hypotheses
Collective motives	Age has an influence on collective motives intention to participate
Intrinsic motives: Balance between enjoyment & interest	Gender has an influence on intrinsic motives intention to participate
Reward motives: Social interaction	Gender has an influence on social interaction intention to participate
Other motives: Sense of urgency	Gender has an influence on sense of urgency intention to participate
Other motives: Lack of time	Age has an influence on lack of time intention to participate
Other motives: Presence of the information meeting or long distance	Age has an influence on presence of the information meeting or long distance intention to participate

Another relationship is about a motive to not participate, a motive to participate and a demographic character (age). Noticeable was that *lack of time* for the age group of 24 and younger was the most mentioned (five) reason for not participating in comparison with the other age groups. The same three of these five respondents also suggested that a large motive to participate would be payment when helping in a citizen science project. This younger generation did not see a citizen science project as a priority to invest their time in. It could be possible that when a direct advantage, as payment, is involved that a citizen science project could get a higher priority and that it could increase the chance of participating.

5.4 More limitations and future research

This research has some methodological limitations. The analysis was partly limited due to the interview questions. The semi-structured interviews were mostly based on the motives from the theory, so for example questions were adjusted on collective motives or reward motives. However, the question asked during the interview did not always match the theme of the intended motive, but instead it matched another motive which sometimes led to less probing questions. This can happen with these types of interviews, so flexibility is of importance.

The 24 respondents that were chosen for this explorative inductive research were a limitation. The limitation of this research design is that it is not possible to interview an infinite number of people. Thus, it is difficult to draw conclusions. Follow-up research should test these relationships (the influence of the demographic characteristics on the motive to participate) with a larger sample size with deductive or inductive research. These relationships can help to better specify the target group of each citizen science project and can better address their needs. It proved difficult to confirm a real relationship between the characteristics and the motives to participate or not participate. Discovered potential relationships could also be random, for example it could have been random that more men than women answered yes on a question. However, this research is a good starting point for further deductive research for exploring these relationships in a larger sample size (as mentioned in section 5.3).

Furthermore, the uncovered motives to participate and not participate can provide a starting point for more future research. Future research can benefit from this research by using this as a foundation for future questionnaires and for further inductive research.

The lack of interview data about the identification and norm-oriented motives to participate could have been because the researcher tried to avoid pointing the respondent too much in a certain direction. Probing questions on these subjects were asked, however if the respondent did not give these specific answers on motives it was not discussed too deeply. The same applies to the lack of information on the identification, norm-oriented motives and intrinsic motive to not participate. However, this could be a good focal point for follow-up inductive research trying to go further in-depth with these motives and interviewing the respondents' network, to get a better image of all the influences. Another option is deductive research, which allows for more respondents and more direct answers.

Another limitation is based on the intention to participate or not participate. This research is mostly focused on the intention to participate or to not participate and not if the respondent actually participates or not. It was not possible to research the real behaviour change, because respondents did not actually participate in the citizen science project but were asked if they would. Moreover, it could not be assumed that people from the sample would participate. Future research can take this into account when studying real behaviour change, multiple contact moments must then be planned, before and after the project (and possibly a third for evaluation), with the potential respondents. A longer time frame is needed for gathering the data. The intention also applies to the motive of the *network* where influences from the respondent on their environment and the other way were studied. This could be seen as a limitation, because intention is assumed, and this cannot be verified. Future research can focus also on this aspect, the network of the potential respondent could be considered and should be interviewed.

Future research could further explore more the details of the *network* of potential participants in participating and how citizen science can diffuse through a network. The role of social pressure as a motive can be studied. This research has looked at network as a motive, but it only touches upon a small part of this. This subject itself can be a study on its own, because network is a dynamic entity. One suggestion is to conduct more inductive research by asking open-ended questions and interviewing participants of citizen science projects. More information can be gathered on who they spoke with, what they discussed and if these discussions led to friends/family/neighbours/colleagues changing their behaviour and joining citizen science projects. This way, more insights in network as a motive can be established. Another suggestion can be more deductive research concerning this research. Since, more people can be reached more different can be data gathered and statements can be made about possible relationships.

Moreover, the identification of opinion leaders in networks could not be done except for respondents naming themselves as one. By interviewing peers this influence can be measured, but during this research opinion leadership could not be confirmed.

A last interesting note is that this research is relevant for increasingly emerging citizen science initiatives, an example is 'Project measure your city' in Utrecht (MCU, n.d.). This is a citizen science initiative of the environmental centre in Utrecht and they want to map climate change together with their residents. The centre wants to know what the residents questions are concerning the subject of climate change and they are inviting them to contribute and join the research. This research can help these initiatives to respond to the motives of the participants so they are more likely to participate. In addition, they can use the recommendations for citizen science projects that best suits them to increase the degree of participation.

6. Conclusion

This research aims to identify additional uncovered motives to participate, but in particular motives for not participating in citizen science projects. Citizen science refers to participation of the public in the generation of new scientific knowledge. Moreover, this research provides recommendations to enhance the degree of participation. This led to the following research questions: *What motives determine the intention to participate or not participate in citizen science? And what recommendations do enhance the intention to participate in citizen science?*

The first part of the research question is answered by first discussing the motives which determine the intention to participate and then the motives which determine the intention to not participate. One frequently mentioned and relevant motive was uncovered which determine the intention to participate: *sense of urgency*. More emphasis is needed on the *sense of urgency* by potential participants when reading an invitation. This is done by providing more information on the risks and the real consequences and be explicit on the project's goal; on why exactly the project is so essential for the potential participants.

This motive is also the motive which determines the intention to not participate, named *lack of sense of urgency,* this sense was lacking by many respondents but can be improved through the same points of emphasis on the *sense of urgency.* Beside this motive, two other important motives were discovered which determine this intention; *presence of information meeting or long distance* and *activity long distance*. When a citizen science project has an information meeting it is advisable to organise it close to potential participants neighbourhoods or to make an informative video instead of organising the information meeting on a distant location. So, potential participants can receive information in the comfort of their own home. Lastly, for *activity long distance*, if the activity of the citizen science project is long distance, an improvement would be to organise the activity closer to the residentials of potential participants or make it more tempting to gather in different neighbourhoods and then travel together to the location of the activity.

The second part of the research question is answered by presenting which recommendations enhance the intention to participate in citizen science projects. The recommendations for future citizen science projects exist of two separate recommendations (*accessibility project* and *feedback in results*) and four recommendations existing of main themes which are: *content of invitation, increasing the fun factor activity, triggers and making the citizen science projects more visible and promotion.* These recommendations are discussed in order of popularity, beginning with the most popular recommendations.

The first main theme*, the content of invitation*, emphasised that the invitation should be easily understood by readers with a different background, through providing continuations steps, know your target group well, providing clear explanation of organisations, terms and abbreviations and more emphasis on urgency. The second main theme is recommendations for *trigger*s, through more emphasis on enthusiasm and visualisation on the citizen science project invitation. Thirdly, the main theme of the recommendations is *increasing the fun factor activity.* This can be done by making a citizen science project a group activity, adding a competitive element, organising an event or to give a reward in the form of a free walk or a walk with a discount with a ranger or forester. The first individual recommendation is of giving *feedback of end results* of citizen science projects. The fourth main theme is recommendations on making the citizen science projects *more visible and promotion*. The first could be done through promoting during the activity, promote citizen science projects at schools and

universities, involve companies to help clean and promoting citizen science on a large scale through social media as Facebook. Finally, is the second individual recommendation of making the citizen science projects as *accessible* as possible by making it easy to execute and not involve too many steps.

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9. Appendices

Appendix A: Interview design for non-participants

Introductie

Hallo, Ik ben Sabina Pruis en ik volg de master Sustainable Business & Innovation aan de universiteit Utrecht. Ik ben op dit moment mijn scriptie aan het schrijven in samenwerking met KWR, een onderzoeksinstituut op het gebied van water in Nederland. Voor mijn scriptie doe ik onderzoek naar de mogelijkheden hoe burgers bij onderzoek doen betrokken kunnen worden.

➔ Toestemmingformulier kort bespreken en dan laten ondertekenen.

Het onderzoek zal rond de 45 min duren en ik zal de spraakrecorder nu aan zetten.

A) Algemene vragen
- Zou je jezelf willen voorstellen?
  - o Leeftijd, studie/werk/hobby's

B) Thema vragen
Eerst een aantal vragen om wat meer te leren over jouw interesses.

Milieu
1. In hoeverre ben actief bezig met het milieu? *(Collective)*
   a. Is het een belangrijk thema in je leven?
   b. In hoeverre vind jij het belangrijk om kennis op te doen over de natuur?
2. Doe jij graag mee aan projecten/activiteiten die je dichter bij de natuur brengen? Zo ja, welke? (Collective)
   a. Ben je graag buiten/lid van een natuur blad/donateur (wwf)?
3. Deel je jouw/deze activiteiten met je omgeving? Waarom wel/niet? *(Norm-oriented)*
4. Word je door je omgeving gestimuleerd om met het milieu bezig te zijn? Zo ja, door wie precies? *(Identification/norm-oriented)*
   a. Hoe gaat jou omgeving met milieu om? Hoe vind jij dat?

Wetenschap
1. Ben je zelf geïnteresseerd in wetenschap? *(Collective)*
   a. Is het een belangrijk thema in je leven?
   b. Hoe komt dit tot uiting? Lid van wetenschappelijke magazine/studie/hobby's?
   c. Deel je jouw activiteiten met je omgeving? *(Norm-oriented)*
2. Word je door je omgeving gestimuleerd om met wetenschap bezig te zijn? Zo ja, door wie precies? *(Identification/norm-oriented)*
   a. Hoe gaat jouw omgeving met wetenschap om? Hoe vind jij dat?

C) Vragen uitnodigingen projecten

Ik laat je zo twee voorbeelden van projecten zien waarin burgers betrokken worden bij het onderzoek doen. Hierover zou ik je graag een aantal inhoudelijke vragen willen stellen, maar eerst een algemene vraag.

Beide projecten deze algemene vragen stellen:

Plasticsoep

1. Wat is je eerste reactie als je deze uitnodiging ziet?
   a. Wat valt je op?
   b. Wat spreekt je aan?
2. Is deze uitnodiging wat voor jou? Waarom wel/niet?
   a. Wanneer zou deze uitnodiging wel wat voor jou zijn?
   b. Wat zou jij op een uitnodiging willen zien zodat jij wel overtuigd zou worden om mee te doen?
3. Wat zouden voor jou redenen zijn om niet mee te doen? Wat zit je in de weg?
4. Zou je anders hebben gereageerd als de projecten over bijvoorbeeld blik/glas zouden gaan?
   a. Zouden je antwoorden op de vragen over de projecten anders zijn geweest als de projecten over andere onderwerpen waren gegaan? Zou je bij andere onderwerpen eerder geneigd zijn dan wel of niet mee te doen?

Lood

1. Wat is je eerste reactie als je deze uitnodiging ziet?
   b. Wat valt je op?
   c. Wat spreekt je aan?
2. Is deze uitnodiging wat voor jou? Waarom wel/niet?
   b. Wanneer zou deze uitnodiging wel wat voor jou zijn?
   c. Wat zou jij op een uitnodiging willen zien zodat jij wel overtuigd zou worden om mee te doen?
3. Wat zouden voor jou redenen zijn om niet mee te doen? Wat zit je in de weg?

- Ben je wel eens een uitnodiging van zo'n soortgelijk project tegengekomen? Ben je er op ingaan? Waarom wel/niet?

- Heb je voorkeur voor een persoonlijke of algemene benadering van zo'n uitnodiging voor een project?

➔ *Na bespreking beide projecten (3 mogelijke scenario's)*
- Stel je zou deze uitnodigingen tegenkomen op een prikbord in de bibliotheek of sportschool zou je dan meedoen? En aan welke? Of zou je dat niet doen?
  1) Geen van beide; hoe zou het voor jou veranderd moeten worden om wel mee te doen? En als je daarin tegemoet zou komen zou je je dan inschrijven? Waarom dan meedoen?
  2) Beide
  3) Voorkeur voor één

D. Specifieke vragen uitnodigingen projecten

Nu kijkende naar beide projecten/ 1 project.

Reward motives:
- Heb je voorkeur voor individueel werken of samen? (en wil je nieuwe mensen leren kennen?) En waarom? Beide mag ook

Norm-oriented norms:
- Stel dat je mee zou kunnen doen met deze projecten, zou je het dan belangrijk vinden of je er direct of indirect invloed uit kan halen? Waarom?
    o Welk direct/indirect voordelen kan jij identificeren?
        ▪ Ja, kwr: vervangen loodleidingen en beter voor gezondheid
        ▪ Nee, Afval: geen direct voordeel, wel voor onderzoekers.

Reward motives:
- Stel dat je mee zou doen met een van de twee projecten zou je dit dan delen met anderen? Waarom? (andere betere informeren/wil laten zien waar je mee bezig bent/jezelf een beter gevoel geven)

Hedonistic of intrinsic motive:
- Stel je zou (toch) meedoen aan deze projecten, zou je deelnemen omdat je het leuk vindt of puur uit interesse?
    o Wat vind je er zo leuk (spelelement) aan? (Dat je na zoveel data verzameld hebt een tussenstand kunt zien van alle deelnemers bv→ prijs)
    o Wat vind je er zo interessant aan?

E. Einde
1. Als je de uitnodiging zo voor de laatste keer ziet heb je dan nog wat om aan te vullen? Heb je nog een laatste tip om jou over de streep te helpen om mogelijk mee te doen.
2. Is er nog iets wat je wil vragen of opmerken in het algemeen?

Bedankt voor je tijd en het helpen van mijn onderzoek. Ik ga dit interview uitwerken en dan stuur ik het naar u op ter controle, mocht ik binnen twee weken niks van u hebben gehoord dan ga ik er vanuit dat dat alles goed is. Zou je het eindresultaat van mijn scriptie willen ontvangen?

Appendix B: Invitations of citizen science projects for interview

1. Plastic soup project

Bestudeer afval langs rivieren

Word rivierafvalonderzoeker en help mee om de plastic soep te bestrijden.

Wat ga je doen?

Je schrijft je in via de website. Je krijgt in koppels één of meerdere afgebakende tracés aan de Maas en Waal toebedeeld in Gelderland, Brabant of Limburg. Hier ga je volgens het standaardprotocol het afval tellen en indelen volgens categorieën. Door in koppels te werken kan je elkaar ondersteunen in het volgen van de standaardprotocol en juiste categorie indeling blijven hanteren. Met de resultaten van deze actie weten de onderzoekers wat voor afval er langs de rivieren ligt. Zo kunnen onderzoekers oplossingen vinden voor het collectieve afvalprobleem.

Waarom doe je mee?

We kunnen er vandaag niet meer omheen: we hebben een plasticprobleem. Wereldwijd verzamelen miljoenen mensen zich om stranden gezamenlijk op te ruimen. Dat is natuurlijk een geweldig initiatief, maar de hoeveelheid afval die ons vanuit de zee via de rivieren bereikt blijft nog onderbelicht. Door een grootschalige inventarisatie te maken van dit afval, kunnen onderzoekers iets doen aan dit probleem.

Wie kan meedoen?

Iedereen. Het maakt niet uit waar je woont, maar het is natuurlijk handig als je in de buurt van de Maas of de Waal woont.

Wie organiseert het?

Schone Rivieren is een initiatief van IVN Natuureducatie, Plastic Soup Foundation en Stichting de Noordzee. IVN (Instituut voor Natuureducatie en duurzaamheid) laat jong en oud de natuur van dichtbij beleven, in de buurt, in de Nationale Parken en op school. Bijna 25.000 vrijwilligers en leden van IVN laten zien hoe fascinerend, leuk, gezond en belangrijk de natuur is door verschillende projecten te organiseren.

2. Lead project

Beste mevrouw/heer ....,

Graag nodigen wij u uit om deel te nemen aan een onderzoek naar loden waterleidingen. Tijdens werkzaamheden aan huis komt Dunea vaker delen loden leiding tegen dan je zou verwachten. Meestal zijn dit de leidingen in huis. Om betrouwbaar water ook betrouwbaar uit de kraan te laten komen, zoeken we graag samen met u en onderzoeksinstituut KWR naar een methode die helpt bij het opsporen van loden waterleidingen in en om het huis.

Uw adres is geselecteerd omdat u woont in een wijk waarin veel huizen voor 1960 zijn gebouwd. Mogelijk heeft uw huis nog loden waterleidingen. Looddeeltjes kunnen dan in uw drinkwater terechtkomen. (Ongeboren) baby's en kinderen tot en met 6 jaar zijn het gevoeligst voor lood. Daarom adviseert de overheid en uw GGD loden leidingen te laten vervangen.

Doe mee! Door deel te nemen aan het onderzoek weet u gelijk of uw huis nog loden leidingen heeft *en* draagt u bij aan een wetenschappelijke kennis die ons helpt keuzes te maken in de toekomst. U kunt hier meer over lezen op kwrwater.nl/projecten/citizen-science-en-lood.

Het onderzoek
Het onderzoek bestaat na een voorlichtingsbijeenkomst op onze productielocatie in Scheveningen (za 25 mei), uit twee delen:

1 - Metingen aan de keukenkraan
U ontvangt speciale flessen en neemt zelf monsters aan de kraan, die een laboratorium gratis voor u analyseert. Ook houdt u een strookje onder de kraan, en meet de waterkwaliteit zoals in een aquarium. Een medewerker haalt de monsters op wanneer het u uitkomt.

2 - Metingen bij de watermeter
U maakt foto's bij de watermeter, meet de lengte en omtrek van enkele leidingen en geeft deze gegevens online door.

Als deelnemer aan dit onderzoek wordt u schriftelijk op de hoogte gesteld van de resultaten van uw metingen, dus of u loden leidingen heeft en of er lood in het drinkwater is gemeten of niet. Zo wordt u wijzer en wij ook.

Graag zien wij uw reactie via deze link tegemoet **voor 13 mei 2019.** Wij kijken uit naar uw deelname. Geeft u het ook aan als u niet wilt deelnemen?

Hartelijk dank!

Appendix C: Radar charts to participate and not participate

1. Radar charts other motives to participate

These other motives are illustrated in radar charts together with the three remaining demographic characteristics; education (Figure 6), age classifications (Figure 7), environmentally active (Figure 8). Figure 6 shows that more men than women deem *sense of urgency* as an important motive. Figure 3 demonstrates that respondents with a HBO background found *sense of urgency* important. By the age classifications 24 and younger and 65 and older in Figure 7 found *sense of urgency* important as a motive. Just as the semi-environmental types who also deemed this motive as relevant, see Figure 8.
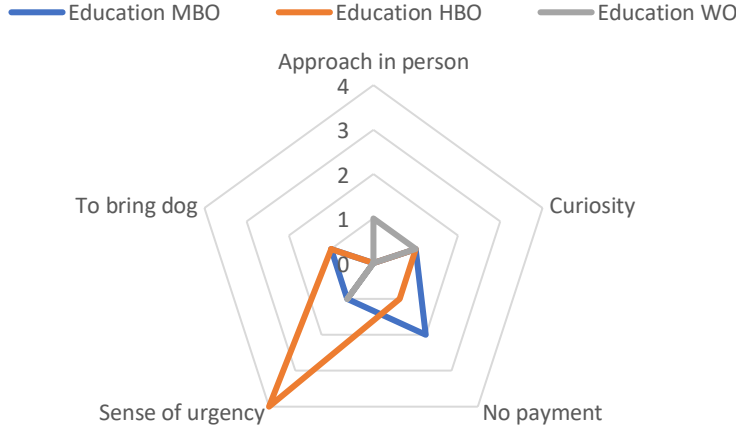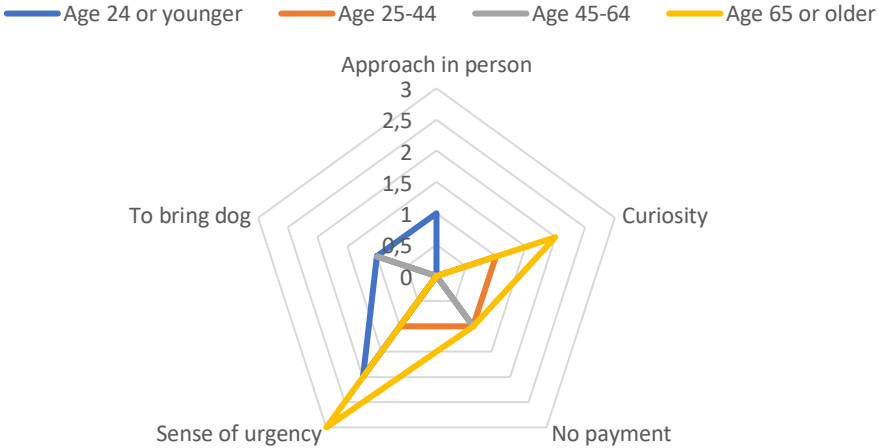

Figure 6: Other motives to participate and education

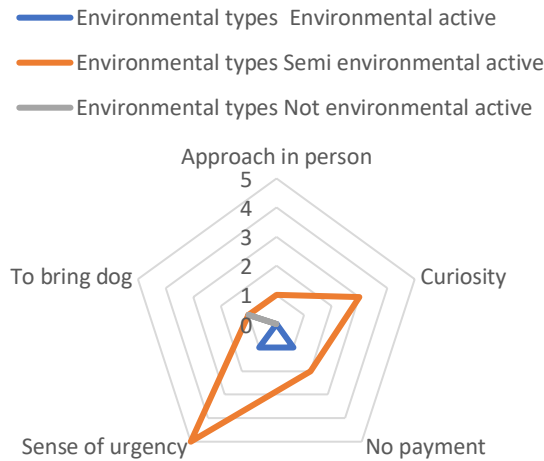*Figure 7: Other motives to participate and age classifications*

Figure 8: Other motives to participate and environmentally active

2. Radar charts other motives to not participate

Here, radar charts are presented to give a good overview of all the motives to not participate and possible relations between the demographic characteristics; education (Figure 9), environmental type (Figure 10). It seems that the educational background are fairly similar when looking at the other motives. Figure 10 shows no clear influences between the different environmental types, especially that the majority of the respondents were semi-environmentally active.
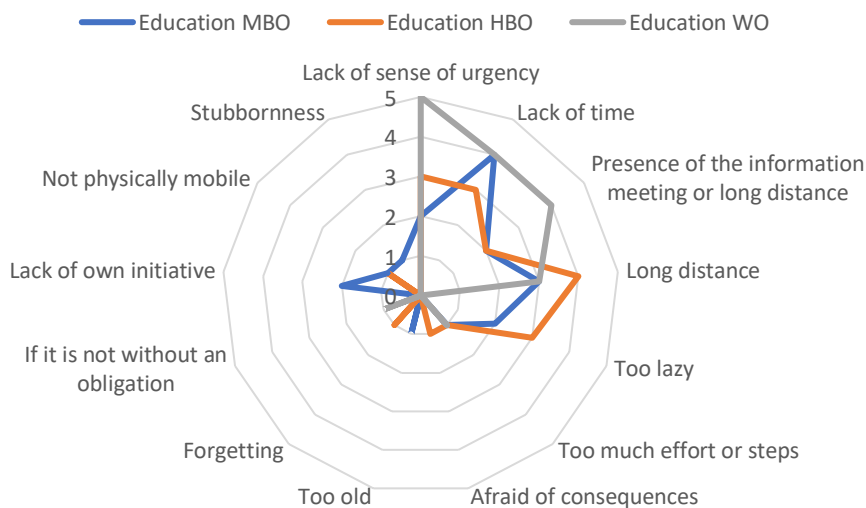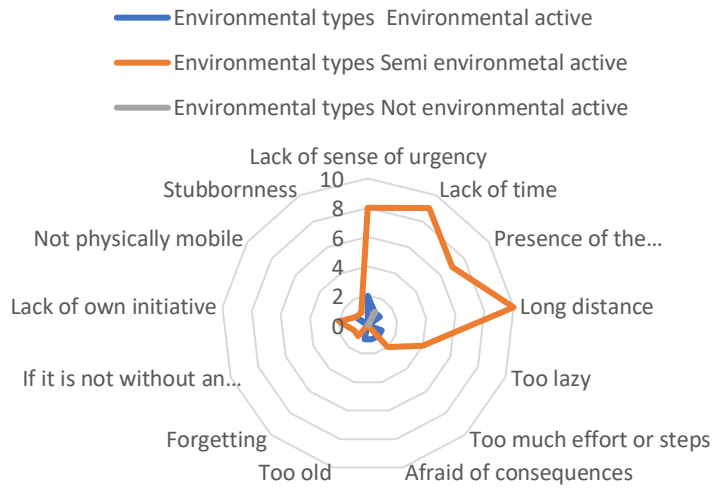

Figure 9: Motives to not participate and education

Figure 10: Motives to not participate and environmentally active