Opening up science as a recursive public: a study of Do-It-Yourself Biology in the Low Lands

Master thesis

Engaging Public Issues

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Abstract

The emergence of gene-editing using CRISPR-Cas9 technology has changed the field of biology at a rapid pace. In the dim light of biotechnological developments, an international movement of Do-It-Yourself Biology (DIYbio) communities has grown, which makes research instruments available outside of institutions by inventing and producing cheap alternatives, working open source and practicing biology outside traditional labs. This thesis examines the Do-It-Yourself Biology (DIYbio) community, with a focus on initiatives in the Netherlands and Belgium. According to the existing literature, one of the outcomes of DIYbio is that science is democratized. This thesis builds on work of STS-scholars, I use the concept of the 'recursive public' by Christian Kelty (2008) to build the argument that the DIYbio community is a recursive public by of the interwovenness between their practices and their formation as a public. The concept of the recursive public has been formerly used to understand several bottom-up movements that challenge authorities, aspects which are characteristic for DIYbio, but has not been used to analyze the community of DIYbiologists. I argue that understanding DIYbiologists as a recursive public will give a more in depth understanding of the use of the concept recursive public by analyzing a group of people that come together online as well as online. Democratizing science, arguably one of the pillars of DIYbio, can be done and understood in several ways. It is thus relevant to get an understanding how DIYbio practices this and what effects this has on those wanting to partake and on the accessibility of the natural sciences.

I argue that while DIYbio opens science up as a recursive public, it is not able to fully democratize science. To build this argument I have analyzed the practice of democratizing science through participant observation during online meetups and on forums to understand how participants act like-minded while content analysis of websites gives a better understanding how the community presents itself publicly. In five in-depth semi-structured interviews with participants I got a deeper understanding of the motivations to participate in DIYbio. The research is conducted using digital means because the DIYbio movement relies for a bigger part of knowledge and network infrastructures on the internet and operates online as well as offline. During the period of research their work fully took place online.

Keywords: *open source, biohacking, do-it-yourself science, recursive public*

1. Introduction

Wandering around on YouTube, you may find videos with titles such as How to Genetically Engineer a Human in Your Garage or We made fluorescent beer with CRISPR IRL. The videos show people who gene-edit beer, or themselves, using CRISPR/Cas-9. In 2012 with the invention of CRISPR, gene-editing became almost as easy as text editing for scientists. CRISPR is "a revolutionary new class of molecular tools that scientists can use to precisely target and cut any kind of genetic material" (Molteni, 2019). With the invention of new technologies like this controversial CRISPR/Cas-9 system (Baumann, 2016), the field of bio-engineering has developed rapidly in the past decade. In the dim light of the revolutionary developments in bio-engineering, Do-It-Yourself biology (DIYbio) and biohacking have emerged and grown. DIYbio is the practice of biology outside scientific institutions, with an open-source mindset (Bohemen & de Vriend, 2014). The emergence of DIYbio is strikingly similar to that of the internet and hacking culture of the late '80s and early '90s. Zettler et al. (2019) argue that, in the same fashion as wide access to computers gave rise to computer hacking at the end of the 1970s, the recent accessibility and affordability of genome editing technologies have spurred interest in genetic biohacking. This rise in direct-to-consumer genetic testing and modification has brought individuals to conduct genetic experiments outside traditional scientific labs and in some cases even on themselves. The motivations of practitioners to self-experiment are diverse: they vary from a belief in a universal right to practice science, business opportunities or creative expression (Zettler et al., 2019). Although governments and the

academia have stated their concerns about conducting experiments outside the traditional spaces, there is a growing involvement of people (especially in the USA, Europe and South East Asia) who are actively practicing DIY biology. They argue that taking ownership of biology and demystifying the science behind genetic and medical tests is empowering (Wollinsky, 2009).

The organizational model of DIYbio is in many cases modeled after hacker spaces: collectively run spaces called open labs, fab labs or wet labs where people gather to talk about and work on experiments, which are now widespread in mostly Western countries. And the DIYbio movement does not merely resemble computer hackers in organizational form, the two also share an anti-establishment activist mindset. Elements such as openness regarding data and knowledge sharing, go hand in hand with openness in access to scientific institutions. DIYbio also shares values of computer hackers such as a communitarian spirit, individualism, entrepreneurial drive, and distrust of bureaucracies (Delfanti, 2010). Lastly, the making of the infrastructure in which they exist, such as working with DIY instruments and communicating online through forums is distinctive for the community itself, as a recursive public (Kelty, 2008).

The formation of DIY biologists as a public and their practices to democratize science asks for further exploration, because of the endless ways in which democratization of science can be done. While the internet started as a place filled with ideals of open source information sharing and democracy, the internet mostly did not become the free space envisioned by the pioneers and hackers. Rather it became a hyper-capitalist structure riddled with privacy issues that has changed the way we live in a drastic way (Stikker, 2019). The

impact of the rapidly developing field of biotech cannot yet been overseen but might have far-reaching effects on humankind. This is why it is of great importance to get an understanding what the hackers of this field (i.e. DIY biologists) are doing, focusing on practices surrounding democratizing science.

This thesis builds on the works of Christian Kelty (2008) and Dorien Zandbergen (2017) to bring the concept of recursive public into practice. Although DIYbio is a topic that has been covered extensively in the last years, the concept of the recursive public has not yet been applied on this group of people. Central in this research is the question of how DIYbio's formation as a recursive public shapes how practitioners of DIYbio democratize science. To reach an answer to this question, I used online content analysis, participant observation and semi-structured interviews in a three part analysis.

I argue as a result of my analysis that DIYbiologists can be considered a recursive public that opens up science through their practices, but are not able to fully democratize it. This thesis is structured as follows: it starts with an elaboration on the emergence of DIYbio to get a broad understanding of the field. Subsequently, I delineate the concept of the recursive public and the practice of democratizing science, building on theories from the field of Science and Technology Studies (STS). These concepts are used to research the issue at hand and will thus be operationalized. Thereafter, I describe the research process and lastly I will share my analysis and conclusions on the issue.

2. Theoretical framework

2.1 The emergence of Do-It-Yourself Biology

A brief overview of the rapid emergence of the movement is needed in order to get an understanding of the global Do-It-Yourself biology movement and its actors, the challenges and its organization. As argued by several scholars we are witnessing the emergence of the DIYbio movement: a global movement spreading the use of biotechnology beyond traditional academic and industrial institutions and into the lay public. Practitioners of DIYbio include a broad mix of amateurs, enthusiasts, students, and trained scientists (Keulartz and Beltz, 2016; Ikemoto, 2017; Delfanto, 2011). DIYbio represents, according to Keulartz and Beltz (2016) an almost direct translation of hacking culture and practices from the realm of computers and software into the realm of genes and cells. Although the movement is still in its infancy, the contours of a new paradigm of knowledge production already show (Keulartz and Beltz, 2016). DIYbio refers to itself as a community, situating local projects in a broader collective through online communication. Knowledge is shared online and one of the goals is to reduce the cost for equipment and resources for experiments. While this may suggest an anti-capitalistic mindset, commercialization is also part of DIYbio: certain parts of the community for example work together with sponsors, are with a company or have started to sell DIY-kits to practice DIYbio (Ikemoto, 2017). This shows that actors and practices in DIYbio are varied and that people with several ideologies are part of DIYbio.

There are however geographical nuances in the fields of work. Zooming in on the Europe, Seyfried et al. (2014) argue that the European amateur biology scene is carried by individuals who initiate local DIYbio communities and work for the bigger part on the intersection of science, art, and entrepreneurship. The first DIYbio lab in Europe was the Parisian La Palaise. In the Netherlands there are just a handful communities that affiliate with DIYbio, and they work for the bigger part on the cutting edge of science and art. There are also projects that focus on developing prototypes to commercialize, such as a prototype mobile malaria diagnosis device (Amplino) as early as in 2012. European communities however, face an important challenge in contrast to their counterparts in the United States: in Europe we see strict regulation of biotechnology by national governments. (Seyfried, Pei and Schmidt, 2014). Next to these regulations, the financial infrastructure also impends the continuity of projects, as most initiatives are self-funded. Lastly, the bigger part of the communities in Europe are not interested in serving as a test-bed for biotechnology start-ups, since their main goal is to provide open-source and easily accessible biotechnology (Seyfried, Pei and Schmidt, 2014). This shows that, while the DIYbio movement is internationally connected, it is important to be aware of local nuances to understand what is happening when studying DIYbio communities in the Low Lands.

Whatever the different motivations to practice DIYbio and the local context the community exists in, working open source and making biology accessible is intrinsically part of the practices of the DIYbio community. Seyfried et al. (2014) argue the emergence of synthetic biology as a field, has sparked this development: the techniques used in synthetic biology made it easier to engineer, in contrast to traditional genetic engineering.

This development made it possible to broaden the user base for engineering beyond academic institutions and industries towards amateur movements. These scholars define DIYbiologists as individuals who conduct biological experiments as an avocation with a great interest in the scientific principles and the social implications of the projects (Seyfried, Pei and Schmidt, 2014). This means that to be part of DIYbio, individuals have to believe first and foremost in open science.

As stated earlier, the (online) infrastructure of DIYbio resembles hacker culture which can give an understanding how individuals who practice DIYbio organize. Denisa Kera (2012), a scholar researching DIYbio communities in South East Asia, demonstrates that hacker spaces offer rich material to understand how several Do-It-Yourself communities work with developing technologies and define novel forms of engagement with those technologies, "by a bottom up approach of community building and experimenting with new knowledge and technologies" (Kera, 2012, p.3). This embodies, according to Kera (2012) what Latour and Stenger label cosmopolitics: new alliances between human and non-human actors that expand political and social participation and shape new truths through practice, for example by designing new tools as a community. This assembling of human and non-human actors is an experimental process with a desire to allow everyone and everything to become an active part in both research and policy-making. Following this thought process, the global DIYbio movement enables citizens to take active part in biological and medical research (Kera, 2012). This suggests that opening up science together is ingrained in the way the actors form a public, which will be further explored in the following paragraphs.

2.2. Do-It-Yourself biologists as a public

As argued above, DIYbio sparks the imagination of individuals with different backgrounds and a shared interest to practice open source science, which happens while gathering as a community of actors and non-actors. Providing alternatives for traditional ways of doing science by building an open source information network and easily accessible biotechnology happens through organizing outside the realm of institutions. This gives DIYbiologists the tools to be critical on what is happening within the traditional institutions such as universities. This is done through shared social imaginaries about what the role of science and knowledge is. I argue that the DIYbio community is a recursive public (Kelty, 2008) because of their autotelic features and their anti-authoritarian sentiments. Autotelic features of a public are important to get an understanding of the notion that a public organizes itself outside institutionalized power and can explicitly not be formed through institutions. Kelty (2008) recognizes this features in the formation of geeks as a recursive public in relation to the internet. He argues that geeks work together to maintain the structures they exist in to become an independent public, and develop a desire to defend their independence.

Securing their independence is ingrained in the layers of their formation (Kelty, 2008). Geeks find, as an example, affinity with one another because of a shared moral imagination of the Internet, a technical infrastructure which has made it possible for them to develop and maintain their shared affinity. This shows the way in which a recursive public comes together is decisive for its formation. For the geeks this meant that the formation into a recursive public includes that they communicate through and about the networks and tools,

meaning making, maintaining and modifying Internet networks and software. Kelty (2008) stresses, using Warner's concept of counter publics, that the recursive public furthermore is realized by the circularity of phenomenons, such as certain methods or objects. These phenomenons enable the discourse that is developed by the public.

According to Kelty (2008) recursive publics exist independent of and as a check on constituted forms of power, such as governments, markets and corporations. This becomes even more clear in the practices of another recursive public. Zandbergen (2017) uses the concept of the recursive public to research the Air Quality Egg (AQE) project surrounding the development of a device for the measurement of air quality, producing alternative data on air quality, as a check on the information provided by the government. Zandbergen (2017) considered the global participants of the AQE-project as a recursive public because of the sovereign sphere they created without hierarchy and the open source tools of sensing and data visualization they produced. The collective consist of people from various range backgrounds that joined the project for individual motivations, which resembles Kelty's geeks. The AQE project participants ranged from independent activists, to corporate innovation managers that had several, sometimes contradicting understandings of what the project entailed. Although they did not achieve the goal of the project (to build a prototype), the concept of the prototype itself became a metaphor for the transformation facilitated and experienced by the social collective, which meant that the performativity of the community was of great importance for the existence of the community (Zandbergen, 2017), and the assembling factor for the group.

2.3 Co-producing the democracy of science

The theories laid out earlier show DIYbio can be considered a recursive public through the interwovenness of their practices to come together as a public, which centers around the belief of democratizing science by working open source and making science accessible for all. The notion of democratizing science can be approached in several ways. In this research I focus on two practices of democratizing science: the accessibility to participate in practicing science and the act of decision-making about what is considered science. Democratizing science is introduced by looking at the meaning DIYbio communities give to this practice. To get a better understanding of the history of opening up science for laypeople, I will look at the history of democratization of science in the Netherlands and Salomon's study (2000) on boundaries between the layperson and the expert. To understand who is able to make decisions about the credibility of knowledge, I use the work of Jasanoff (2004) and Giordano (2018). This gives an understanding of the co-production of science and society, which affects who gets to decide what is and isn't considered science.
In the Biopunk Manifesto published in the early days of DIYbio, Meredith Patterson (2010) argues that it is a human right to be curious and this should not be restricted by rules or not being able to be empowered by scientific literacy. The motivations to practice democratization of science through the medium of DIYbio are clearly worded in the manifest:

> We the biopunks are dedicated to putting the tools of scientific investigation into the hands of anyone who wants them. We are building

> an infrastructure of methodology, of communication, of automation, and of publicly available knowledge. (Patterson, 2010)

Making scientific literacy available for anyone, resembles the emergence of science shops in the Netherlands. In the 1970s most public universities in the Netherlands started science shops as 'participatory mechanisms to democratize science' (Wachelder, 2003, p. 244) and were established in the wake of students protests of the late 1960s. The main goal of the science shops was to give activists and interest groups free access to scientific knowledge. They also wanted to open up the 'bourgeois' universities and get academia out of isolation by working interdisciplinary, which fitted the zeitgeist: the establishment of elected advisory counsels made universities more democratic and gave universities the chance to make independent decisions about funding. While the science shops found their origin in student counter culture, they became increasingly professionalized in the 1980s and their role changed in mediating between students and clients that needed research. This introduced a decline in the amount of science shops in the original form, continuing in the 90s and 00s. As Wachelder (2003) states, this was the result of a changing political climate. The executive boards of universities became more powerful in contrast to the elected councils, which led to financial cutbacks that led to the disappearance of science shops in their original form (Wachelder, 2003) The history of the science shops shows that initiatives to democratize science depend on the ideology of its initiators and the political climate, as are its funding options. This means that a scientific institution's willingness to give all access

to scientific knowledge is strongly influenced by societal and political changes, as also argued by Salomon (2000).

Salomon (2000) writes that scientific institutions are by definition not the most democratic spaces because democracy implies that anybody, expert and layperson can take part. This conflicts with being a scientist in the academic sphere and to be part of an intellectual elite. But, this does not mean that politics have no role in academia: politics have become increasingly important in science. Science is ingrained in society and with the development of new, less understandable and more life threatening technologies –such as nuclear explosions and genetic engineering– science has begun to conflict with democracy through of a lack of understanding of the matters. Events like Hiroshima, have however awakened people to be concerned with science. This awakening is also reflected in academia itself: In 1975, biologists discussed adapting a moratorium on research on genetic engineering, and a worldwide ban on human cloning followed, imposed by UNESCO. The debate in academia on the boundaries of ethical research is not a traditional scientific debate: finding new barriers in knowledge had historically nothing to do with the potential consequences. The demand for transparency arose according to Salomon (2000) because of the increasing complexity of technical systems that can only be operated by experts, a practice that excludes people from democratic oversight. This meant that the growth of information is not matched by the transparency of society. But it takes two to tango: the limits on transparency are on the one hand set by the producers of knowledge and on the other by the receivers of this knowledge: a public that is not able to understand it. This, however, does not mean that the ideal of transparency shouldn't be tried to be reached for

the sake of democracy, because "experts should not have the last word in debates where the consequences are never purely technical, but are deeply connected to values and interests" (Salomon, 2000, p. 50). According to Salomon (2000), the amount of participation possible depends on a paradigm shift in the decision-making field –in the case of academia, scientists– because this means they have to follow rules that are not explicitly set by themselves (Salomon, 2000).

2.3 The politics and rhetoric of Do-It-Yourself biology

Jasanoff (2004) takes the argument that science and politics are increasingly intertwined further with her concept of co-production. According to Jasanoff, co-production is: "shorthand for the proposition that the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we choose to live in it" (Jasanoff, 2004, p). Jasanoff (2004) argues developments in science and technology are always interwoven with issues of meaning, values and power. In other words: the making of science is inherently political which means it cannot be neutral, or inherently good (Jasanoff, 2004). This is why according to Giordano (2018) while studying the democratization of science, the remark that post-colonial and decolonial scholars make about democracy have to be taken into consideration: democracy and inclusion politics are not necessarily enacted to create more justice –wars are fought in the name of democracy and liberal democracy itself has been historically tied to (neo)colonialism. This means that a closer look is needed when the stated motivation is democratization, because of the ways in

which democracy is used as justification for a variety of inequitable social arrangements (Giordano, 2018).

As we have seen, do DIYbio communities practice science in an autonomous and autotelic way, outside institutions and in co-production with society. According to Giordano (2018), this strong sense of anti-establishment within the community and the use of terms as ‘everyone’ and ‘all of us’ code to a belief in a post-racial society, which are proclamations related to social justice thinking, such as the right to science for everyone to combat exclusion. Moreover, do the rhetoric of the DIYbio communities suggest a false binary between science and the public which shows the belief in a post-racial and post-feminist society. Giordano (2018) analyzed the rhetoric of DIYbio, focusing on the claims that DIYbio is a new way of doing science, based on democratic and affordable practices. According to Giordano (2018) DIYbiologists say they show solidarity with ‘the public’, unlike the institutionalized field of biology. This is possible through a re-configuring of the boundaries between science and ‘the public’; by claiming to represent a public outside traditional science. Giordano (2018) is skeptical of these claims and inquirers how dominant discourses of a post-racial and post-feminist world shape the development of the ethics of the DIYbio community and if deeper principles of democratic science grounded in social justice are obscured. She does so by identifying how the community defines itself and what the rationale is to create more democratic sciences. Giordano (2018) argues that the split between science and the public is a false binary because of the contingency between science and the historical and cultural context in which it is always produced. Giordano

argues that DIYbio community has placed itself outside traditional academia at the side of the public while performing principles of democratizing science.

Christian Kelty (2010) argues that, rather than putting themselves in the realm of the broader public, the DIYbio community is more like a leaky boundary between elite science and something slightly less elite. He argues that outlaw biology (as he calls the DIYbio community) does not exist outside the existing order of –the so-called– Big Bio but rather is an integral part of it. Therefore, Kelty (2010) asks us to move away from a simplistic model of being inside or outside of science. The starting point for the statements and practices of DIYbio, as portrayed by Kelty (2010) and Giordano (2018) are the conviction that science is unquestionably good, while feminist scholars argue that science serves the interests of those who produce it. This begs the question: which knowledge should be included in the practices of DIYbio? Giordano (2018) therefore argues that DIYbio communities use social justice rhetoric while they do not include opposing voices that challenge the belief that science is neutral (Giordano, 2018).

The work of these scholars display that the DIYbio community can considered to be a recursive public that is formed by and through their practices of gathering, to open up science. The history of democratizing science in the Netherlands has shown that this practice is dependent on funding and political climate in- and outside academia. While the amount of participation possible by the layperson in scientific decision-making is dependent on the academia's power to change the rules, the DIYbio community has taken action to put the tools for scientific literacy in the hands of anyone. But there are important factors have to be taken in consideration when democratizing science is stated as a goal, when the

belief that science is neutral is not opposed and when there is a lack of diversity on perspectives.

4. Methods

4.1 Place and space

This research is conducted using digital means in its entirety. DIYbio is in part a global online community and identity, so this was a fitting space to conduct my research. The international character of the online community had as an effect that the participant observation and content analysis transcended the Dutch and Belgium borders, the participants for the semi-structured interviews were however sampled on being part of the Dutch/Belgium DIYbio community. The research was accomplished from my home, behind my laptop, working with digital artifacts (Akemu & Abdelnour, 2020) for the content analysis and participant observation. Digital artifacts can, in contrast to physical artifacts be altered through reprogramming and editing and are not exclusive because they can be copied. While doing qualitative research using digital means, two notions of digital artifacts should be taken in consideration: digital as an archive and digital as a process (Akemu & Abdelnour, 2020). In my research process I used both understandings of digital artifacts: I used digital as an archive in my content analysis, such as documents, video's and other media that are published as finished products. For my participant observation I focused on digital as process: asynchronous messages, video conferences and wiki's that were interactive and could still be edited. In the explanation that follows I state my research process, including the alterations that I had to make during the time of research. This

method section starts with the translation of the most important concepts of my theoretical section in my research design. This is followed by an explanation on my research methods and insights in how I applied the specific research method and which decisions I made while conducting the research.

4.2 Operationalization of the recursive public and democratization of science

The two central concepts in this research are the recursive public and the practice of democratizing science, as derived from the theoretical framework. To be able to research this theoretical concepts during my three part analysis I have operationalized the concept as follows.

4.2.1 Recursive public

To analyze if and how the DIYbio community can be considered a recursive public, I have focused on two characteristics of a recursive public: the infrastructures that the community uses to gather and the circularity of phenomenons to examine if this could be understood as autotelic and sense of anti-authoritarianism. The infrastructure where the community gathers is researched by looking at the way the online infrastructure is set up, during the content analysis of websites and participant observation: this considers for example lay-out of websites, the editability of content on websites or forums, the language used. The circularity of phenomenons was analyzed by the materials, knowledge and the definition DIYbiologists gave DIYbio during semi-structured interviews as well as their broader beliefs about nature and society. Sense of anti-authoritarianism was analyzed by focusing on

statements made about traditional institutions, by aiming attention at the codes are ethics that were underlined in the DIYbio community.

4.2.2 Democratization of science

To be able to research democratization of science I focused on two aspects: the accessibility to participate in practicing science and the act of decision-making about what is considered science. I focused in my content analysis and participant observation on the accessibility of science by researching the possibilities for anyone with an internet connection to access information published by DIYbio and whether it requires resources such as money or certain knowledge. In the semi-structured interviews this was translated in questions on the practice of open source online, on the accessibility considering of the spaces where DIYbio happens and decision-making about projects that are executed. The accessibility of online- and offline spaces already grasped the aspect of decision-making about scientific knowledge because of the simple fact that to be able to make decisions one has to be there, but this aspect was further analyzed by homing in on the relationship between laypersons and the experts in the field of biotech in the labs and the ways processes enabled people with varied levels of knowledge to work together.

4.3 Research Methods

To understand the practices of the DIYbio movement I interpreted the motivations of the participants of the field of this study. Here, I was and still am aware of my role in constructing the research field. Following the tradition of STS I worked with the notion that, as a researcher, I am influencing the process and outcomes, and performed reflexivity.

To reflect on my own assumptions and influence on the research process I used the techniques that are suggested by Cassell and Symon (2004), such as writing down my presuppositions at the start of the research process, to reach to these during each stage of the research process and I kept a research diary to record my own feelings about the process. To get insight into the actions and motivations of the DIYbio movement I used a set of qualitative methods, this is a three-part approach, and I used triangulation (Lune and Berg, 2017).

The first part of my three part-analysis, was content analysis. The content analysis allowed me to gain understanding of the language and projections which are used by the community to the outside world and how the community organizes itself online. The second part of the analysis was participant observation. After analyzing how the community behaves online and presents itself to outsiders, the participant observation gave me an understanding of the practices of the community when they come together in group formation. Lastly, I conducted five semi-structured interviews with persons that are or were involved with organizations that give space to DIYbio practices or affiliate their organization with the Dutch or Belgian DIYbio community. I also interviewed a person that worked individually on projects outside of academia but does not self-identify as a DIYbiologist. The respondents were selected through target sampling and snowball sampling to be able to select relevant actors in the small local field of DIYbiologists. Because of the small local field in the Netherlands I chose during my target sampling to also interview an organization in Belgium. The interviews gave me a deeper understanding of the motivations and practices within the community. I used the interviews also to reflect on the data that I

obtained during the first and second parts of the analysis, to be as complete as possible in gathering the data.

Although I have been working on the methods simultaneously, I started my research with content analysis. During my content analysis I have focused on several websites, starting with the websites of the Dutch and Belgium initiatives that were also subject in the semi-structured interviews. During the content analysis I aimed attention at language used in organizations' communications, the practices and events they described and promoted. I also examined (if present) house rules, financial information such as funding and workshop prices, and the ability to interact with the website as a visitor. I also analyzed two prominent websites in the global DIYbio internet sphere, Hackteria and DIYbio.org. Both websites function as a place where DIYbiologists can document their experiments on wiki's, give an overview of initiatives happening around the world and providing forums for discussion. Point of interest while examining these two websites was the content published in the wiki's. To get a better understanding of phenomenons that circulate in the Dutch DIYbio community I analyzed one episode of the Biohacking Podcast about DIYbio and Youtube video's published by Dutch DIYbiologists that reflected on the DIYbio community or showed experiments.

The second research method I used was participant observation. The initial plan was to visit meet-ups and open labs in several cities in the Netherlands, but during the research period, this was not possible because of lockdown measures during a pandemic. I was able to be present by two of the meet-ups I planned to visit, because they were held online. During these online meet-ups I focused on the organizational set-up of the meet-up, the

participants, the themes that came to the attention and on the questions and ideas that were discussed in the live chat that was happening synchronously to the presentation.

Additionally, I analyzed the online activity on six forums and online groups. These types of messages can be considered online, asynchronous communication and were mostly published on forums that were linked to important websites of organizations within DIYbio. I made the decision to examine messages published between January – April 2020 to analyze if there were similar developments or recurring themes visible on the forums. I analyzed the themes of the messages, the activity per message (answers on questions, likes (if possible) on messages, if the message was shared if possible) to understand what were considered important topics and how persons interact with one another. I also analyzed the codes of conducts, forms of gate-keeping and how moderation was practiced on the forum.

Lastly, I have conducted five semi-structured interviews. My initial plan was to interview participants that I would meet during workshops/meetups or at open labs during participant observation. This process had to be altered because of the lockdown, and started with interviews with people that are part of DIYbio organizations in the Netherlands and Belgium. I approached respondents through email of Facebook to ask if they wanted to participate in an interview. I have also interviewed someone who has done biological experiments outside academic institutions but is not part of an organization and does not identify as a DIYbiologist.

While scheduling the interviews via email I asked consent for interviewing the respondent on the record and to use anonymized interviews in my research. The interviews were for the bigger part held using video meetings and telephone calls. I also received

complementary information from one of the organizations via email. The interviews were semi-structured, meaning that I used a preconceived set of questions for all participants, but also asked follow-up questions on themes that came up during the conversation. There was however a difference in questions for people that were part of an organization and the DIYbiologists that work individually. I started each interview with the question to define DIYbio, followed asking about the path that had led the respondent to DIYbio and if they could describe how a project came into being: what was needed, what materials were used, why did they choose the project. The following questions were asked for example:

- Can you tell me about a project you worked on?
- What kind of instruments or resources were needed for this experiment?
- Why are you interested in practicing science outside of institutions?
- What would you consider the shared values for the cooperation with the other persons in your organization?
- What do you consider to be the boundary of experiments?

Using this combination of methods made it possible to focus on all characteristics of the central concepts, the recursive public and democratizing science, to be able to answer my research question.

5. Analysis: the infrastructure of opening up science

In the next paragraphs, the analysis is presented. Through analyzing mixed media using content analysis and participant observation in online DIYbio communities and interviewing several persons from different spectra of the field of DIYbio I have researched how science is democratized by the practices of DIYbiologists as a recursive public. The analysis starts with DIYbio's practices, by inspecting how group membership is sculpted to understand how DIYbiologists behave as a recursive public. The analysis shows that to be part of the recursive public of DIYbiologists is to put in the work to be able to produce open source knowledge and to identify yourself as a DIYbiologist. These two parts are essential and interconnected. When one of these two components is missing, a person is not considered part of the public. After shedding light on DIYbiologists as a recursive public, I present my analysis on the practice of democratizing science: how is this done and in what way is democratizing science (im)possible? This part of the analysis demonstrates that DIYbio is able to break open how science is done by critically reflecting on it and altering this practices, which enables people to partake. I argue, however that DIYbio is not able to fully democratize science: there is a certain amount of knowledge, time and money needed to practice biology outside of institutions, which is not possible for all. I argue that this is connected to the type of knowledge needed to understand and do the practices of DIYbio. Although DIYbiologists use other instruments to experiment than those used in institutionalized science, it still uses institutionalized science for protocol, methods and knowledge.

5.1 Do. It. Yourself.

5.1.1. Doing

I argue that one of the two components to be able to be part of the DIYbio public is the practice of doing biology and sharing what you are doing openly. This is ingrained in the on- and offline infrastructures of DIYbio, such as websites, languages and organizational choices. The online infrastructure exists of open collaboration projects on the internet, where DIYbiologists publish about what happens offline in open labs and at their homes. This means that the online and offline practices are interconnected by the doing, that happens offline, and the sharing, which happens online. Online this happens on forums where DIYbiologists come together to share projects and seek help, and on websites that make it possible to share and propose edits to existing information or code, such as wiki's and public repositories (e.g. GitHub projects). This also happens through using searchable hashtags such as #diybio on Instagram to share pictures and video's on projects.

While shedding light on the offline practice the act of putting in the work yourself is central. I argue that this is reflected in language used which is demonstrated on- and offline, and the organizational structure of open labs. Exemplary for this is the jargon used in the questions asked in the DIYbio.org Facebook-group in the period of research messages mostly concerned sharing an ongoing project or asking for assistance in solving something that has to do with a project the topic opener was working on (DIYbio.org Facebook-group, 2020). The centrality of practicing science is translated to the language used in the messages. The following messages demonstrate that the person asking uses

jargon, which can only be understood with a considerate amount of knowledge about the subject.

> "I am trying to understand if copper hurts bacteria. There is a history of such an effect. My test in these photos shows that e coli are not bothered by copper in the least. This test was: LB agar, copper filings sterilized with boiling water, washing the plate with the filings, placing a drop of NEB Turbo e coli on the plates, incubating ~9 hours. The first photo is 200x. In the second photo, you can see the growth reaching these copper flakes and not 'caring' at all. Any ideas?" (DIYbio.org Facebook [private group], 2020)

While the post is readable for a layperson, one has to have a certain understanding of the biological processes and the materials mentioned to be able to join in on the discussion, meaning someone has to be doing biology themselves or has to have an (academic) background in biology to be able to partake in these forums.

The organizational structure of open labs underlines the focus on doing it yourself, which became clear when all respondents that I interviewed who are or were affiliated with an open lab shared similar experiences with people who inquired if the respondent would do experiments for them. For example Richard, an initiator of a now-defunct open lab told me about artists that reached out to the lab to create fluorescent plants for them. "Well, we only helped them out, but my heart was not in this. Look, helping out is very important but making our hands dirty for them, no" (Richard, initiator of closed DIYbio-group, 2020).

It is, considering the name given to this community, Do-It-Yourself Biology, obvious that practicing biology yourself should be the core principle, but -as is often the case- a deeper underlying reason is worth exploring. According to one of the respondents, the reason why doing is of such importance is because of the autonomy it gives: “I think there is added value in the tangible, being able to shape something gives another perspective on meaning. You are not able to understand the meaning of something when you do not know how it works” (Alfred, initiator of an open lab, 2020). This means that the act of doing is seen as a tool to reflect critically on biology as a science. For Alfred, being able to Do-It-Yourself for the sake of reflecting critically on a subject is a personal motivation to practice almost anything that he does, also outside the field of biology. He underlined this with referring to the motto “If you cannot open it, you do not own it”, which is grounded in the maker-scene (Hertz, 2018). Using doing as tool echoes the content of the Biopunk Manifesto in which Patterson (2010) argues that gaining scientific literacy helps to understand the world around us.

Alfred’s beliefs in the power of DIY as a mean to reflect critically, motivated him to enable others to also do this by initiating an open lab which could provide a ‘third space’ for people. A third space is a place next to one’s home and workplace where a person can come together with like-minded people to exchange ideas freely (Alfred, initiator of an open lab, 2020). Such a third space is enacted through the Biohack Academy, that has as main goal to teach participants to set up an experiment autonomously and built their own lab during the Academy. The experiments, lectures and information on how to build the lab are documented on GitHub, and accessible for anyone (Waag, 2020). This can be

recognized as a very literal translation of Kelty's notion of the autotelic feature of a recursive public: participants communicate about and through the structure they build, in this case an alternative for a traditional lab, to work autonomous on their own experiments. This intertwines again with the other important part of doing: doing it openly and together by recording the process and sharing it, to enable others to duplicate or work on projects.

That open source is at the core of doing DIYbio became clear when talking to two respondents that do not define themselves or their organization as full part of the DIYbio sphere. Both respondents argue that they would like to work open source, because of the importance for scientific breakthroughs to work together with others because "there has never been an invention that is done by one scientist" (Jeroen, writing a PHD-proposal, 2020), or because they are doing something in a new way and want others to learn from them (Sarah, project manager at a circular lab, 2020). But, both respondents chose to not work open source because of vested interests. In Jeroen's case, his career in the academic field. Academic peers advised against publishing ideas online because of intellectual property. Meanwhile, Sarah told that entrepreneurs who work at the lab cannot share their ideas openly because these are their 'business cases' they have to sell at one point. Although working open source lays at the core of DIYbio, Alfred (initiator of an open lab and workshops on DIYbio) argues that sharing knowledge and working together on projects does not come naturally:

> "A condition is of course that you share what you do, and the documenting. But a lot of people are not interested in this. They want to do it for themselves, and they do not feel like sharing it, writing

> down a protocol asks a lot from people" (Alfred, initiator of an open lab, 2020).

One of his workshops enabled working together: the course was an international cooperation between four different open labs that would follow the same course. He argues that the structure of the workshop forced the participants to work together, which resulted in working internationally together on building the same machines. These findings all underline that the practice of doing biology and sharing what you are doing openly is the first component of becoming part of the DIYbio public.

5.1.2. The name game

I argue that the other important component of DIYbio as a public is how DIYbiologists gather, this is a somewhat messy process, which stems to the anti-establishment sentiments within the community.

> "People that do not feel like any of that all come together in something called DIYbio, which also has other labels: biohacking, community bio, that is also part of the phenomenon, that it has a lot of names and that this ambiguity has to exist. If it becomes too evident, a lot of people will rebel against it, that is an important part of it, this anti-establishment is definitely part of it" (Alfred, initiator of an open lab, 2020)

This name game became also apparent in one of my first encounters with the Dutch DIYbio scene while listening to the Biohacking Podcast. During the introduction of the subject of the podcast episode, four different labels were already given to the phenomenon of doing science outside of institutions (Joosten, 2020). While it is questionable for some respondents if DIYbio even can be considered a community, because of the variety of ideologies to practice DIYbio, gathering under a common flag is needed to be able to work open source. Alfred highlighted the online function of being together as group, in the form of Google Groups and such. Gabriella, the lab manager of an open lab I spoke to also underlined that working online together internationally on projects might be more important for their open lab than the local activities. Jeroen, who defines himself as outside DIYbio added that this is exactly why he does not feel like being a part of DIYbio, although he has been working on experiments outside the university:

> "Well, I think that it is kind of an identity for some people, I think I have seen Reddit posts of people that describe themselves as such, that they are part of it and also, and I never do that, maybe because I do not have a social network of people that participate in this" (Jeroen, writing a PhD-proposal, 2020).

Sculpting DIYbio as an identity is actively shown by the fact that DIYbio can also happen without the label: "Outside the urban setting it is considered normal to do stuff yourself. In Romania, you do not find DIYbio, but that is of course not true, they just do not bother to label it, build a community around it" (Alfred, initiator of an open lab, 2020). This

showed that doing biology outside of institutions alone without identifying yourself as practicing DIYbio and sharing the work also means not being part of this public.

I argue that these practices define DIYbio members as recursive public, because they show the autotelic features of them building infrastructures for doing and open source sharing and the sculpting of identity that is related to anti-authoritarianism. In the theory section I have highlighted two different groups that have been analyzed as a recursive public: geeks by Christian Kelty and the participants of a citizen-led open source project by Dorien Zandbergen. In both cases, the main characteristic of the recursive public was the ongoing process of building an autonomous space to gather. This is exactly what DIYbio is doing online and offline as well. They build together, with varying motivations the infrastructure that is needed to share information open source. Binding them together is being critical of doing institutionalized science. To become part of this infrastructure, the messy process of defining DIYbio as a community is needed, which is messy because of the anti-authoritarian sentiments, Lastly, to become part of the public, you have to know the phenomenons of biology, such as jargon and institutional biological knowledge.

5.2 Democratization of science

5.2.1. Opening up

One of the recurring themes of DIYbio is the motivation to democratize science, and I argue that, while DIYbio opens up science by critically reflecting on it, it does not fully democratize it. This is demonstrated by the analysis of two practices of democratizing science: the accessibility to participate in practicing science and the act of decision-making

about what is considered science. The way that DIYbiologists come together as a recursive public are crucial for understanding their efforts to democratize science.

All organizations I spoke with are working in a variety of ways on opening up science. This varies from critically reflecting on science through practicing it, but also working with self built instruments and making it affordable to join in by using cheaper alternatives. One of the ways this is done, is through the earlier mentioned Biohacking Academy, by sharing everything that is done on GitHub, meaning that anyone can follow the classes online, and find, amend and improve all the information needed to built their own lab (Waag, 2020). Other ways to open up science is by building alternative instruments and openly sharing them, as Richard did with building an open source PCR machine that he and his team 3D-printed. In this example the practice of building the cheap alternative for the PCR machines used at university labs and the experiment that is done with the DIY PCR machine are both motivated by accessibility of science:

> "One of us said, one of the things we normally cannot do is to do paternity tests in anonymity, but if we build a PCR machine we could… and if we learn our students to do a PCR-reaction, than they can do this in anonymity when they grow up" (Richard, initiator of now-defunct DIYbio-group, 2020).

That different aspects of the accessibility of doing science exist is demonstrated in choices open labs make about space and place. Two organizations, the open lab where Gabriella is affiliated with, and the now defunct initiative of Richard, focused on making science

accessible for all by lowering prices for participants to be able to join workshops, and choosing locations that were welcoming for all, such as a working class neighborhood. These two initiatives focused more on being open for younger generations, and giving them the opportunity to learn without needed basic knowledge.

The accessibility of knowledge, which was addressed earlier on, surfaces once more here and can also be approached differently. Alfred's lab focused on breaking science open through critical thinking and doing, and was located in a space that is considered an elite urban cultural institute. While the open lab evenings were free of charge to visit, the workshop he initiated costed €2500, which attendees may try to finance by requesting a grant from one of the funds listed on his website. When a person wants join the open lab nights, there is a certain amount of knowledge needed to do biological experiments, and although the means are given to learn about biology through the open source network, the work has to be done by one's self and has to be understood to be done safely. To be able to obtain this knowledge is not possible for anyone, as Alfred mentioned talking about the open lab nights at his open lab:

> "Everything was possible, depending on the money and time people had and if it was safe or not. That made it also exclusive, you had to have the knowledge, you had to have the time. I can help you, but the most part you have to do yourself, those are the three things that work as a barrier for a lot of people" (Alfred, initiator of an open lab, 2020).

This shows that several aspects of DIYbio open up science that are also recognized in the literature on DIYbio: doing science on locations outside of institutions and thus making it accessible for everyone, working with open source machines and reflecting critically on existing rules and institutional science by doing the experiments in an alternative way. But, there are barriers to entry.

5.2.2. The right knowledge

While science is opened up by the infrastructure of knowledge sharing and by some organizations through actively working on making science accessible, DIYbio does not fully democratize science, meaning not all can join the practice of doing biology, because of the certain amount and kind of knowledge, time or money that is needed to practice biology outside of institutions. According to some, this is for the better. Roland van Dierendonck, one of the organizers of the Biohack Academy states in the Biohacking Podcast that:

> "In this culture of fast knowledge sharing on Twitter and Facebook I can imagine that it {experiments} will be seen by the wrong people who will copy it. It is important —because you lose context online— to know what someone is doing, how much work has put in it and what you should know before beginning" — (Van Dierendonck in Joosten, 2020).

DIYbio opens up science for the people that have the resources to do so, but is not open for all. That a specific kind of science is needed is best illustrated by the discussion about which knowledge can or cannot be part of DIYbio. While all initiatives told me that

people are free to conduct all sorts of experiments as long as it is safe and inside the boundaries of the law because "if you want to set something on fire, the lab is always a safer place" (Gabriella, lab manager open lab, 2020), there were contradicting views on welcoming certain kinds of knowledge, although this knowledge is used to experiment outside the academic boundaries. Jeroen argued that anti-vaxxers and flat-earthers can also be considered DIYscientists:

> "People that ask themselves questions and are looking for answers by themselves. If you broaden the definition, anti-vaxxers and such people should be included, they do the same stuff but maybe somewhat less scientifically based" (Jeroen, writing a PhD- proposal, 2020).

But there is gate-keeping, to make sure that anti-vaxxers will not become part of the knowledge infrastructure, based on the beliefs that people should not be able to harm others with false knowledge or take advantage of the presence of amateurs. This is done, for example by asking a set of questions to people before they become a member of one of the international DIYbio Facebook-groups. Aspirant-members have to fill in three simple questions, that ask (1) if you realize you have to act civil, (2) that you believe science is for everyone and (3) what attracts you towards DIYbio. One of the moderators of the group tells me that the answers tell a lot about underlying motivations. The moderators never reject requests on spelling or such things, "But, anti-vaxxers, sorry...no" (Gabriella, lab manager open lab, 2020).

This shows that DIYbiologists have to have specific beliefs, norms and values, which was also underlined by Alfred. He recalled a DIYbio meetup in the USA where he questioned how open the community really is, because of the slogans that were projected at the meetup about openness: “but if you ask, is it really open for everyone, also for fascists? They say no, not for them” (Alfred, initiator of an open lab, 2020). While drawing a hard line in the sand at fascism is always good common sense, it also demonstrates boundaries are placed on what knowledge is considered science and who is or isn’t able to partake in the creation and consumption of that knowledge. This does, however, ask for a critical reflection on the knowledge that is considered right, which seems to be knowledge that is rooted in institutionalized science. This resembles what Kelty (2010) argued to be leaky boundary between academia and DIYbio, instead of a new kind of science in the making. As Giordano (2018) and Jasanoff (2004) argue, science is not neutral but a historically contingent product that is formed by norms and belief, such as the belief in a post-racial world. Giordano (2018) argues that when opposing voices that challenge the belief that science is neutral are not included, DIYbio will not be open for all (Giordano, 2018).

Salomon (2000) argues that the amount of participation possible depends on the viewpoint of decision makers. In the case of DIYbio the amount of participation possible by people who approach science differently like anti-vaxxers or flat-earthers, is through gate keeping infrastructures such as moderators, but also through the bigger part of the community that might call them out or just not consider them to be DIYbiologists. Although they have (limited) access to the information and communication networks through

the open source structure, they are not recognized as DIYbiologists that put in the work, because they do not use traditional science knowledge and/or methods that are considered unethical.

Looking back at the statement made in the Biopunk manifest about democratizing science, it is seen that the initiatives do their part of "putting the tools of scientific investigation into the hands of anyone who wants them" (Patterson, 2010) by building and maintaining the open source information structure, thus work on democratizing science. But, looking at the two components central to this research, the democratization of science by accessibility and decision-making, I argue that fully democratizing science is not possible, because on the one hand accessibility is challenged by the need for the means to do biology yourself, such as traditional scientific knowledge and money and on the other hand does gate keeping not give space for approaches that differ from traditional science (which is in certain cases for the better).

6. Conclusion & Discussion

This research aimed to identify the way DIYbiologists behave as a recursive public and democratize science through their formation as a recursive public, building further on theories from STS-scholars. Based on a three part qualitative analysis on the formation of DIYbiologists as a recursive public and the democratization of science, I argue that the participants of DIYbio can be considered a recursive public because of the two main characteristics of the group: the autotelic feature of constructing their open source

infrastructure by doing the work and the ongoing and somehow ambiguous process of labeling themselves as an anti-authoritarian community.

These autotelic features of DIYbio as a recursive public enable to open up science, but do not to fully democratize science. The opening up of science happens through the open source knowledge sharing and practicing science outside institutions with alternative tools. While there is a near-infinite well of information on how to do biological experiments online which could theoretically lay the tools for doing biological experiments in everyone's hands, and thus democratize science, this does not translate fully to practice. To be able to understand the phenomenons circulating in DIYbio, specific knowledge is needed. While it is possible to gain this knowledge autonomously, time to learn and money to invest in the resources to do the experiments are needed. This has as an effect that people without the ability to reserve time to invest unfunded in the gathering of this knowledge and/or people that don't have the money to purchase the instruments and resources for experiments cannot be part of DIYbio. Another aspect that further stifles democratization of science is the kind of science used in DIYbio, that is to say, science rooted in (Global North) academia and which is considered neutral. As long as opposing voices are not included, science will not be for everyone. My results demonstrate what Jasanoff (2004) calls co-production: At the one hand is the emergence of DIYbio inherently intertwined with the technological developments of the internet, the legacy of hacker culture and the emergent technologies in biology. At the other hand do societal structures such as the unequal opportunities to be able to gain institutional knowledge and the notions of what is ethical science affect who

can become part of DIYbio and thus makes it impossible for DIYbio to democratize science fully.

I have been able to get to my conclusions using qualitative research methods. By using a three part analysis using content analysis, participation observation and conducting semi-structured interviews I have been able to get an understanding of how DIYbiologists behave as a public. Through the analysis of mixed media content produced by DIYbio groups themselves, I got an understanding how DIYbiologists present themselves towards each other, and laypersons. The participant observation gave me an understanding of the way DIYbiologists interact with each other about topics, what norms and values are present, and what kind of discourse is used. The semi-structured interviews gave insight how DIYbiologists reflect on group membership, what their motivations were for being part of DIYbio and what their norms and values where and how these were reflected in their practices. Because my research was conducted entirely online, I was not able to get a firsthand understanding of the offline practices of DIYbio. This has been a limitation for the research, but because of the inherent online identity of the public and the focus on formation as a public it has not juxtaposed the research process or the outcomes of the research. Another limitation of my research is the small group of respondents for interviews, but the quality of the interviews gave me nevertheless insides to gain understanding.

With this research, I aimed to contribute to the existing literature on DIYbio by analyzing DIYbiologists as a recursive public, and by focusing on the way in which ways democratizing science is practiced. I have also applied the concept of the recursive public

in a new way, by working with the concept to analyze DIYbio, which as a group has not yet been analyzed in this way, which gave new insights on how the practices of a public can impact gate keeping. This research may also give a new perspective on how this concept is applicable on groups that are interconnected on- and offline. Lastly, this research contributes to work on the history of democratization of science in the Netherlands, by focusing for the bigger part on DIYbio initiatives from the Netherlands within the inherent international movement.

For further research on the democratization of science I would recommend questioning the possibility to fully democratize science while using traditional sciences, because of the historical formation of institutional knowledge, done for the bigger part by and for white people in the Global North. While DIYbio is an anti-authoritarian public, they use the authority of traditional science that is historically formed from a white male perspective. While this notion is growing in the social sciences, by for example intersectional feminist scholars and the field of decolonization studies, this might not yet be of impact on the natural studies that are most often considered neutral.

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8. Appendix

8.1 Attachment 1

Topic list semi-structured interviews

Introductie respondent	Leeftijd, achtergrond, woonplaats, interesses.
Pad naar DIYbio	Definitie? Hoe in aanraking gekomen? Eerste ervaring Waarom geïnteresseerd? Nu bezig met een project?
Netwerk/samenwerking	Met wie deed samen? Hoe groep mensen omschrijven? Wat waren gezamenlijke waarden voor samenwerking? Hoe zag de samenwerking eruit (waar, hoe contact, hoe vaak?) Wanneer is iemand een DIYbioloog? Ken je veel mensen die hiermee bezig zijn? Hoe onderhoud je contact met anderen?

	In hoeverre is er een gevoel van community voor jou?
Wat?	Wat was het project Waarom hiervoor gekozen? Wat was hiervoor nodig (materialen)? Beschrijven van werken aan een project? Hoe waren de waarden die jullie hadden gereflecteerd in het project? Waar ligt voor jou de grens voor experiment?

8.2 Attachment 2: Sample transcribed interview

I: Interviewer

R: Respondent

--- 9:49

I : allereerst een hele simpele vraag, hoe zou je diybio definiëren?

R: haha ja ik wist dat je daarmee zou komen, maar dat is ook goed want dan weet je gelijk hoe ik het zie. Dus sowieso is het een grijs begrip, er zijn geen duidelijke kaders. Ligt er aan aan wie je het vraagt, ik heb heel erg gemerkt dat er verschillende stromingen dwars door die DIYbio heen lopen. Bepaalde hoek in mensen die juist kritisch willen reflecteren op de biotechnologie en net als ik willen kunnen doen net zo als ik willen doen

om het te kunnen bevragen, wat heb je nou eigenlijk aan gentherapie of wat heb je aan een biomateriaal, hoe, wat betekent dat nou eigenlijk, daarvoor willen we het eerst begrijpen, kunnen, willen toegang tot de labs, we willen het gewoon zien, in contact komen met die mensen en om dat te kunnen doen moet je het enigszins beheersen. Eh, weet je de kritische, vaak ook vanuit de kunst hoek en zijn vaak kunstenaars die ook materiaal gebruiken om het te kunnen bevragen. Dat is een sterke stroming, daarnaast heb je een stroming van mensen en die zijn bezig met onderwijs, open knowledge, ze wilen, ja dat ze open kennis net zo belangrijk vinden als vrijheid van meningsuiting, ze zien het als een liberaliserende beweging, alles in het publieke domein toegankelijk maken en ze geloven dat daarmee de wereld beter wordt. Een hele stroming ondernemers, zien het meer als een startupscene, als een potentiële entrepeneurs het hele mantra om het biotech is de nieuwe technologie van de 21e eeuw en we gaan allemaal miljonair en biljonair worden en de nieuwe bill gates, Steve Jobs zit tussen deze diybiologen, nou ja daar ben ik zelf niet zo van overtuigd, ik geloof niet zo in dat sprookje, er is een hele grote groep mensen die in die in die ondernemersscene, dan zie je dat het diybio doorstroomt naar een soort incubator eh, wereld eh heenloopt. En dan heb je ook de hobbyisten, mensen die het leuk vinden, gewoon voor de fun, laat ik is een keer een bacterie glimmen ofzo gewoon ja waarom niet, beetje in die hoek dus dat is gewoon hacking for fun en eh, ja kijken wat er kan, beetje uitproberen, eigen kennis vergroten kijken hoever ik kan komen in iets het gewoon leuk vinden, puzzelen zoeken, ja en dat gaat af en toe dwars door elkaar heen. Iemand die eerst een beetje aan het zoeken is kan op eens heel activistische open source activist

worden of iemand die met de kunst bezig was begint op een s een bedrijf, die stromingen die ik over het algemeen zie.

I: herken je die stromingen ook allemaal in Nederland of is dit internationale vlak?

R: ja in Nederland zijn er nou ja, Nederland zijn er niet zo heel veel mensen heel actief bezig, er zijn mensen die er tegenaan schuren maar als je het hebt over het ondernemerschap kan ik 1-2-3-4- mensen aanwijzen, echt eh meer activistische, het is ook een beetje een anti-establishment movement zo begon het ook echt he in boston, als je terug leest op die open web ware wiki, die eerste notulen van de bijeenkomsten was van ja we zitten hier allemaal op mit maar we kunnen niet doen wat we echt willen, want laboratorium is een bepaald regime en dan moet je een phd doen en noem het allemaal maar op dus die zochten een plek om te kunnen doen wat ze niet konden binnen die institutionele beperkingen. En eh daar zit ook een bepaalde stroom mensen die zich afzetten tegen het systeem, dan heb je natuurlijkk de pharma, en de universiteit en de eigen logica van wat goed fout is., en ja de start up scene is natuurlijk ook een soort bubbeltje en mensen die daar allemaal geen zin in hebben komen allemaal samen op een plek die DIYbio heet maar ook andere labels op, biohacking, community bio, dus dat is ook onderdeel van het fenomeen dat het veel namen heeft en dat die ambiguiteit moet blijven bestaan als het heel duidelijk wordt wat het is dan gaat het, dan gaan heel veel van de mensen zich er tegen afzetten dus dat is een belangrijk onderdeel ervan, dus dat anti-establishment kantje zit er zeker in. Maar het beweegt ook wel, je ziet ook wel evolutie, want dat echte ruige randje is er voor een groot deel wel van af hoor, zeker sinds het full circle is gegaan en je weer terug is bij mit, zeg maar sinds david cong en de mensen rond

mit media lab en dat de mensen hebben gezegd he, dit is wel een interssante ontwikkeling, dit willen we binnen onze instituten hebben, dan zie je weer een enorme institutionalisering eh, kolonialisering van het hele fenomeen, brands, labels, hierarchien, iemand wordt weer fellow van een instituut, het wordt helemaal geinstitutionaliseerd, je merkt al een beetje aan me, ik vind het echt vreselijk, dat heb ik altijd proberen te voorkomen maar het is gewoon zo een machtsstructuur in de vs en het label mit is voor zoveel mensen zo aantrekkelijk om zich daarmee te affilieren, en daarmee start het volgens mij allemaal weer, dan ontstaat er een machtsstructuur waar je juist weer van af probeert te komen. ja. En dan is het weer tijd voor de volgende cirkel, ja haha.

I: ik wou het even met je hebben over {*anonymized*} en de tijd daar, hoe heb je het open lab opgezet?

R: Eigenlijk organisch gegroeid in de zin van, ik was al bezig, ik was altijd bezig met biohacking met zelf apparaten maken, zelf spulletjes kopen en experimenten doen was ook een beetje vanuit het startup idee hoor, we waren bezig met een diagnostisch apparaat ontwikkelen, we dachten met een paar vrienden we maken er een bedrijfje van en toen kwam dus dat MIT tech review artikel tegen van een jongen uit ierland, ik weet niet hoe actief hij nu nog is, Cahal Harvy ja, hij had zijn eigen gmo gelicenseerde slaapkamer in ierland, als enige in europa in ierland mag, een huis als gmo… hij was echt zo'n posterboy. Van oke wauw het is wel gaaf dat iemand dat kan, dat wil ik ook wel! Maar hoe ga je dat doen, dus ik dacht ik organiseer een bijeenkomst in den haag, dus ik had op [*anonymized]* zo´n platform website gezet, waar je bijeenkomsten kunt organiseren, dus op die eerste bijeenkomst kwamen iets van tien mensen, en zes daarvan waren journalist, haha,

ik stond daar ik kwam, van hallo wie ben jij? Ja ik ben journalist van de volkskrant en de volgende ja ik ben journalist van het nrc. Ok grappig haha, dus er zaten zes journalisten in de zaal en vier mensen die echt geinteresseerd waren, ehh dus ja, dan zie je maar hoe zoiets geks gebeurd. Stond daarna in alle kranten een artikel en toen hadden we nog twee of drie keer zo'n bijeenkomst gedaan en toen kwam een keer [*anonymized]* en die zij vind je het leuk om dat in[*anonymized]* te doen, ik kende [*anonymized]* helemaal niet, we hebben een plek en kunnen dat doen. Toen zei ik leuk, interessant dus toen hebben we een paar keer zo'n bijeenkomst georganiseerd en dat beviel goed en het klikte met opgezet, was echt ja, groeide uit tot een hele hub.

I: Toen jullie van start gingen, bij elkaar gaan de die ook qua filosofie ook heel erg heeft van technologie, if you cannot open it you do not own it (?) weet je wel, de hackermentaliteit, dus toen zijn we gewoon begonnen goh, we hebben een kamertje hier in [*anonymized]* ullen we dat omtoveren in een lab. Zo is het gaan rollen en [*anonymized]* is natuurlijk gewoon een eigen stichting dus dat is gewoon, je bedenkt projecten, je zoekt er geld voor, daar waren we ook best succesvol in omdat het iets nieuws was, iets spannends, het was iets om allerlei combineert: het is kunst, het is debat, het is allerlei manieren konden we daar aansluiting bij vinden dus toen zijn we enorm gaan groeien en deden we projecten, we hebben bijvoorbeeld een camper omgebouwd tot een lab en daarmee hebben we zes maanden door Europa gereden, van alles en nog wat gedaan, dus ook die [*anonymized]* opgezet, was echt ja, groeide uit tot een hele hub.

ERASMUS UNIVERSITEIT ROTTERDAM

CHECKLIST ETHICAL AND PRIVACY ASPECTS OF RESEARCH

INSTRUCTION

This checklist should be completed for every research study that is conducted at the Department of Public Administration and Sociology (DPAS). This checklist should be completed before commencing with data collection or approaching participants. Students can complete this checklist with help of their supervisor.

This checklist is a mandatory part of the empirical master's thesis and has to be uploaded along with the research proposal.

The guideline for ethical aspects of research of the Dutch Sociological Association (NSV) can be found on their website (http://www.nsv-sociologie.nl/?page_id=17). If you have doubts about ethical or privacy aspects of your research study, discuss and resolve the matter with your EUR supervisor. If needed and if advised to do so by your supervisor, you can also consult Dr. Jennifer A. Holland, coordinator of the Sociology Master's Thesis program.

PART I: GENERAL INFORMATION

Project title: Opening up science as a recursive public

Name, email of student: Roos Vermijs, 550337rv@eur.nl

Name, email of supervisor: Jess Bier, bier@essb.eur.nl

Start date and duration: 15-03-2020 - 20-06-2020

Is the research study conducted within DPAS YES - ~~NO~~

If 'NO': at or for what institute or organization will the study be conducted?

(e.g. internship organization)

PART II: TYPE OF RESEARCH STUDY

Please indicate the type of research study by circling the appropriate answer:

1. Research involving human participants. YES - ~~NO~~

If 'YES': does the study involve medical or physical research? ~~YES~~ - NO

Research that falls under the Medical Research Involving Human Subjects Act (WMO) must first be submitted to an accredited medical research ethics committee or the Central Committee on Research Involving Human Subjects (CCMO).

2. Field observations without manipulations that will not involve identification of participants. YES - ~~NO~~

3. Research involving completely anonymous data files (secondary data that has been anonymized by someone else). ~~YES~~ - NO

PART III: PARTICIPANTS

(Complete this section only if your study involves human participants)

Where will you collect your data?

Via online resources and videocalls.

What is the (anticipated) size of your sample?

The anticipated size of my sample is between the 5-10 respondents

What is the size of the population from which you will sample?

75

1. Will information about the nature of the study and about what participants can expect during the study be withheld from them? ~~YES~~ - NO

2. Will any of the participants not be asked for verbal or written 'informed consent,' whereby they agree to participate in the study? ~~YES~~ - NO

3. Will information about the possibility to discontinue the participation at any time be withheld from participants? ~~YES~~ - NO

4. Will the study involve actively deceiving the participants? ~~YES~~ - NO

Note: almost all research studies involve some kind of deception of participants. Try to think about what types of deception are ethical or non-ethical (e.g. purpose of the study is not told, coercion is exerted on participants, giving participants the feeling that they harm other people by making certain decisions, etc.).

a. Does the study involve the risk of causing psychological stress or negative emotions beyond those normally encountered by participants? ~~YES~~ - NO

b. Will information be collected about special categories of data, as defined by the GDPR (e.g. racial or ethnic origin, political opinions, religious or philosophical beliefs, trade union membership, genetic data, biometric data for the purpose of uniquely identifying a person, data concerning mental or physical health, data concerning a person's sex life or sexual orientation) ~~YES~~ - NO

c. Will the study involve the participation of minors (<18 years old) or other groups that cannot give consent? ~~YES~~ - NO

d. Is the health and/or safety of participants at risk during the study? ~~YES~~ - NO

e. Can participants be identified by the study results or can the confidentiality of the participants' identity not be ensured? ~~YES~~ - NO

f. Are there any other possible ethical issues with regard to this study? ~~YES~~ - NO

If you have answered 'YES' to any of the previous questions, please indicate below why this issue is unavoidable in this study.

What safeguards are taken to relieve possible adverse consequences of these issues (e.g., informing participants about the study afterwards, extra safety regulations, etc.).

There are no unintended consequences of which I am currently aware. This means that for now, safeguards are not needed.

Are there any unintended circumstances in the study that can cause harm or have negative (emotional) consequences to the participants? Indicate what possible circumstances this could be.

There are no unintended circumstances in the study that can cause harm, as far as now can be foreseen.

Please attach your informed consent form in Appendix I, if applicable.

Instead of a form, I asked for consent within email conversations.

Part IV: Data storage and backup

Where and when will you store your data in the short term, after acquisition?

On Surfspot.

Who is responsible for the immediate day-to-day management, storage and backup of the data arising from your research?

I (Roos Vermijs) am responsible for the management, storage and backup of the data.

How (frequently) will you back-up your research data for short-term data security?

Every week

In case of collecting personal data how will you anonymize the data?

I will use fictional names, and if needed I will also use fictional job descriptions of other descriptions that have to do with someone's function. I will keep data that can identify personal details separated from the rest of the data and I will work will a code-system.

PART VI: SIGNATURE

Please note that it is your responsibility to follow the ethical guidelines in the conduct of your study. This includes providing information to participants about the study and ensuring confidentiality in storage and use of personal data. Treat participants respectfully, be on time at appointments, call participants when they have signed up for your study and fulfill promises made to participants.

Furthermore, it is your responsibility that data are authentic, of high quality and properly stored. The principle is always that the supervisor (or strictly speaking the Erasmus University Rotterdam) remains owner of the data, and that the student should therefore hand over all data to the supervisor.

Hereby I declare that the study will be conducted in accordance with the ethical guidelines of the Department of Public Administration and Sociology at Erasmus University Rotterdam. I have answered the questions truthfully.

Name student: Roos Vermijs Name (EUR) supervisor: Jess Bier

Date: 1-3- 2020 Date: