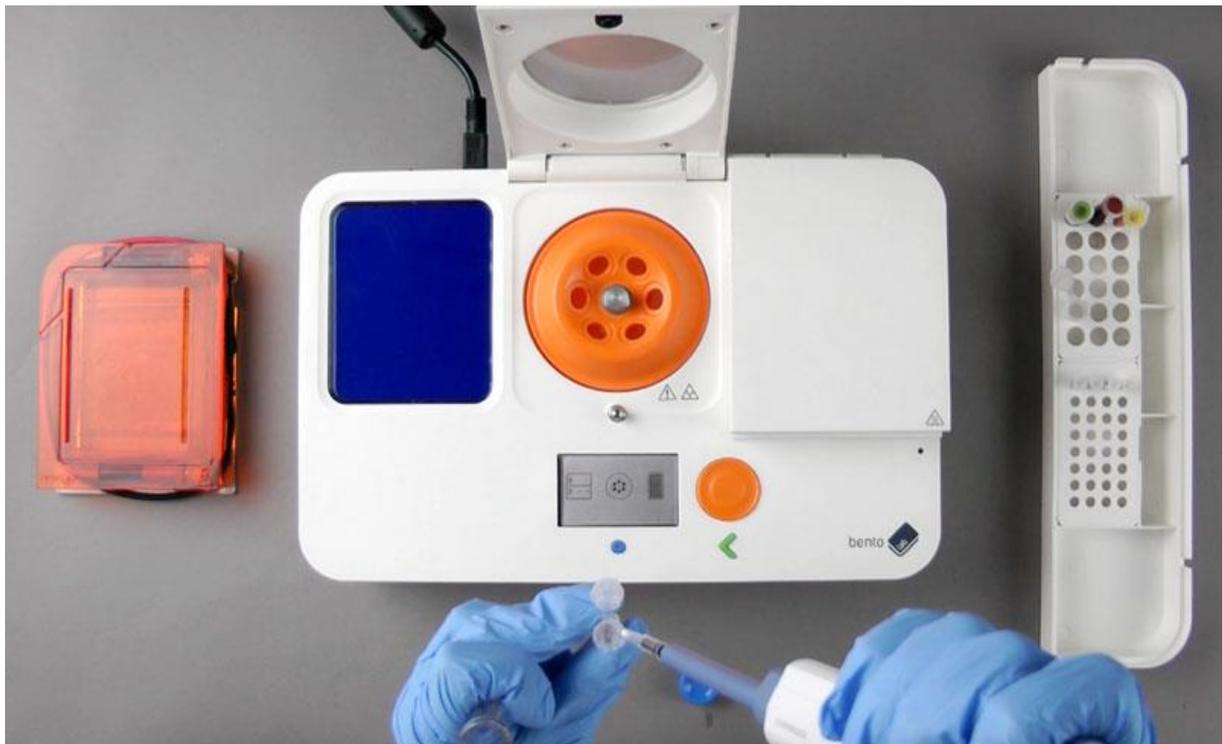


The Convenient Lab

A study of how a portable DNA laboratory can affect the social using script analysis.



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Foreword | Warning

This thesis may not look like an average thesis for a Design, Culture, and Society Masters you have read in terms of the writing style. I have decided to write this thesis in the first person. This was a conscious decision. It fits the theoretical framework and methodology I am working with to analyse the object. On top of that, I am staying close to myself and my academic background in feminist research practice. In this field, feminist science and technology studies to be precise, knowledge-making is perceived as a subjective and personal matter; the author relates to their academic and worldly surroundings.¹ I am trying to stay away from a positivist outlook in which an author is posing research questions to the ‘matter’ under discussion and can find the answers out in the (research) ‘field’. This way of doing research renders the writer neutral – which I am not – and creates the risk of implying to be objective – which, again, I am not. A writing process and research process is something I view as going back and forth between myself, the studied material, and the questions. The questions evolve as the process furthers, and so do I.

¹ For further reading I recommend *Feminist Research Practice* composed by Hesse Biber (2014).



Figure 1 'Wat Makes Us Human?' in *The Future Starts Here*, Victoria and Albert Museum (V&A), London.



Figure 2 'Self' in *The Future Starts Here*, V&A, London.

Introduction



Figure 3 Bento Lab on display, *The Future Starts Here*, V&A, London.

“A Home DNA Lab”

Bento Lab
Bento Bio
2016

This portable kit allows anyone to experiment with simple DNA analysis without expensive software or specialist knowledge. With it, you can test yourself for lactose intolerance or identify genetically modified organisms in your food. But what ethics should guide increasingly broad access to the viewing and manipulation of genetics, the fundamental technology of life?

Commercially available product, PCR thermocycler, centrifuge and gel electrophoresis box, and power supply Bento Lab (www.bento.bio)²

Bento Lab – a portable DNA laboratory

The Bento Lab was ‘housed’ at the bottom of the right-wing of the display (Fig. 1,2,3), during the exhibition, *The Future Starts Here* in the Victoria and Albert Museum in London.³ Bentham Wolfenden and Philipp Boeing saw a demand for portable laboratories in the communities around them and started their developing journey in 2013.⁴ After having success presenting and reviewing their prototypes, they managed to get funded in 36 hours on a Kickstarter campaign in 2016. Kickstarter is a crowdfunding website where products can be ‘launched’ with the hopes of ultimately realising the production phase. The Bento Lab is a fully functioning portable DNA laboratory and did not leave my mind after seeing it on display in conjunction with Heather Dewey-Hagborg’s *Radical Love* (Fig. 3).⁵ A feeling of unease flooded me, the idea that DNA research can be conducted at home prompted many questions for me. Usually, the technologies used to process and analyse DNA are present in an institutional, clinical, or laboratory realm. My connotation with these professional or renowned institutions was initially that the technology is safely ‘tucked away.’ Protected by job descriptions and protocols: only accessible to those who would need them. This, I think, says a lot about my naivety and trust in these institutions. I perceive safety through protocols when it concerns human or biological

² Description of Bento Lab during the exhibition, typed after personal photograph.

³ *The Future Starts Here* ran from 12 May 2018 to 4 November 2018, About *The Future Starts Here* (2018).

⁴ Kickstarter Bento Lab 2016.

⁵ Heather Dewey-Hagborg, *Radical Love* 2016, genetic materials, custom software, 3-d prints, documentation.

matter. The Bento Lab is commercially available and suddenly made me aware of my preconceived notions of safety and bioethics. It mostly fascinates me from my role as a master student of the Design, Culture, and Society program. In this master, I have developed a particular interest in studying the impact of objects in relation to biotechnology, organic materials, and the relationship between humans and non-humans within the bio-technical discourse. Objects such as the Bento Lab will most likely influence how one can and should deal with DNA as a (research) matter. Bento Lab ‘democratises’ on the one hand: it makes doing DNA research more accessible. On the other hand, it might make some living beings or matter more vulnerable. For instance, people performing DNA analysis without the consent of the sample provider. I think that the discourse of design history can help to understand the layered and vast impact devices such as Bento Lab can have on societies. Design history is a discipline in which the relations between (designed) objects and humans are addressed.⁶ By studying a recently developed object while it is entering societies, and viewing it through a lens of historical object-thinking, I hope to offer insights into ways humans can deal with emerging biotechnological devices such as Bento Lab. Building forward on Madeleine Akrich’s script analysis and Actor-Network Theory as a method for design studies, I will attempt to uncover the different facets and implications of the ‘home DNA lab’ on a practical, socio-cultural, (bio)technical and ethical level.

Theoretical Framework

The study of design and design history is an interdisciplinary multi-faceted field of study. The combination of the terms ‘design’ and ‘history’ in the academic field can be lead back to as recent as the 1980s, and the birth of design studies or design history took place in the United Kingdom.⁷ According to historian and art critic John A. Walker – the author of one the first comprehensive books on design history methodology – the purpose of the discipline is “to explain design as a social and historical phenomenon.”⁸ It seems to me that this has become the discourse in which design studies is performed. I will, therefore, study the Bento Lab from the standpoint that design is part of the social and historical realm of human activity. For this thesis, I will use Albena Yaneva’s definition of design:

“Design ensures that we encounter numerous non-humans (objects and environments) in our routine trajectories, and mediates our communication with other humans. [...] Design, I argue, is a way of producing additional attachments that make a variety of actors congregate, forming different groupings and assembling social diversity.”⁹

⁶ Woodward 2007, p. 4.

⁷ Walker 1989, p. xi.

⁸ Walker 1989, p. 1.

⁹ Yaneva 2009, p. 282.

I have noticed in the field of design history that an object's description is mostly relying on a study on its presupposed workings and, when sources are present, how it is used.¹⁰ Which takes away a large part of the role of design and how it might enact 'the social.' The social position of an object is dependent on the context in which it is used or presented. To go back to Yaneva's definition of design, the context influences which 'variety of actors congregate.' Since I encountered the Bento Lab in an unfamiliar environment for its intended purpose, I am interested in studying the object in three different contexts in which the setting is present in order to be able to see how the object acts or connects in these different settings. The settings in this thesis concern: being inscribed, being in use, and being on display. To examine the lab, I will use script analysis as a research method. Script analysis, coined by Madelaine Akrich, views an end product developed by designers as the 'script' or 'scenario.'¹¹

The method of analysis stems from the concept of actor-network theory (ANT) and is intended for the social sciences; sociology of technology, but is a useful theoretical framework in the study of material culture and design.¹² Ian Woodward, for example, explains ANT as a framework in which new technology objects can be studied. It mostly involves technical objects that *act* for people, such as a remote control or a mobile phone.¹³ An actor is – as Bruno Latour, one of the initiators of ANT, argues – “any thing that does modify a state of affairs by making a difference.”¹⁴ This way of looking at human-object relationships makes it possible to shift away from merely describing the a priori assumptions of how the object is perceived or used by humans.¹⁵ Instead, according to Latour, the relationship should be studied in a way that things might “authorise, allow, afford, encourage, permit, suggest, influence, block, render possible, forbid, and so on.”¹⁶ The Bento Lab is an actor when one looks at what the portable lab affords its user to do; render the invisible of biological matter visible. It encourages a variety of actors to assemble in their quest for the ability to sequence DNA. I, therefore, consider the object

¹⁰ Take for example one of the 'bibles' in the study of design: *History of Modern Design* by D. Raizman, 2010. Many of the objects are described through the knowledge about the artefact. This approach leads to a reading of 'facts' from the object, including a 'social explanation' by providing a historical context. I think that the social, or societal, should not be narrowed down to an explanatory matter of fact. Instead, it should be approached as a network of interconnecting factors providing the opportunity for design historians to analyse an object from many different angles. Furthermore, it will open up the discussion about plural narratives in history writing, as this is a subjective practice in my view, and take away the focus on a general narrative. Shifting away from the general narrative can create a more open view on how things may have been used, or how the use of objects has affected human (social)life. Which can hopefully lead to (new) insights to how humans and non-humans relate to each other.

¹¹ Akrich 1997, p. 208.

¹² Woodward 2007, p. 12.

¹³ Woodward 2007, p. 13.

¹⁴ Latour 2005, p. 71.

¹⁵ Latour 2005, p. 71.

¹⁶ Latour 2005, p. 72.

appropriate for script analysis. Kjetil Fallan and Yaneva have both proposed script analysis as a research method in design studies.¹⁷ Their arguments on how to conduct script analysis within design studies, and Latour's introduction to ANT, together with Akrich's founding article on script analysis, will form the theoretical backbone of this thesis.¹⁸ The main question I pose the object is the following: How does Bento Lab, studied from an actor-network theory lens using script analysis, contribute to enacting the social? I define the social – in this case – as a “momentary association” linked to social ties. These social ties are almost always consisting of human-object, object-human, human-human, object-object relations with its connections running to and fro.¹⁹ With the Bento Lab as the starting point, I perceive the social as enacted in the momentum when different actors gather to conduct DNA analysis or contemplate the concept of DNA analysis.

Script analysis focuses on how objects *act*. In my first encounter with Bento Lab, its presence affected me, yet it was not being used for its intended purpose. The object was not *acting*. The Bento Lab still did something with me: it made me feel uncomfortable and forced me to think about the new technology and how this can affect human life in the future. I find the passive state of the lab to still contribute to enacting the social, because of my immediate response to the object. Script analysis and ANT do not offer any methodological tools to analyse how the social is affected by an object in a passive state or when it is not ‘working’. I find that a deficiency in the theory as an object on display can affect the social while not *acting* through its material or physical properties. Latour and Akrich have prioritised the acting over being passive. In order to grapple with this prioritisation, in the third chapter, I will use Caroline Braunmühl's call to go ‘Beyond Hierarchical Oppositions’.²⁰ Braunmühl's article is a critique on feminist studies scholar Karen Barad and her work within New Materialism. New Materialism, a term created in the 1990s, pursues a decentralisation of the human in relation to non-human actants.²¹ Feminist new materialisms do not only acknowledge the social constructions of gender, sexuality, and race, they “also consider how material bodies, spaces, and conditions contribute to the formation of subjectivity”.²² Especially Karen Barad's work on how matter and humans ‘act’ among one another seems to be in line with how Akrich and Latour view the social coming into existence between material actants and actors. Barad argues the following on agency and matter: “Therefore, the human does not act on matter, but rather humans and non-

¹⁷ Fallan 2008 and Yaneva 2009.

¹⁸ Akrich 1997 and Latour 2005.

¹⁹ Latour 2005, p.65 and 74.

²⁰ Braunmühl 2018.

²¹ Sanzo 2018.

²² Sanzo 2018.

humans are agential actors in the world as it continuously comes into being.”²³ Barad refers to this as agential realism. Braunmühl points out how, even though Barad is attempting to go beyond existing hierarchical power structures, she does position the active above the passive. Braunmühl suggests to “open up different meanings of ‘activity’ as well as ‘passivity’ in contexts involving different forms of matter and mind” and trying to shift away from defining subjectivity and objectivity in hierarchical terms.²⁴ These thoughts, coming from new materialisms, help prevent to think in dichotomies in a valuing and devaluing way. In the example of ANT and script analysis the acting of objects results in the social through interaction between humans and nonhumans, and passivity would not lead to interaction. Instead, I want to use the dichotomy thinking as a way to describe the state of an object without it affecting the quality of potential meaning-making and interaction within the network in which the object is present. I will elaborate on identifying these processes of passivity and activity in the third chapter.

Feminist theory plays an essential role in my life as it allows me to put my thoughts into well-articulated arguments coming from a recognised school of thought. During my art history bachelor, I found myself frustrated with the focus on the ‘great Masters’ of art. It is evolving now, but in my time (2011-2015), it was a male-dominated science both in terms of art and scholarly production. My professors or lecturers would generally try to take emancipation into account and foster discussions about history writing and the concept of importance in this practise during classes. Nevertheless, I found the basic required knowledge to mostly repeat patterns in which female artists are ‘othered’ or not recognised. Resulting in the canonised [male] art history still being taught and functioning as the norm. A minor gender studies during my bachelor taught me to analyse power structures regarding norms, interaction, and validity within humanities. It also made me realise that it is incredibly complicated to ‘break free’ from existing epistemologies or norms in a society and encouraged me to pursue a master in gender studies. The discussions of power structures, normativity, subjectivity, and objectivity in feminist theory incentivised me to take a critical look at design theory and resulted in my decision to use script analysis to study the setting.

By having each chapter focussing on one of the three different contexts in which the Bento Lab acts, I will attempt to answer the research question. In the first chapter, I will analyse how Bento Lab is pre-inscribed by its designers and how the intended script surfaces by studying the relation between the form and function. The second chapter revolves around the portability of the Bento Lab. I will highlight the different environments in which the Bento Lab is used and

²³ Sanzo 2018, footnote 9.

²⁴ Braunmühl 2018, p. 235.

how this affects the social. In the third chapter, I will grapple with the Bento Lab in a seemingly passive state: on display. How do objects enact the social when they are part of an exhibition? Studying these different contexts in which the Bento Lab acts can hopefully shed light on how the social is affected through its presence, and what needs to be taken into consideration when introducing new technologies as the Bento Lab to a society.

Chapter 1: De-scribing the inscribed:

Introduction

I will analyse the prescribed or pre-scripted reality of the Bento Lab by studying the starting position of the object. How are the lab and its usage structured and presented? For the scope of analysis to examine the inscribed I study the Bento Lab's user manual, the different packages available with the object, the crowdfunding journey of the lab, and the Bento Lab itself. The area of study focusses on Bento Lab around the acquiring stage, which means the moment after production and before usage. I will focus on how the Bento Lab functions as an actor, enacting or assembling the social. When describing the object, I will not go too much in-depth on the technical aspects of the lab, as I am a design historian and not experienced in doing DNA research. Latour pointed out the following for those using ANT in their analysis: "we don't ask the enquirer to become a specialised technologist".²⁵ Instead, the goal is to find out how the object positions itself in a network or affects the social. Analysing the prescribed conditions of the Bento Lab will create the opportunity to see how 'normal' use was intended and how its acting as such can affect the social. For those interested in specific technical properties of the Bento Lab, I have added the link to the online manual.²⁶ The following question is the central question in this chapter: How do the prescribed conditions of Bento Lab position the actors surrounding it and thus affect the social?

Object Description

In this thesis, I study how Bento Lab enacts the social. I view the object as an actor in the sense that it facilitates the space and requirements to conduct DNA research, leading to encounters that have social consequences in society. Akrich and Latour have developed a vocabulary to ensure that the social and the object are always approached as intertwined and involved in a reciprocal relationship.²⁷ Not only does an object enact the social, but the social might also affect how its usage or its script is perceived. I will clarify the terms I am using for the script analysis and the analysis of the prescription itself in the next section. However, first, to perform a script analysis, I will start with an essential step in the field of design history: describing the object of study. Walker explains this step as "drawing a circle around a certain body of material."²⁸ I will do that by describing the technical features and external character of the Bento Lab in order to provide my starting point for the analysis of the object in question. I understand that by writing a *description*, to stay with the analogy of the circle, I am drawing up certain

²⁵ Latour 2005, p. 79.

²⁶ Manual Bento Lab.

²⁷ Akrich, Latour 1997, p. 259-264.

²⁸ Walker 1989, p. 22.



Figure 4 Bento Lab in arrival package.



Figure 5 Bento Lab with gel box, tube rack and pipette.

limitations. The risk of this act is that I might not include aspects of the Bento Lab that others may find crucial to its specifications. However, this also brings me to the advantage and need to map out this ‘circle.’ Describing the object as such makes it clear what I view as the object in question when I place it in a context, which opens up the space for discussion on the results in the following chapters. The ‘circle’ of description I have mapped out for this chapter involves the previously mentioned scope of the inscribed: The Bento Lab, its user manual, the different packages available with the lab, and the crowdfunding aspect of the lab.

As stated in the introduction, the Bento Lab is a portable laboratory which contains the hardware necessary to execute DNA analysis. It combines a centrifuge, PCR, and gel visualisation (Fig. 4, 5).²⁹ The Bento Lab reminds me of a ‘bento box,’ a food concept stemming from Japanese culture (Fig. 6). The history of the word ‘bento’ can be traced back to being slang for *convenience*.³⁰ A bento box generally contains either lunch or dinner and separate compartments for the ingredients that make up the meal are a signature aspect of the box. The contents usually are a source of rice, vegetables and meat, fish or tofu.³¹ The Bento Lab, just like many bento boxes, is held together with elastic straps and – when opened – it is clear that every aspect of DNA analysis has its place. The Bento Lab does not have a lid.



Figure 6 Bento box example Asian restaurant.

²⁹ General description Bento Lab.

³⁰ The word “bento” was derived from the Southern Song Dynasty slang term *biàndāng*, which means “convenient.” Buck 2016.

³¹ Sarata et al. 2015, p. 480.

Every element of coverage also serves a technical purpose. The bottom part of the lid functions as a tube rack when the lab is in use (Fig. 4). The top right houses a thermal cycler with a lid that partially functions as the heater and has space for up to 32 samples that can be brought to the right temperature (Fig. 4). In the centre of the lab is the microcentrifuge, with a see-through lid and has space for six samples (Fig. 4, 5). On the left of the centrifuge is a blue LED transilluminator with a gel electrophoresis power supply used with an outer gel electrophoresis container sitting on top of that (Fig. 4,5). The system of the lab can be operated using the panel that appears when taking off the tube rack. It has a screen that displays the menu. This menu can be navigated by using the blue 'home' button, the green 'back' button, and the orange click dial (Fig. 7). The Bento Lab is standing on four 'feet' which have a double function as a storage space for the elastic ribbons holding the lab together when ready for storage or transport (Fig. 8). The

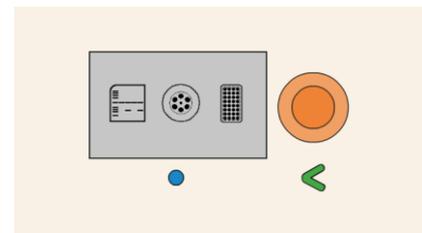


Figure 7 Display panel and buttons.



Figure 8 Bottom of the Bento Lab.

bottom part also contains one of the vents for the active fans of the thermal cycler. On the right side, there are more vents visible. The left side of the Bento Lab has black and red connectors supplying the power for the gel electrophoresis. The back of the laboratory locates the power switch and 4-pin power connector to provide the general power supply. The Bento Lab is available in two different settings: 'Pro' and 'Entry.' The differences are the ranges of the PCR (12-102°C instead of 21-99°C), the centrifuge (500-8000g instead of 2700g) and gel (50-120V versus 50V fixed). These two settings lead to a difference in price (£1599 instead of £1299).

Then there is also the option of choosing an extended warranty. The Bento Bio team has developed a "Biotechnology 101 Kit" for the parties interested in learning how to use the Bento Lab and start their research path in biotechnology.³² This starter kit involves "10 mini projects based on real-world research examples."³³ It comes with the essential reagents and a guide book with clear instructions on how to conduct the experiments.³⁴ The online shop offers the reagents and consumables separately, as well as a pipette, spare gel box, and a merchandise T-shirt and lunchbox.³⁵ There is also the possibility of getting in touch with Bio Bento in case the interested party wants

³² Bento Bio Biotechnology Starter Kit.

³³ Bento Bio Biotechnology Starter Kit.

³⁴ Basic reagents are: microtubes, PCR tubes, PCR master mix, primers, agarose tablets, TBE buffer, DNA stain, 100bp DNA ladder, variable micropipette, and pipette tips from Biotechnology Starter Kit.

³⁵ Bento Bio Shop.

something custom made.³⁶ The laboratory's production line is depending on crowdfunding.³⁷ The funding parties have the opportunity to have a say in the developing journey.³⁸ They provide feedback, suggestions, and are the core of the Bento Bio network.

Describing the Inscribed

As a researcher, I am interested in studying the relationship between humans and things. By looking at how Bento Lab affects the social, I hope to get more of an insight into how Bento Lab's existence is perceived and why or for whom this is important. In this chapter, I am mostly interested in how Bento Lab, as it is offered on the market with its inscriptions, can affect how people think and act around things concerning DNA research. How does the Bento Lab affect the social? The social involves, in my view, the perception of self and society from the actor, nevertheless, also from the bystander who may hear about the lab's existence. The inscribed, as Akrich puts it, is, in essence, the designers' vision of the world 'written' into the object.³⁹ I will describe the inscribed in this section. Akrich and Latour explain the act of describing as "the opposite movement of the inscription by the designer."⁴⁰ In the previous section, I have described the object and thereby defined the scope of the script analysis for this chapter. I will follow the order of the described above for my script analysis, for which I will 'read against the grain' of my description. Akrich and Latour argue that the best condition for a script analysis is when there is a conflict or counteraction towards the existing script, hence my reading against the grain.⁴¹ This means that I will question the described by hypothesising what would happen if the opposite or a different situation was the case. I will first shortly introduce the ANT or script analysis vocabulary and my usage of it. Then I will explain the process and results of my script analysis on the inscribed of the Bento Lab. First, I will address the 'Bento' aspect of the lab and how this can affect the social concerning DNA research in society. Then I will point out how the objects' workings seem to enmesh definitions of morality related to design ethics, which leads to the concluding part: focusing on the crowdfunding aspect of the Bento Lab concerning inscription. I will question how crowdfunding and crowd creation can affect knowledge-making and meaning creation of the social in the scientific and personal realm. I have created a figure containing the terms and definitions composed by Akrich and Latour in their article elaborating on the vocabulary for the semiotics of human and non-human assemblies (Addendum 1). I will use this as a guide to ensure consequent usage of appropriate terms and perform a thorough analysis. So far, I refer to Bento Lab in many different ways; by calling it by its

³⁶ Bento Bio Shop.

³⁷ Kickstarter Bento Lab 2016.

³⁸ Kickstarter Bento Lab 2016.

³⁹ Yaneva 2009, p. 275.

⁴⁰ Akrich, Latour 1997, p. 259.

⁴¹ Akrich 1997, p. 207.

brand name 'Bento Lab' or calling it an object, device, laboratory, etcetera. From now on, I will refer to Bento Lab as a **setting**. The term setting emphasises the Bento Lab's situatedness in a social, physical, and technical environment. I argue that studying an object as a setting prompts the understanding of an object as always already partaking in a social network; when created, analysed, used, or misused. It opens up the debate of a different 'reading' of Bento Lab by stepping away from providing a fixed definition. As a result, I view the social and technical as inherent to the setting and inevitably intertwined. Throughout the analysis, I will go back and forth between the designers and users, as this forms a crucial part of script analysis since all the nodes in a network affect one another.⁴²

The Convenient Lab

Designers have certain 'competent users' of their setting in mind; these competencies are **pre-inscribed** in the setting.⁴³ The intended actors are expected to *understand* or easily pick up on the workings of the setting. When **prescribing** a setting, the designer is drawing up what the setting **affords** and **allows** within the network of operation. The prescription affects the actors' possible **programs of action** in this network. I will elaborate on the affordances and allowances in the next section. The programs of action are not only affected by what the setting affords or allows, but also in what *shape* the setting makes its usage possible.



Figure 9 Monbento lunchbox.

Seeing the setting for the first time in the Victoria and Albert Museum, I wrote down Monbento in my notebook. As I explained the reference to a bento box, the setting reminds me of my lunchbox: a 'Monbento.' Many people, including myself, are 'hooked' to the food-hype of bringing your lunch in a practical and aesthetically pleasing box (Fig. 9). The setting shows similarities with the Monbento: both the name and look of the setting seem to hint to the convenience and clear-cut divide of a bento box. With bento being vernacular for convenient, I wonder how this affects the use of the setting. It seems to me that the idea of convenience and ease of use is inscribed into the setting. I am deducing this inscribed convenience by envisioning a DNA laboratory without the use of the setting. One would need more space to set up the three machines (PCR, Centrifuge, Gel Electrophoreses and Transilluminator) incorporated into the setting. Unlike the setting, these machines would all have a different user interface, power input and maintenance. Thus, the setting is designed in such a way that

⁴² Fallan 2008, p. 65.

⁴³ See Addendum.

actors need to perform fewer steps when conducting DNA research. Usually, one would have to set up their laboratory in a mindful way, bearing research protocols in mind. With this setting, the layout of your laboratory is pre-inscribed and ready to use. Should a DNA laboratory be convenient? Convenience and fewer steps, to me, are synonymous to fewer opportunities for contemplation. How does the pre-inscribed convenience work for the earlier mentioned 'competent user' envisioned for the process of inscription? Citizen scientists, or Do It Yourself (DIY) biologists, tinkerers, students (secondary school and higher education), and scientists are all a part of the target group for the setting.⁴⁴ The setting is inscribed with the intent of making molecular biology more available and catered towards synthetic biologist.⁴⁵ According to Emma Frow, "synthetic biologists are concerned with making biology easier to engineer."⁴⁶ Sara Giordano elaborates on the general purpose of synthetic and molecular biologists outside of the science communities. She points out how they aim to create and become "the properly informed public."⁴⁷ A 'convenient' and pre-prepared laboratory, available to anyone who can afford it, seems to fit that purpose but can also be viewed as the antithesis of 'biohacking' or citizen scientist communities. Biohacking and biohackers, to use Richard Fuisz's definition, are "those who focus on modifying biological systems, including bacteria, plants, animals, or humans explicitly through genetic modification."⁴⁸ 'DIY Bio,' "a movement that focuses on individuals doing their biological experiments outside of institutional settings," is founded on these principles.⁴⁹ The setting might be too closely related to the scientific institutions that they are trying to shift away from or rebel against, mainly because the setting's first concept was part of a research project at University College London.⁵⁰ The convenience and 'properness' of the design are, from my standpoint, intimately related to the ideals of a sterile lab. Potentially too far removed from the independent or emancipatory realm in which citizen scientists, as part of the DIY Bio community, wish to operate.⁵¹ The setting's inscribed convenience can be read as creating a lower threshold for people to partake in projects involving synthetic or molecular biology. The social is thus affected as such that a broader audience can become an actor within the network of this setting. Whether this is desired by the actors or societies is, in my view, an important question that arises from this part of the inscription

⁴⁴ The statement of the designers about their target group: "[...] Instead, let us look at how movements like Arduino or Raspberry Pi are empowering citizens to co-create and be technology-literate. By building a diverse community around inclusive and accessible molecular biology, we want to enable professionals and non-professionals to engage with genetics in an open and responsible way. This is for everybody: curious makers, ambitious students, innovative artists and cutting-edge scientists. Find out more about how you can get hands-on with genetics and help us build a better future for biology." – From *Join us on our mission* on Bento.Bio.

⁴⁵ Kickstarter video developers.

⁴⁶ Frow 2018, p. 2.

⁴⁷ Giordano 2018, p. 401.

⁴⁸ Fuisz 2017, p. 658.

⁴⁹ Fuisz 2017, p. 658.

⁵⁰ Kickstarter Bento Lab 2016.

⁵¹ Frow 2018, p. 5.

analysis. 'The social contract,' as Frow identifies peoples' expectations related to science and DNA research, is altered or expanded by this setting.⁵² Questions about the convenience through which people can now 'tinker' with DNA are, I think, extremely relevant. I will build forward on this notion of convenience embedded in the script and how that affects the social contract related to science in the next chapter, by analysing how the settings' usage in the field of biotechnology and synthetic biology affects the social.

Prescribing Morality

When doing script analysis, the **subscription** of an actor; its response, is just as important as the intended use of the setting.⁵³ The setting will not always function as intended, because the subscription of the actors might lead to a different process or network in which the setting acts. Fallan describes the actions of artefacts as a result of a setting's inscription, subscription, and **re-inscription** the following way: "[artefacts are] transforming meaning as they form and move through networks."⁵⁴ With its limitations **circumscribed** in the setting, the actors might be 'misusing' or 'abusing' the setting, according to its designer. In script analysis, this is viewed as **re-inscribing** the setting by following or creating **anti-programs**.⁵⁵ The setting is a critical node in the network of the program of action for both actors and designers. Thus, the setting is creating meaning for both the purpose of the setting and how that is facilitated. This is how I, as the analyst, **ascribe** meaning to certain parts of the script. I have ascribed significance to the convenience the setting exudes. The convenience is a result of the clear steps the actor can follow when using the setting. This is due to the circumscription of the programmes of action. In this section, I will grapple with the circumscribed of the setting and how that is affecting the social's moral and ethical traits.

The setting is strongly guided by the provided manual. The manual even contains a section on how to unpack the setting. It 'acts' as a non-human chaperon over the pre-inscribed conditions of the setting. The **interface**, as explained in the manual, helps the actor navigate the setting and gives access to all of the affordances and allowances pre-inscribed in the setting. On top of the chaperoning element of the manual, the setting itself has been inscribed with allowances to ensure the safety and success of the actor. An example is the lid of the centrifuge: the interface will not provide the opportunity to select the start of a spin-cycle of the centrifuge when the cover is open. The setting itself will not *allow* the action, and it has taken away the opportunity for a human to perform a spin-cycle without closing the lid. Alternatively, as suggested by Langdon Winner: the setting *discriminates*

⁵² Frow 2018, p. 4.

⁵³ See Addendum.

⁵⁴ Fallan 2009, p. 62. [artefacts are added by me, the author]

⁵⁵ See Addendum.

against those who want to do something that might cause an accident or failure.⁵⁶ The setting safeguards a moment that *translates* to a non-human ‘telling’ the actor to “close the lid!” This is an example of the designer *delegating* the range of actions for the human and non-human involved in the assemblage.⁵⁷ The decision of the designers to entrust safety measures to the setting comes with the consideration of morality, responsibility, and ethics. As Latour points out:

“No human is as relentlessly moral as a machine, especially if it is (she is, he is, they are) as ‘user friendly’ as my Macintosh computer.” [...] “The program of action is in practice the answer to an antiprogram against which the mechanism braces itself.”⁵⁸

Even though it might seem like a marginal part of the setting, I find, the designers have circumscribed quite a few steps into the programme of action of the centrifuge. Which results in the following circumscription: Trying to start a spin cycle with the lid open. → The rotator will not work. → The display will portray the problem and how to solve it. → The click dial button will not function to enable the user

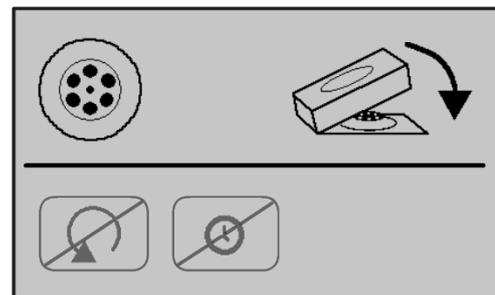


Figure 10 Display when centrifuge lid not closed.

to start the selected process when pressed before the lid is closed (Fig. 10). → Which translates to the overall message from the setting: CLOSE THE LID! I think the program of action of the centrifuge is an excellent example of how script analysis reveals the relation between the setting and the discourse of design ethics. A practice that is still in a developing phase and did not exist as an academic field around the time of script analysis’s birth.⁵⁹ In analysing the prescription of the setting, I find that the process of inscription involves defining and circumscribing concepts such as safety and ‘good’ or ‘bad’ usage of the setting.

⁵⁶ Latour 2009, p. 235.

⁵⁷ Latour 2009, p. 234. The Oxford English Dictionary defines ‘assemblage’ as “a collection or gathering of things or people; a machine or object made of pieces fitted together; a work of art made by grouping together found or unrelated objects; the action of gathering or fitting things together.” The basis of the framework around ‘assemblage theory’ in philosophy is developed by Gilles Deleuze and Félix Guattari in the 1980s and stems from the French word *agencement*: “term that refers to the action of matching or fitting together a set of components (agencer), as well as to the result of such an action: an ensemble of parts that mesh together well.” - Manuel De Landa 2016, p. 1. The assemblage in this case, I argue, is a consequence of the social network that evolves when different actors congregate within a momentary association to perform an action. For an overview of assemblage theory see De Landa 2016.

⁵⁸ Latour 2009, p. 234 – 245.

⁵⁹ TU Delft is now making it into a separate field of study. Ethics and design have previously been discussed as part of Science and Technology Studies. In the last 10 years academics have expressed a need for a deeper understanding of design ethics and how this can be included in studies of product design and technological development.

Peter-Paul Verbeek is one of the first to bring design ethics and script analysis together.⁶⁰ Jeffrey K.H. Chan described Verbeek's work as creating a "mediation paradigm" in the field of design ethics.⁶¹ Verbeek argues that technology can be a mediator in moral choices.⁶² He views a designer as being in the process of "materialising morality," resulting in technologies, as actors, being "inherently moral entities."⁶³ Verbeek claims that "when technologies co-shape human actions, they give material answers to the ethical question of how to act."⁶⁴ With a setting in this scenario being a *moral* entity within the field of design ethics, I find it helpful to define the difference or relation between ethics and morality. Verbeek does not explicitly articulate a distinction between the two. Chan, on the other hand, defines ethics as "the branch of philosophical knowledge on moral ideas and principles," resulting in "more fundamental positions on the good or worthwhile life."⁶⁵ He argues that morality is taking place when there is necessary action within the social norms and rules as defined in the ethical paradigm.⁶⁶ I will follow these definitions of morality and ethics throughout the thesis. What makes Chan define 'technology as mediation' as a separate paradigm in design ethics? Eleonora Fiore's recent publication approaches design ethics from a different angle. She will agree with the previously defined distinction between morality and ethics but approaches design ethics from an 'instrumental paradigm.'⁶⁷ A paradigm that is argued for as a more practical way of introducing ethics to design theory because it can generate a set of actions for designers and design studies.⁶⁸ In the instrumental paradigm, humans are viewed as the only actors with agency on a moral and ethical level.⁶⁹ Leaving the ethical responsibility with the designer and human actors when technology comes into play. As Fiore argues: "We believe that computers can be agents, but cannot be moral agents, in other words, cannot be held morally responsible for a decision."⁷⁰

Even though the instrumental paradigm will be useful to convey knowledge on the importance of design ethics and can help create protocols in design education, I view the mediation paradigm as more functional when trying to assess how the social is affected by actors such as with the setting discussed in this thesis.⁷¹ As previously stated in this chapter, the setting *acts* as it attracts other actors

⁶⁰ Verbeek 2006.

⁶¹ Chan 2018.

⁶² Chan 2018, p. 189.

⁶³ Verbeek 2006, p. 369.

⁶⁴ Verbeek 2006, p. 361.

⁶⁵ Chan 2018, p. 188 and 184.

⁶⁶ Chan 2018, p. 186.

⁶⁷ Fiore 2020, p. 7.

⁶⁸ Fiore 2020, p.1 and Chan 2018, p. 190.

⁶⁹ Fiore 2020, p. 8.

⁷⁰ Fiore 2020, p. 8.

⁷¹ The social is enacted in the momentary situation in which the actors and actants gather to perform a certain task within the assemblage. It is not said that the task will be exactly what the designers inscribed the setting with. A subscriber can also develop an anti-programme based on the affordances and allowances. The setting is inscribed with concepts of morality and ethics, but the subscriber has agency relating to those and making their

to congregate and perform DNA analysis or work on projects related to DNA research. In order to address the social – consisting of different configurations of human-object relations with its connections running to and fro – I think the analyst is required to view the setting as having moral and ethical agency. The actors in the network are forming an assemblage during the momentary association of congregation, influencing each other's decisions on how to act, thus resulting in the social.⁷² It might not be feasible to hold the setting accountable for their ethical and moral contributions as such, but it can provide an understanding of how the social is affected by it. This is why I believe that the pre-scripted reality of the setting, such as the centrifuge and its affordances and allowances, is inscribed with moral decisions within the discourse of design ethics. Resulting in a setting that affects the social in a way that it steers other actors towards a particular ethical paradigm providing the option to collaborate or subscribe by re-inscribing it with anti-programmes. Chan argues that the mediation paradigm invites to entertaining the idea that it is not just morality that is 'designed' into the object, but that ethics might also materialise in a setting.⁷³ When, as Verbeek proposed, the design is perceived as materialising ethics and morality, then script analysis can play a supportive role in revealing these ethical and moral values absorbed into the setting and how this affects the social. This can help with creating policies, rules, and legislation surrounding new technologies in society.

Knowledge Making

Akrich describes the process of prescription as a consent to a future reality.⁷⁴ Prescribing a setting, therefore, involves the expectation that it will be part of a human-nonhuman assemblage in the future. This setting, though, has already been re-inscribed by its designers after its initial inscription. Its future reality has already been re-anticipated. The crowdfunding process creates a positive feedback loop to the designers. The initial feedback resulted in a few material changes, the distance of the incorporated devices is revised, and the Biotechnology 101 kit is a response to the need for a 'basic skills' manual.⁷⁵ The possibility to acquire a 'pro' or 'entry' level of the setting and all the different packages available with the setting, increases the potential programmes of action, which leads to different types of affordances and allowances geared towards different kinds of actors. The broad range of programmes and the positive feedback loop complicate the script analysis, for me as the analyst, as there are several

moral decisions. As Fallan points out, the users, designers, and setting influence each other. Thus, responsibility cannot only lie in the merits of a designer or user, there is an interaction between the humans and nonhumans. An instrumental paradigm is not taking into account that anti-programmes are part of a setting. The mediation paradigm is maybe implying accountability towards an object, but I find it opens up space to analyse how the situation/social comes into existence. Which makes it possible to then address accountability and or desirability of the processes at play surrounding the setting.

⁷² Latour 2005, p. 65 and 74.

⁷³ Chan 2018, p. 191.

⁷⁴ Akrich 1997, p. 215.

⁷⁵ Kickstarter Bento Lab 2016.

potential prescribed realities. These different realities relate to Yaneva's explanation that analysing design through a script lens provides a new outlook on the study of design as a whole.⁷⁶ Design and objects are not singular. The setting can be analysed in different networks and processes; when a beginner scientist uses the setting, it 'acts' differently than in connection to the designer or a molecular biologist. The setting diversifies the different groups that can congregate in the name of biotechnology. Bento Bio does encourage to "talk about bioethics and responsible science," but offering new affordances and allowances to a social network does not mean that the social conventions surrounding these new opportunities are changing alongside the new pre-scripted reality.⁷⁷ Alternatively, with the previous section in mind, I argue that the ethics surrounding biotechnological developments will not necessarily be ready for the moral dilemmas incorporated in the 'new' setting. Not all dilemmas are accounted for in the setting, even though they are part of the script. The most pressing one, according to me, is the confirmation of consent or permission to use the DNA sample acquired for research. There is no moment in which the setting stops functioning until the subscriber confirms they have permission to use the samples. This dilemma is inscribed in the setting, as it affords the user to study DNA, but it comes down to the user's moral compass and knowledge of existing research protocols whether or not the foundation of the research is ethical. Which means that humans need to actively re-identify their ethical stance on DNA research since the home as a place to do DNA research or any other place outside of (academic) institutions is novel and leads to new moral dilemmas such as this one. DNA research in the institutional realm generally requires a signed form of consent if human DNA is being studied, or an ethical statement as part of the research statement by the person studying the DNA. Akrich mentions that "once technical objects are stabilised, they become instruments of knowledge."⁷⁸ In the case of this setting, its inscription is an ongoing process in which the designers are open to re-inscribe it after the subscription has led to the development of anti-programs. Can this setting and its evolving capacity be considered stable? According to Verbeek, an object can have multiple stabilities.⁷⁹ He refers to Don Ihde's phenomenon of 'multistabilities'; in which the context of an object depends on or helps to shape what counts as 'real.'⁸⁰ Putting the concept of multistabilities into the ANT realm, I view a setting as a stable actor within a particular context. At that moment, the setting is co-creating the social and contributing to 'the real.' Therefore, when the setting is 'acting' in any way, I analyse it as an instrument of knowledge, stable in its network, and affecting how humans perceive biotechnology or DNA research as a field of study and experimentation. The crowdfunding aspect of this setting expands the multi-stable realities.

⁷⁶ Yaneva 2009.

⁷⁷ Yaneva 2009, p. 277.

⁷⁸ Akrich 1997, p. 221.

⁷⁹ Verbeek 2006.

⁸⁰ Verbeek 2006, p. 366.

The setting's impact on knowledge-making and perception of DNA research might be more comprehensive than initially understood. The character of a *crowd-based* production affects the social in a way that it touches upon different crowds and yet brings them all together. Especially in the case of this setting, Bento Bio has created a social platform alongside the setting.⁸¹ Such a broad social network – based on the width of the programs of action – can be understood as complicating the creation of a body of knowledge on synthetic biology. However, it offers the opportunity to address the ethical and moral aspects of the setting amongst the diverse crowd of actors that congregate to form a network with the setting. In that way, it can be seen as fitting the paradigm in which biohackers or DIYBio members operate according to Giordano; resulting in a more informed public. The extensive range of programs that lead to various forms of knowledge-making can, on the one hand, bring institutions and the public, or private, together. This will, on the other hand, require a momentum in which these parties are brought together. Bento Bio does provide their network as a potential space to gather and deliberate on all the different facets connected to the settings pre-inscribed reality. In the next chapter, I will elaborate on the subscription of the setting. The subscribers can all be found in the Bento Bio network and have different scripts at play affecting the social in various ways.

⁸¹ Bento Bio Blog.

Chapter 2: Subscription and (anti-) programs

Introduction

This chapter revolves around the subscription of the setting. I will highlight different contexts or environments in which the setting is in use and how this might affect the social. The scope of analysis consists of the settings' usage in the following user fields: educational, institutional, and personal. I will first introduce some environments in which the setting is *acting* and how its user fields overlap. Then I will address how the settings' script and subscription are associated with acting as a democratiser of science. I will juxtapose different definitions of democratisation in science connected to the setting. The portability and availability evolving from the setting's script bring DNA research to a new social context: the domestic sphere. In this final section, I will discuss the opportunities and concerns related to the setting in the personal and domestic environment. The novel addition of DNA research in the domestic realm prompts questions about – on-demand – consumer science and responsibility.

Subscription

The setting is mentioned on biotech websites as an exciting new gadget and is discussed in peer-reviewed articles as an object that influences citizen science movements all over the world. Bento Bio maintains a user network of the setting and updates all interested parties with their latest news via their blog.⁸² The contexts that form the scope of analysis in this chapter are part of the Bento Bio network and can be found either through their blog or user testimonials.⁸³ I have decided to derive the scope of analysis from the companies' network since all known usage I could find is also featured on Bento Bio's website.⁸⁴ As stated in the previous chapter, subscription forms a large part of script analysis as it makes it possible to analyse what conditions and mechanisms are in play when the setting is part of an assemblage.⁸⁵ These conditions and mechanisms can then be put in light of the social, asking: how is the momentum of gathering affected by the setting? Trying to discover the scripts at play in a human-technology assemblage, Akrich argues, can prevent an object analysis from becoming a utopia or dystopia discussion. Instead, script analysis emphasises the different roles of actors. This

⁸² Bento Bio Blog.

⁸³ Bento Bio Blog.

⁸⁴ Bento Bio follows and publishes any online trace of Bento Lab use on their website. The setting has been available on the general market for almost four years now. I assume that every form of online coverage on the setting will be relevant for Bento Bio to document and display, as this can help them solidify their product on the market. There will also be users who have not come forward online about their experiences with the setting. These users are hard to reach and I have decided to draw on the given information after searching the world wide web. I do think that the different spheres in which the setting acts as set out in the scope provide a good ground for a script analysis on the subscription of the setting. As these spheres require different modes of operation and will affect the social in varied ways.

⁸⁵ Akrich 1997, p. 206.

provides a better understanding of how technologies affect the relations between humans and technology.⁸⁶ In this chapter, I analyse the assemblage in the surroundings of use, showing the wide range of programmes inscribed in the setting. These surroundings overlap in many instances and are all related to education, institutions, and personal use. I will first introduce some examples of subscription and for what purpose the setting is being used. The different roles of actors become apparent when analysing the current use. It also becomes clear to me that all user environments are related in some sense: institutional environments are generally involved in educational programmes and individuals interested in synthetic biology are almost always (ex-)members of educational or institutional organisations or both.

An example of the usage of the setting in an institutional realm is that of Sophie Zaijier at the New York Genome Center (Fig. 11).⁸⁷ Zaijier used the setting in combination with the MinION device “a USB compatible handheld DNA sequencer” to execute a “rapid, inexpensive, and portable strategy to robustly re-identify human DNA”.⁸⁸ With the help of the setting, she



Figure 11 Sophie Zaijier, NY Genome Center.

managed to extract DNA in 55 minutes, of which Zaijier created a time-lapse video called *Democratizing DNA Fingerprinting* (see [video](#)). Zaijier argues that the setting can be used in many different professional fields (such as by the police force and in hospitals) that are currently relying on long waiting times from external laboratories performing DNA research for them.⁸⁹ Another



Figure 12 Bento Lab during YCAM Interlab Camp 03-2019.

institutional environment in which the setting recently acted is the Yamaguchi Center for Arts and Media (YCAM in Yamaguchi, Japan). YCAM organised an event as part of their Interlab Camp called: Personal Biotechnology, in which they tried to create a “bridge between bio-art, design, and everyday life” by hosting workshops “led by engineers and researchers that operate at the forefront of their respective fields”.⁹⁰ The example of the YCAM shows that the setting is used to experiment within an institution. They are doing DNA research,

⁸⁶ Yaneva 2009, p. 277.

⁸⁷ I consider a place to be an ‘institution’ if it is related to or funded with the primary goal of academic research and I will follow Frow’s definition of ‘academic’ in an institutional environment: “universities and scholars and researchers whose professional standing carries with it the rights and responsibilities of academic freedom.” - Frow 2018, p. 11. She found the definition in the rapport on US Presedential commission for the study of bioethical issues. In her article, Frow highlights the differences of policy and jurisdiction surrounding bioethical questions with the rise of synthetic biology and DIYbio.

⁸⁸ Zaijier 2016, p. 1.

⁸⁹ Zaijier 2016.

⁹⁰ YCAM programme.

but also open up the idea to be creative while doing it and contemplate what this means for people in everyday life.



Figure 13 The setting in use at Monash Science School, Australia.

The fact that the setting is used in educational programmes shows that these schools are perceiving the setting as an educational tool, unlike DIYbio members who treat it as a means to reject or subvert the exclusive access of DNA research for existing institutions. Both means of use are part of the affordances and allowances of the script of the setting. The implementation of the setting into a school curriculum is different per school or educational programme.⁹¹ The John Monash Science School in Australia, for example, is a secondary school that is teaching its students about DNA technology and has incorporated the setting into their educational programme (Fig. 13).⁹² Virtually all secondary schools in Switzerland are using the setting through Bio Outils, “a science communication platform developed by the University of Geneva in Switzerland”.⁹³ It is their goal to support education in modern biology by making devices and research skills available for schools.⁹⁴ Some schools in the UK are also using the setting in their classrooms.⁹⁵ Bento Bio is encouraging the use of the setting in secondary education and has developed a teacher training in which the teacher can learn how to deliver practicals in a confident and hands-on manner.⁹⁶ These classes can also be viewed as the designers highlighting particular inscriptions of the setting to make sure the subscribers in the educational field get as literate as possible on the programmes of action that might be interesting for them. Bento Bio also offers time slots for personal demonstrations of the Bento Lab, in which I can imagine them pointing out specific affordances and allowances per intended user field.⁹⁷

Defining ‘the personal’ is complicated. The Cambridge dictionary shows that the definition of personal distinguishes itself as the opposite of an institutional and educational realm: “relating or belonging to a single or particular person rather than to a group or an organisation.”⁹⁸ ‘The Personal’

⁹¹ I define educational in this chapter as education programs, classes, or materials developed for government schooling programs. Particularly the transitioning programs between primary school and college, often referred to as secondary education (age 12-18), focusing on pre-university education within the subject of biology. I have derived the definition of secondary education from a rapport on the USA school system from the university of Minnesota and the Office of the Secretary-General of the European schools.

⁹² John Monash Science School website and their twitter.

⁹³ Bento Lab Education Applications.

⁹⁴ Bio Outils.

⁹⁵ Mostly London area and Manchester area. See Bento Lab Education Applications.

⁹⁶ Bento Bio teaching programme.

⁹⁷ Bento Bio, contacts, book demo.

⁹⁸ Cambridge Dictionary definition personal.

concerning design seems to be an oxymoron. David Raizman touches upon this when he identifies the difference between design and arts and crafts.⁹⁹ The difference lies in a designer being “concerned with the client’s needs rather than their own, as well as with producing instructions for serial rather than unique artefacts.”¹⁰⁰ Design, in this case, cannot be personal as it is always part of a group of users, or the user identifies themselves with the ‘brand’ or concept belonging to the design. That is why I agree with Yaneva that “design has a social goal and mobilises social means to achieve it, thus striving to enrich not to diminish, to fortify not to weaken the public bonds.”¹⁰¹ Therefore I identify ‘the personal’ usage, as a usage that is not contingent on an institution or educational program but through the users’ interests stemming from their daily life and livelihood. Defining the personal as such keeps the option open that this person does affiliate with institutions or educational programs. The personal surrounding, in this case, provides the opportunity to analyse how the setting might affect the social on a private and domestic level. What happens when the setting enters the daily routine of a user without the identification of a broader educational or academic purpose?

I am writing this thesis during the times of the SARS-CoV-2 pandemic, and more users publish their home-based experiments or work with the setting via social media because of the imposed quarantine (Fig. 14). Shaun Stice, for example, is “testing bacterial isolates from grocery store onions for allicin resistance

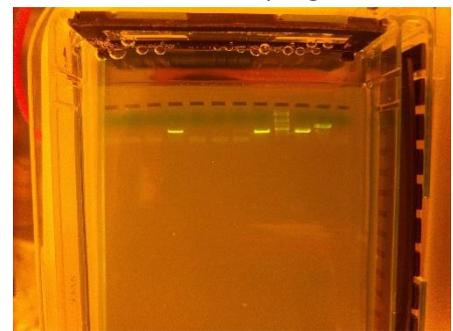


Figure 14 Photo of the setting's gel cast.



Figure 15 Kevin Chen with Brico Bio on the DIY-biology summit in Ottawa, Canada 2016, the setting is on the right in the bottom.

genes during my COVID quarantine thanks to @theBentoLab”.¹⁰² Stice is a graduate research assistant working in the plant pathology department of the University of Georgia. His scholarly overview does show he studies onions for his university job.¹⁰³ This home-testing might be for his job, but it does also allow him to embark on different projects outside of his work-related research field.¹⁰⁴ The same can be found about Kevin Chen, co-founder of Brico Bio – the DIYbio establishment in Montreal, Canada – and the medical start-up Hyasynth, he brings the setting to conferences and DIYbio meetings but also uses it to tinker wherever he likes (Fig. 15).¹⁰⁵ Both Brico Bio

⁹⁹ Raizman 2010, p. 13.

¹⁰⁰ Raizman 2010, p. 13.

¹⁰¹ Yaneva 2009, p. 276.

¹⁰² Twitter Shaun Stice.

¹⁰³ Shaun Stice scholar.

¹⁰⁴ Fuisz 2017, p. 661.

¹⁰⁵ Bento Bio Kevin Chen, Brico Bio Kevin Chen, and Kevin Chen DIY Bio summit Canada.

and Biohackspace (DIYbio) London work with the setting during workshops, and their members are part of the clientele of Bento Bio.¹⁰⁶ These specific scenarios in which the setting is acting reveal that it is hard to provide a conclusive definition of 'doing it yourself' as many of the DIYbio community members are working for academic institutes or have an academic background. The subscription to the setting alters in the different contexts provided in the scope of analysis in this chapter, affecting the social in various ways. As stated in the previous chapter, the setting affords many different ways of subscribing. I will concentrate on the overarching trait that is perceived or expressed during subscription and how the meaning of that trait changes in every field, uncovering diverse ways of *acting* of the setting and consequently affecting the social in various ways. The overarching trait I am alluding to is democracy.

Democratising Science

The majority of the user environments mentioned above bring up the concept of democracy to the setting's affordances and allowances. Zaaijer for example, titles her time-lapse video *Democratic DNA fingerprinting* and Chen states that the setting "helps to democratise science".¹⁰⁷ Democracy might have an intuitive meaning to many, but with my academic background in gender studies (I often describe it as the study of power structures: trying to define and strive for social justice within those structures), I find the statements problematic. The term democracy is un-defined when used in testimony about the setting or the type of science it allows. I agree with Giordano that "for the most part it [positively claiming that science is democratised] is an unexplained assumption that democratic science is better."¹⁰⁸ In this section, I will present the connotations with democracy within the scope of analysis and juxtapose them with conclusions from the Fem STS and bioethical studies disciplines. Cambridge dictionary defines democracy in the following way:

"The belief in freedom and equality between people, or a system of government based on this belief, in which power is either held by elected representatives or directly by the people themselves."¹⁰⁹

I will apply this definition as my basic understanding of the term democracy in this chapter.

¹⁰⁶ Bento Bio Applications.

¹⁰⁷ Bento Bio Kevin Chen and Zaaijer 2017.

¹⁰⁸ Giordano 2018, p. 417.

¹⁰⁹ Cambridge Dictionary definition democracy.

Giordano suggests that the combination of the terms science and democracy puts the sciences forward as a means to battle social injustice in societies.¹¹⁰ The issue that comes to the fore when studying democracy in relation to science from a Feminist Science and Technology Studies (Fem STS) perspective is that the initial goal of equality between people is no longer addressed or unwrapped.¹¹¹ When a scientific or technological solution for a specific social problem is offered, the focus goes out to the new development, rather than towards the social injustice. The solution becomes the focal point, drifting away from defining the lack of social justice. I find that this drifting away towards the solution can delegitimise ethical or practical challenges brought up by the affected public about ways in which the(ir) problem is attempted to be solved by the scientific or engineering community. In other words, they can lose their voice and therefore, their power within the social system. Especially since the scientific community tends to be perceived as having expertise and the group suffering from social injustice (often minorities) their lived experience is not judged as ‘having expertise’. This shows that even though the setting is perceived as a democratiser of science, it can act as one within a specific social scenario, and yet act as the opposite for another. Giordano points out how claims for democracy, rights, and inclusion are, within the Fem STS paradigm, viewed as socially and historically situated and cannot be judged out of context or viewed as a matter of fact.¹¹² The term democracy and its meaning are similar to the settings’ subscription: dependent on the context of use. Morgan Meyer detected that democratisation within synthetic biology, and DIY bio groups seem to be based “upon the material processes” rather than a general belief of freedom and equality between people.¹¹³ With affordability, accessibility, and mutability as the primary goal concerning technological development in the sciences.¹¹⁴ The setting as it is acting in Zaijier’s research project affords a less costly process of MinION sketching, making it possible to re-identify human samples in a cheaper and more time-efficient way.¹¹⁵ The word democratic in the title of the time-lapse pertains to the less time-consuming and more affordable setting, which makes the technology more accessible. As Meyer pointed out, these are material motives to refer to democracy. I find that the availability of the setting on the market is treated as if it is inscribed in the object and then conflated with democracy. Giordano points out that:

“Much has been written about the relationship among ethics, public participation and legitimacy in the sciences, but surprisingly little of it has addressed the contexts of racial

¹¹⁰ Giordano 2018.

¹¹¹ Giordano 2018.

¹¹² Giordano 2018, p. 417.

¹¹³ Meyer 2013, p. 117.

¹¹⁴ Meyer 2013, p. 117.

¹¹⁵ Zaijier 2017, p. 1.

and gendered power in which those relationships form, shift, and generate new knowledge projects.¹¹⁶

Giordano is hitting the nail on its head concerning the conflation of availability and democracy in this quote. The social consists of relationships and connections between humans and non-humans; they can live together based on their beliefs of what makes the world a better place. The social is situated in a particular ethical framework, as I established in the previous chapter, this framework is contingent on definitions and beliefs of a worthwhile life. What seems to be happening here is that democracy, as it is used in combination with the setting, does not involve the gendered and racial power that is involved in the social and knowledge creation. The availability of the setting is viewed as a given by the parties claiming that it can democratise. Even though acquiring the setting involves having the funds to obtain it. Following Giordano's call to take racial and gendered power structures into account, I view the term availability as carrying definitions of justice and injustice. When the availability is argued for as democratising, it is assumed that 'everybody' has (financial, physical, and infrastructural) access to the setting. Yes, everybody *can* buy it, but that does not automatically mean that everyone can *afford* it. Such an assumption, to me, carries social inequality.

The previous argument that experts can delegitimise lived experience of target groups, thus making the social less democratic in the scientific realm, can be tackled by the setting. Frow argues that the process of democratising biotechnology can happen with the existence of devices like the setting since "it is not a technology that requires experts."¹¹⁷ The people subjected to social injustice can demand more agency within the scientific community if expertise or knowledge is no longer dividing the scientists from the public. Affordability, mutability, and accessibility are inscribed in the setting, and this can be experienced as affecting the social in a way that DNA research becomes more democratic. Granted, the setting is sufficiently present for all parties of the social to partake in the democratic system, and there are clear definitions of what social injustice will be impacted through the setting's presence. Within education, for example, most secondary schools in Switzerland are using the setting through Bio Outils' services. Alternatively, the setting's presence in the education system of the United Kingdom or on the Monash school in Australia seems to depend on access to funds in order to invest in these programs. The economic situation of a country and its citizens is naturally also linked to definitions of social justice in terms of opportunities through public funding. Availability does, therefore not automatically deem the setting more democratic, as the setting is active within a network that might not work towards social justice. In this case, it might lead to a discrepancy amongst adolescents who have been in contact with these technologies and others who will only start their

¹¹⁶ Giordano 2018, p. 404.

¹¹⁷ Frow 2018, p. 4.

DNA research journey through an academic career.

This awareness that the availability of the setting does not promise access to everyone in the world is, I argue, crucial in understanding why democracy and availability are often conflated. For a setting to be available and to ‘democratise’, it will require awareness of the actors involved in the social of the setting. How are they regulating who can partake in their network? The actors need to self-reflect on their policies or actions involving inclusion and exclusion. Otherwise, this concept of viewing an object as ‘democratising’ without defining democracy creates a sense of contributing to social justice without defining justice and injustice altogether. This awareness of inclusion and exclusion also comes to the fore in the work of Sara Tocchetti and Sara Angeli Aguiton. They study the collaboration between the American Federal Bureau of Investigation (FBI) and the DIYbio network. These parties are collaborating “to prevent biosecurity risks and to establish a safe network.”¹¹⁸ Tocchetti and Aguiton trace the establishment of this collaboration and argue that “the generative capacity of technoscientific promises is also entangled with the cultural construction of biological risk.”¹¹⁹

The crowdfunding process also affects definitions of risk, safety and access. The crowd can increase the programmes of action and therefore its user scope. When an actor has feedback on the setting, Bento Bio will process the feedback and alter the setting if the anti-programme developed by the actor helps the programmes of action to function better or satisfies the desire for new programmes. This happens in their blog; Bento Bio publishes about anti-programmes offered by the users.¹²⁰ In a way, they are re-inscribing the setting by posting these entries online. For example, the manual states that the setting is best used indoors, away from humidity or any other factors that might affect the samples of your research.¹²¹ ‘The crowd’ suggests the need for a list of safe batteries to use in the field to power the setting. The use of a battery to power the setting in a “unique environment” is an example of re-inscription.¹²² Initially, this usage of the setting goes against the protocol provided by the manual. The feedback offered through their network, or crowd, urges Bento Bio to re-inscribe a safe protocol for portable power solutions onto the setting. Both the actors and designers can be satisfied, as the anti-programme was desired and is now *safely* re-inscribed onto the setting. The crowd is involved in the journey of inscription and re-inscription of the setting after its initial launch. Crowdfunding helps with making products come into existence and therefore, more available and accessible. In that sense, it is sometimes argued to be democratic, as the people have a say in whether or not a product is worth it on the market. Kieran Long stated the following about democracy and crowdfunding: “[...] it is a pitiless and undemocratic future for the city when only those able to run an

¹¹⁸ Tocchetti, Aguiton 2015, p. 827.

¹¹⁹ Tocchetti, Aguiton 2015, p. 829.

¹²⁰ Bento Bio Blog.

¹²¹ Bento Lab Manual Safety Warnings.

¹²² Bento Bio Blog.

effective Kickstarter campaign obtain the facilities they need.”¹²³ The concept of democracy, as argued for by the current actors through availability and accessibility, depends on much more than it being more *affordable*, resulting in omnipresence. The Kickstarter campaign has to be designed attractively. In the educational field, it needs to be in general use to prevent the unfolding of unequal opportunities. Then there are the DIYbio community laboratories, offering access to the setting in which actors without any scientific background can join biohacking communities to ‘tinker’ with DNA. These spaces in which individuals can learn by teaching themselves and each other through projects that might not be on the agenda within academic communities are often perceived to be democratic because they are not part of the established order. Therefore, they provide more equality and agency to the general citizen of a society. Giordano makes an interesting point in terms of inclusion and exclusion involving knowledge-making:

“My point is not to say that academia does not gatekeep. The larger picture, however, shows us that academia is not the only place in society where gatekeeping happens, and we must ask whether setting up shop outside the gates of academia means that everyone would have equal access.”¹²⁴

The setting’s script offers a broad scope of programmes of actions and its usage, as described in the subscription section, proves to be malleable and useful in many different environments. As Fallan pointed out: users adapt objects to their needs, but the behaviour and mindset of an actor are also altered by the objects.¹²⁵ It is the use of an object, or the application of the setting within the social, that makes the setting act in a situation, making it an *actant*.¹²⁶ The occurrence of DNA laboratory research exceeding the institutional environment does not only require the actors to (re)define their definitions of social justice. It will also transform the discussion on the meaning of social justice regarding DNA. If it is becoming apparent in adolescent education, as well as ‘hobbyists’ at home, I wonder how far we are removed from all having our personal DNA sequenced. Will it seep into processes of a ‘normal’ live in Western civilisation of finding a job, insurance, or a home? I think it is an important question to ask if the setting is becoming a ‘normal’ concept in societies. Whose DNA will be researched using the setting? Especially in combination with MinION, which saves generated data into the ‘Metrichor’, the cloud of Oxford Nanopore – the company that developed MinION.¹²⁷ How far are we removed from becoming DNA citizens? Having DNA research and results impacting our daily

¹²³ Long 2018, p. 63.

¹²⁴ Giordano 2018, p. 418.

¹²⁵ Fallan 2008, p. 68.

¹²⁶ Verbeek 2006, p. 372.

¹²⁷ Ginsberg 2018, p. 141.

lives. This will be the central question of the next section concerning the setting's role as an actor in the domestic sphere.

Domesticating the Setting: 'Window to the Sequence'

Verbeek describes technologies as helping to shape what counts as 'real'.¹²⁸ He uses the example of medical imaging technologies, specifically the ultrasound made during pregnancy.¹²⁹ He points out how the interpretation of pregnancy and identification of a 'normal' or 'complicated' foetus affects how the pregnant body or foetus is perceived by its surroundings.¹³⁰ I would like to draw further on the example of Verbeek on how the script of the sonogram has impacted society by providing an example from my personal life. Fallan identifies the domestication of artefacts as "the utilitarian and emotional adaptation to, and appropriation of artefacts."¹³¹ He then continues to say that the term domestication describes "how we 'tame' technology and artifacts."¹³² The ultrasound machine has found its way into the domestic spheres, from hospitals to highstreets in my country of residence: England.¹³³ There are portable ultrasound machines used by midwives to scan at home, but these are only used for medical purposes. The domestication, as I define it, is the shift from medical purposes to the purpose of leisure.

During my pregnancy in 2018, I found out that many women around me received a 4D scan for their birthday or their 'baby shower'.¹³⁴ Around this time, I noticed a clinic called 'Window to the Womb' in the highstreets in my area.¹³⁵ 'Window to the Womb' offers services on top of the National Health Service's (NHS) ultrasound coverage during pregnancy.¹³⁶ The sonographers working in their clinics generally also work in a hospital.¹³⁷ Window to the Womb offers medical scans such as 'early viability' and 'fetal wellbeing scans' which can function as a second opinion on the scans executed through the NHS. Then there is the option to receive the 4D scan, this scan shows the baby in 3D including the heartbeat, of which the customer – depending on their package – will receive printed

¹²⁸ Verbeek 2006, p. 366.

¹²⁹ Verbeek 2006, p. 366.

¹³⁰ Verbeek 2006, p. 366.

¹³¹ Fallan 2008, p. 68.

¹³² Fallan 2008, p. 68.

¹³³ An ultra sound machine creates an image using a high frequency sound.

¹³⁴ A baby shower is a party dedicated to the mum to be and her baby. Friends and family give gifts surrounding comfort for the mother and baby essentials for when the baby is born. Unfortunately, in my opinion, this is often a highly gendered event focusing on the mother and sometimes coincides with the 'gender reveal party'. These parties all focus on stereotypes of masculinity and femininity already bestowed upon the fetus before it is born. The other parent to be is left out of the festivities and sometimes not even welcome.

¹³⁵ London Area, Hertfordshire area.

¹³⁶ Window to the Womb.

¹³⁷ Window to the Womb.

photos, a heartbeat bear (stuffed animal with the recording of the heartbeat), etcetera.¹³⁸ The ultrasound started as having a medical function, transforming the perception of health for both mother and baby during the gestational period of the child.¹³⁹ I experienced every ultrasound as a delightful encounter with my 'peanut' until one variable was off, and suddenly I was shifted from the lowest risk category to a high risk one. This shift had a significant impact on the final weeks of my pregnancy.¹⁴⁰ Verbeek argues that ultrasound technology transforms the perception of mother and baby, and I can personally relate to that.¹⁴¹ The reason for building forward on Verbeek's ultrasound example is that I see a substantial similarity with the DNA research technology shifting from an institutional realm to a customer's demand and supply realm via the setting. The setting, to use Fallan's words, is *taming* the technology and adapts it for different types of usage, amongst them leisure. Which leads to an important conclusion from Fallan: "Artifacts are adapted to patterns of use, but they also create new patterns of use."¹⁴² The *taming* of objects, or domesticating of objects is happening based on the demand/supply relationship in the first place, the designers have found a market for the creation of the setting. This does not mean that the setting will be merely operated in the envisioned environments. The domesticating of the setting will also lead to unpredicted ways of usage, anti-programmes, and re-inscription of the setting.

I was told by the nurses in the hospital that it is best to disturb a foetus as little as possible and that ultrasounds can startle a foetus which is not necessarily good for its growth. I was quite shocked to see then that the sessions of the 4-D scan can take up to double the time of an NHS scan, especially since the customer will have to pay extra for the 'Very Important Baby' package to have more scanning time.¹⁴³ Meyer points out how the history of collaborations between professionals and amateurs in science is not a recent phenomenon and that, in line with Giordano's thinking, "the demarcation of science is a matter of power and authority, rather than a matter of truth."¹⁴⁴ He proposes the term 'citizen biotech-economies' describing the occasion of private clinics and DIYbio as alternatives or additions to established science.¹⁴⁵ Throughout my pregnancy, I experienced that the biotech-economies such as Window to the Womb put the final responsibility with the consumer. The company

¹³⁸ All these scans are executed after 24 weeks, from now on the baby has a chance – with medical help – of survival outside of the womb and therefore is considered a baby.

¹³⁹ Verbeek 2006, p. 366.

¹⁴⁰ The birth process was started through induction and went well. A healthy baby was born: Mia Spasenija Milovic, with relatively little medical intervention thanks to midwife Connie in University College Hospital, London.

¹⁴¹ Verbeek 2006, p. 366.

¹⁴² Fallan 2008, p. 68.

¹⁴³ Window to the Womb VIB: they do provide a disclaimer that all scanning times are in accordance with the NHS guidelines of how long a scan can last.

¹⁴⁴ Meyer 2013, p. 123.

¹⁴⁵ Meyer 2013, p. 127.

claims that their technology should be available for people in need of a second opinion or who just want to see their child. However, in the end, it will be on my account whether or not this will help me and my pregnancy. The ultrasound package states that everything happens within NHS guidelines. Nevertheless, you choose it yourself; therefore, it is up to you to reason what might happen in your specific situation. The domestication has also tamed accountability when you have an ultrasound in a hospital, or DNA research executed through a medical organisation, it is clear that they are accountable. As their client, you are relying on their expertise and knowledge in the field, and you can trust them with your health. With medical devices or biological research devices in the domestic realm, the accountability is shifted more to the consumer and their capacity to estimate the consequences of their actions instead of holding the companies that provide the devices accountable. The designers have taken responsibility by adding a 'warning' in their terms of usage, and that same warning often claims to no longer be responsible if the device is not used as stated in their manual. Bringing DNA research technology into the domestic realm and holding the user responsible can, in that sense, lead to social injustice to people whose DNA is studied without consent by someone owning the setting. Who is responsible in this case? The setting's user, Bento Bio, or the government for allowing such devices? These legal issues are not yet ironed out, whereas the setting is available for those who can and want to buy it.

Fuisz has made an extensive overview of parties offering DNA laboratory kits, amongst them the setting, mostly focussing on the novel possibility of obtaining 'CRISPR-Cas9' kits for personal use. "A system for engineering DNA, consisting of a Cas9 enzyme that can cut DNA and an RNA sequence that indicates where the Cas9 should cut."¹⁴⁶ On the one hand, I would be excited to learn how to work with these technologies and 'tinker' with DNA, on the other hand, I am quite apprehensive about the health effects and social effects these technologies can have in the domestic sphere. Especially with technological devices such as the setting, that offers 'a window' into the sequence of biological structures. I believe that general guidelines written for the citizen biotech-economy are not taking specific instances into account which a single citizen scientist cannot predict: possibly resulting in irreversibly affecting the 'biological' around this consumer-focussed science. If the setting fits in a laptop compartment and can be used anywhere, then how does that influence a person's understanding of biotechnology?

Amy Hinterberger addresses this issue in her article on 'Regulating estrangement: human-animal chimeras in postgenomic biology'. Her work prompts the thought that bringing CRISPR²/CAS technology into the personal and domestic realm requires to ask ourselves what it means to be human. The setting can transform the meaning of 'the personal' when *acting* in a network that potentially

¹⁴⁶ Fuisz 2017, p. 658.

works on the fringes ‘tinkering’ and ‘life-altering’ DNA research. Hinterberger points out that currently only persons “can possess fundamental rights like bodily integrity and bodily liberty because, as they [Nonhuman Rights Project] put it: ‘The only animal with legal right is the human animal. No other animal has any rights at all.’”¹⁴⁷ In the next chapter, I will delve deeper into questions about personhood concerning the setting and how it *acts* as an interrogator of the social when on display in a cultural setting.

¹⁴⁷ Hinterberger 2016, p. 6.

Chapter 3: Passivity instead of activity

Introduction

In this chapter, I will study Bento Lab on display in *THE FUTURE STARTS Here*. I will use a method of analysis for exhibitions coming from ANT developed by Wendy Griswold, Gemma Mangione, and Terence E. McDonnell. They explore the usage of ANT to study how materiality on display in a museum affects people's experience in 'Objects, Words, and Bodies in Space: Bringing Materiality into Cultural Analysis'.¹⁴⁸ Griswold et al. believe that "meaning-making is a function of position and location."¹⁴⁹ The position contains the composition of humans and objects in a place, and location holds the cognitive response resulting from the position.¹⁵⁰ This approach to meaning-making is in line with my motivation to apply script analysis to design theory: script analysis, I argue, avoids proposing an all-encompassing analysis of what constitutes the social. One of the main questions for this chapter revolves around acting and being passive: How do objects affect when they are on display? The scope of analysis consists of my visit to *The Future Starts Here*, its online webpage, the exhibition catalogue, and the V&A as a museum. I will start by describing the scope of analysis, followed by a study on the position of the setting in the exhibition. Then, I will analyse how the location affects the perception of the setting on display. I will conclude the chapter by arguing how the setting on display confuses the object-subject relation humans are familiar with when relating to 'things.'

The Setting in THE FUTURE STARTS Here

The exhibition openings statement comes from Paul Virilio:

"The invention of the ship was also the invention of the shipwreck."¹⁵¹

Curators Rory Hyde and Mariana Pestana want to urge the visitor to think about the new technologies on display and how each of them contains good and bad features that will affect life in the future.¹⁵² Tristram Hunt, the director of the V&A, writes: "*The Future Starts Here* explores the power of design in shaping the world of tomorrow."¹⁵³ Whether or not Hunt consciously attributes power to design to 'shape' the world of tomorrow is unclear, yet his view seems to be in line with ANT and script analysis and the 'acting' of objects. The exhibition and catalogue are divided into four sections: Self, Public,

¹⁴⁸ Griswold et al. 2013, p. 343.

¹⁴⁹ Griswold et al. 2013, p. 346.

¹⁵⁰ Griswold et al. 2013, p. 346.

¹⁵¹ Hyde, Pestana 2018, p. 9. Paul Virilio said this as part of a longer sentence in an interview by Philippe Petit: "When you invent the ship, you also invent the shipwreck; when you invent the plane you also invent the plane crash; and when you invent electricity, you invent electrocution... Every technology carries its own negativity, which is invented at the same time as technical progress." – Virilio et al. 1999, p. 89.

¹⁵² Exhibition Opening video.

¹⁵³ Hunt 2018, p. 5.

Planet, and Afterlife.¹⁵⁴ In these sections questions amongst which: “If Mars is the answer, what is the question?”, “Is Edward Snowden a hero or a traitor?” “Does democracy still work?”, accompany the matter on display, making it, I argue, a contemplative experience between the visitor and the objects on display. The setting can be found in the ‘Self’ section of the exhibition. The display embodies the domestic sphere as they are situated in a décor of homes (figure 1, 3). The Self area is complemented by the questions “We are all connected but do we feel lonely?” and “What makes us human?”¹⁵⁵ The setting’s description titled “A Home DNA Lab” (see introduction) poses what ethics should guide the evolution of home DNA research and postulates DNA as “the fundamental technology of life.”¹⁵⁶ The setting is sharing a showcase with Hagborg’s *Radical Love*, a work using the technology of forensic DNA phenotyping: creating an image based on DNA traits. Hagborg’s masks are a critical response to this emerging technology used in criminal investigations.¹⁵⁷ This technology is presented as ‘objective’ in criminal cases under the notion that DNA does not lie, yet the interpretation of DNA necessary for the imaging involves many presumptions concerning the embodiment of birth-assigned sex and gender. Other objects on display in the Self section are ‘smart’ objects, requiring less involvement of humans. Amongst them are a baby bassinet that will comfort the child, a therapeutic seal-shaped robot for lonely people, and the first social robot for the home.¹⁵⁸ Surprisingly, the setting is mentioned in a different section in the catalogue: The Afterlife. Alexandra Daisy Ginsberg speculates on the use of Oxford Nanopore’s MinION and what will come from the company’s concept of ‘the internet of living things’.¹⁵⁹ Ginsberg argues that reagents for citizen scientist are still hard to get by, but that “Bento Lab can already free scientist from the lab.”¹⁶⁰ The not yet existing internet of living things, according to Ginsberg, should be carefully contemplated as “with any technology, the MinION is shaped by existing values and it is our values that shape the future, not technology itself.”¹⁶¹ I agree with Ginsberg that humans have to be cautious towards technological developments; nevertheless, I follow Fallan’s notion of the relationship between humans and technologies or non-humans: the relationship works both ways.¹⁶² Therefore, as Hunt puts it, technology does play a role in *shaping* the future.

The V&A came into existence as the Museum of Manufactures in 1852, a result of the first Great Exhibition in the Chrystal Palace (1851), London.¹⁶³ Its name was changed to the South

¹⁵⁴ Teacher sheet The Future Starts Here.

¹⁵⁵ V&A website Exhibition.

¹⁵⁶ Description of the setting on display, see Introduction.

¹⁵⁷ Heather Dewey Hagborg, *Radical Love* 2016.

¹⁵⁸ Snoo baby bassinet, Paro robot, Jibo social robot.

¹⁵⁹ Ginsberg 2018, p. 141. The internet of living things is a result from Oxford Nanopore’s online storage called Metriorch, mentioned in the previous chapter.

¹⁶⁰ Ginsberg 2018, p. 138.

¹⁶¹ Ginsberg 2018, p. 141.

¹⁶² Fallan 2008, p. 68.

¹⁶³ V&A story.

Kensington Museum at the end of the 19th century and, because of its extensive collection, it was split up into two museums: the Science Museum, housing machines and technology, and the South Kensington Museum (now V&A) holding the art and design.¹⁶⁴ *The Future Starts Here* is one of V&A's recent blockbusters, in which aspects of technology and design are exhibited together again.¹⁶⁵ In the highlight section of the exhibition's webpage, the V&A presents the 'beta model' of Bentobioworks as one of the twelve exhibitions highlights.¹⁶⁶ This model is a prototype of the setting on display. It is unclear why these objects do not correspond; in this thesis, the setting concerns the object on display in the exhibition and available via Bento Bio.

Position and (new) Materialism

The script of the setting may not explicitly be inscribed for an exhibition, but, when following Akrich's conclusions on script analysis, it is the network in which the setting is 'stabilised' that will create the meaning both constituting knowledge and interpretation of the function of the setting.¹⁶⁷ The subscription of the curators has the intention to 'show' the piece and let people engage with the setting in a cultural network. They do this by asking questions to visitors to identify their humanness and how the setting might affect this. In this section, I will elaborate on the position of the setting. Griswold et al. argue that position, as a process of emplacement, is comprised of relationships amongst material actants, them being: objects, words, and bodies.¹⁶⁸ The network Akrich was referring to falls under the category of location, in this case, a cultural environment. Following Griswold's method, the "location is cognitive. It refers to the schemas and conventions that are triggered by the position of objects, words, and bodies and through which people interpret what they encounter."¹⁶⁹ I will devote the next section to the location and will first identify the material properties of the position of the setting in the exhibition. Griswold et al. follow the definition of agency of 'things' coming from ANT: "Agency of people or of objects, is a relational rather than intentional concept, a role that emerges through interaction."¹⁷⁰ The position of the material actants, and how they relate to one another physically, will affect this interaction and eventually how the location is perceived as well. Therefore, the perception of the setting is both material and cognitive.¹⁷¹ As I have explained in the introduction, script analysis does not have the tools to analyse an object on display that is not *acting* in a sense that it is not working within its scope of programmes of action. That is why in the second part of this section,

¹⁶⁴ Hyde, Pestana 2018, p. 7.

¹⁶⁵ Hyde, Pestana 2018, p. 7.

¹⁶⁶ Hyde, Pestana 2018, p. 7.

¹⁶⁷ Akrich 1997, p. 221.

¹⁶⁸ Griswold et al. 2013, p. 350.

¹⁶⁹ Griswold et al. 2013, p. 350.

¹⁷⁰ Griswold et al. 2013, p. 347.

¹⁷¹ Griswold et al. 2013, p. 348.

I will elaborate on the passive as an opposite of the active but not consequently less valuable than the active. I will do so by using the theoretical critique from Braunmühl on Barad's work in *New Materialisms* and apply it on script analysis and ANT. First, I will identify the position of the setting in the exhibition.

Position

In order to identify the position of objects, words, and bodies of the setting, I will describe how I think these elements are placed towards each other. The row of houses (Fig. 1) is showing objects intended for the domestic sphere, gathered around the centrepiece: a machine that can fold laundry accompanied by the question: "What is human?" The body of the visitor is welcomed by this question and can then decide which side of the display to go to first. The enlarged questions have guided 'chapters' on both sides of the display, indicating the path of the body. The descriptions of the objects are either on the side or underneath the objects on display. The objects themselves have reference numbers next to them, matching the descriptions. This makes it possible to encounter the objects without having read its description. I view the combination of Hagborg and the setting in one showcase as an incentive to think about my personal DNA and how that can now be analysed in a domestic setting (Fig. 3). I find it prompts the question of whether my bodily cells and materials are my property and what it means to be human if one/you/others can tinker with my DNA.¹⁷² This is the meaning I, the analyst, ascribe to the position of the setting on display and relates to what Yaneva refers to as the capacity of the setting to "mold the decisions we make, influence the effects of our actions and change the way we move through the world".¹⁷³ Alternatively, as Fallan puts it, the non-human actor functions as a mediator of human relationships, transforming meaning as they form through networks.¹⁷⁴ In Yaneva and Fallan's work, the focus of analysis is on how a setting affects human relationships, which is also what I am trying to describe throughout this thesis. How does the setting affect the social? The social, as I view it, consists of both human and non-human matter forming a network and enacting a momentum in which meaning is created. This is what I find a strong point of Akrich and Barad; they question the dichotomy of the subject-object by addressing the process of 'becoming of the social' rather than merely focusing on the human relationships fostered through the social.¹⁷⁵

¹⁷² For this larger and relevant question, I can recommend reading Anne Phillips's *Our bodies. Whose property?* – 2013. Phillips challenges the notions of ownership and freedom in relation to markets connected to the physical body such as prostitution, organ trade, pregnancy surrogates, and DNA databases.

¹⁷³ Yaneva 2009, p. 277.

¹⁷⁴ Fallan 2008, p. 62.

¹⁷⁵ Yaneva 2009, p. 276, Braunmühl 2018, p. 235.

The earlier mentioned belief, originating in ANT, that agency evolves from the interaction between people and objects is contrasted by Barad who introduces the term ‘intra-action’ as a feminist alternative to “queer the familiar sense of causality”.¹⁷⁶ Barad argues that “the notion of interaction assumes that there are individual independently existing entities or agents that pre-exist their acting upon one another.”¹⁷⁷ Meaning that ‘we’ (humans) are not the only ‘active’ beings, and agency is an *enactment* rather than something intrinsic to an individual.¹⁷⁸ Instead, as Braunmühl puts it, “everything that partakes in the becoming of the universe is seen to be actively involved in that process.”¹⁷⁹ Therefore, I will use the term intra-action from now on, as I find it useful to address the social as a process of becoming through an assembled network, and it makes it less likely to position one actant above the other as an influence on the enactment of the social.

I consider Barad’s thinking on Agential Realism as able to break specific thinking processes towards binary oppositions, for example between object/subject, male/female, and nature/nurture because it is not so much these categories that matter within her theory as it is studying the intra-action between matter. The individual (human) that is central in Anthropocene-thinking is no longer the only, or vital actor in the enactment of the universe. Which means, to me, that the future analysis of humans and things can take place beyond what the scientific world has demarcated as ‘important’ throughout history. New Materialisms helps to analyse what power or meaning has been attributed to the demarcation of science or scientific thinking. Demarcation is a form of inclusion and exclusion and therefore leads to dichotomies. However, to follow Giordano’s line of thinking of inclusion and exclusion, to ‘set up shop’ elsewhere does not necessarily result in going beyond these dichotomies either.¹⁸⁰ The reason why I introduced new materialisms to the analysis of the setting’s position is that it can shed light on dichotomies engrained in scientific thinking, also present in ANT and script analysis. Braunmühl writes “I regard the main problem with dualistic thinking as being enmeshed with *relations of domination and exclusion*.”¹⁸¹ I think Braunmühl’s theory of domination and exclusion in dualities is present in design theory and its categorisation or analysis of objects. The process of categorisation in history writing is always one of inclusion and exclusion, meaning that particular objects will not be viewed as crucial for design theory and others will. This is why I decided to use ANT and script analysis to study the setting: it acknowledges that humans and non-humans affect one another. Therefore, it is impossible to position me as a neutral, knowledgeable scholar who understands the matter. Instead,

¹⁷⁶ Kleinman 2012, p. 77.

¹⁷⁷ Kleinman 2012, p. 77.

¹⁷⁸ Braunmühl 2018, p. 230.

¹⁷⁹ Braunmühl 2018, p. 229.

¹⁸⁰ Giordano 2018, p. 418.

¹⁸¹ Braunmühl 2018, p. 227. (*italics in original*)

I acknowledge that the object influences my thinking and that my analysis might influence the types of networks in which the setting will act.

In *The Future Starts Here*, the definition of 'acting' concerning the setting is complicated. At first glance, the setting is on display: not *doing* anything. Nevertheless, it does affect the **position** between object, words, and bodies within its **location**. Both ANT and Barad place the opposites of acting and being passive in a hierarchical order, focusing on activity over passivity. Objects act in ANT and have agency in agential realism, and it is the intra-action amongst matter that enacts the social or 'the real'. In the exhibition, the setting itself does not *act* in the way it is intended to act, but I find its passive presence can be viewed as acting in that the objects, bodies and words intra-act. The terms passivity and acting are not mutually exclusive, and I will, therefore, not position them as a duality in terms of evaluation. However, I will continue to address them as different concepts relating to each other since they are affecting the cognitive perception of subjectivity and objectivity in different ways when analysing the location. Griswold's et al. analysis of the position of objects, words and bodies, leads to awareness of the becoming of the social. The constant shifting between humans and non-humans, following Braunmühl's definition of the subject-object dichotomy, means that mind and matter are both involved in meaning-making and therefore the creation of knowledge and the social.¹⁸² In which the influential relationship between mind and matter is reciprocal. In the case of the setting in *The Future Starts Here*, the visitor of the exhibition can be formed by or subjected to the setting. I view this as the body becoming a passive factor during such momentum in the network of the social in relation to the object and words in the exhibition. Thus, the subject and object can both actively and passively affect one another. I view these factors as accumulating into the social. I will elaborate on the setting's passive and active role in the exhibition in the next section, by adding the layer of the location to this previous analysis.

Location: Blurring the Subject-Object Duality

In the first chapter, I argue that the setting could both be viewed as the antithesis for 'biohacking' or DIY communities as well as a tool towards what Giordano calls, creating the general informed public.¹⁸³ In these communities, the setting would be used to conduct DNA research. In *The Future Starts Here*, the setting is visible to the general public, but not acting in the ways explored within the programmes of action thus far. First, I will highlight the earlier mentioned active and passive elements of the setting on display concerning the location and how this affects an informed public. Then, I will reflect on the museum as space for contemplation on ethics concerning the setting.

¹⁸² Braunmühl 2018, p. 223.

¹⁸³ Giordano 2018, p. 401.

The V&A brings technology, design and art together for bodies who find visiting the exhibition worthwhile. The bodies that are attracted to the museum will most likely be interested in the topics addressed in *The Future Starts Here*. The setting on display is described as a 'Home DNA-lab', but it is not only scripted for home-usage. The fact that there is a 'pro' and 'entry' version available and that the setting fits in the laptop compartment of a bag, to me, proves that portability and thus more than one user space is inscribed onto the setting. A visitor passing the display might not have any background knowledge about DNA research technology and is depending on the description of the setting by the museum. There will be visitors who do not read this description and, I can imagine, mostly see a device involving 'something' with DNA. Then, there can also be visitors who do have the background knowledge, and their interpretation of the setting might differ from the visitor following the exhibition's narrative. Caitlin Donahue Wylie and Matthew Shindell address the impact of the presence of laboratories in museums and how the process of meaning-making depends on the body or visitor's perception of the technology on display.¹⁸⁴ Wylie and Shindell write about glass-walled labs that function on display, but I find their point can also resonate with the setting on display while not in use:

"While glass-walled labs don't open black box around science, they offer a window into its workings. What that window displays – and doesn't – offers rich insights into how museums, scientific workers, and visitors understand scientific practices."¹⁸⁵

The position of the setting is arranged by the location: the museum, and the organisation behind it. They affect the meaning-making process at play when humans and objects intra-act in the exhibition. Wylie and Shindell state that the laboratory on display reveals how people understand scientific practices. In the case of the setting, it can reveal how people perceive DNA research and the idea of being able to bring it home. According to Fallan, this process depends on how the script is assessed by users or actants.¹⁸⁶ He claims that in some cases of "illiteracy, the script might be misunderstood or

¹⁸⁴ Wylie and Shindell mostly address the presence of functioning laboratories on display and how the public has different starting points for understanding what might be happening in the laboratory. They give the example of how a young girl defined what was going on in a fossil preparation lab: "Look! People making fossils!" [p.7] The intention was not to show fossils being 'made' in that moment, but the process of preparation for research. According to Wylie and Shindell this proves how meaning making can in certain instances be purely depending on the descriptions provided in an exhibition. As the visitors will only find out what is actually happening when they read the description. On the other hand, the young girl did touch upon a philosophical discussion related to knowledge making. The fossil only becomes more than a 'stone' or material when the researchers acknowledge it as a fossil and prepare it for research. When looking at it from this perspective one could argue that the material is being *made* into a fossil in the laboratory. – These thoughts are a result from a conversation with Prof.dr.ir. R. Zwijnenberg referring to H.J. Rheinberger's thinking on 'Epistemic Things'.

¹⁸⁵ Wylie, Shindell 2020, p. 633.

¹⁸⁶ Fallan 2008, p. 66.

not even detected.”¹⁸⁷ The script, in this case, can be derived from the earlier analysed position of the setting and possible background knowledge. To follow Braunmühl’s suggestions on passivity and activity, I perceive the setting as passive, but its presence proves the potential to play an active role in my (techno)future. When the visitor is not informed and unaware of the script, and it is the exhibition that makes them aware of these developments, an eerie feeling can fall over them of powerlessness. They are confronted with new options in technology and are suddenly encouraged to engage with the question of what makes us human in relation to the setting. Even though the setting is not *doing* anything, the script of the setting will be deduced by different people from different standpoints. The use of the setting can be envisaged in different contexts, or it can be an introduction to DNA research for others. In some sense, I argue, the visitor might experience a shift from looking at an object with the feeling of agency, being a subject with a mind, being in control, to an intra-action with the matter that renders them illiterate and subjected to the technology. The knowledge necessary to understand the specific technological advancements requires background knowledge. If you do not possess this knowledge, you have to relate to the position of the object and all the knowledge embedded in it. I view this as the technology carrying the meaning inscribed onto it and thus having a mind status concerning the not knowledgeable visitor who then turns into matter. The subject-object relation shifts back and forth between the actors and actants. The location can be the common ground in which these ‘worlds’ collide and as Wylie and Shindell put it “museums are valuable for raising questions rather than delivering answers and for portraying science as in-progress rather than preexisting.”¹⁸⁸ I agree with the idea that the museum as a location can help the public in generating concepts of what they want for their future and what leads to a worthwhile life. The setting itself becomes a symbol of its invention and the affordances coming with it, which can be contemplated during the exhibition. This process of position and location, creating meaning makes the cultural institution a place of ethical reflection.

Cultural institution as a place of ethical reflection

According to Griswold et al. it is the position that guides the location and the location that guides the meaning-making.¹⁸⁹ The position of the setting creates the initial perception of DNA research laboratories at home and what that might mean for the definition of humanness and or social life. The location guides meaning-making because the visitor is guided through the exhibit and exposed to the narrative of the V&A. As I argued in the previous section, I believe the setting on display in the V&A can lead to the shifting of object-subject relations, precisely because the museum questions the status

¹⁸⁷ Fallan 2008, p. 67.

¹⁸⁸ Wylie Shindell 2020, p. 621.

¹⁸⁹ Griswold 2018, p. 360.

quo of life and technological developments by involving its visitors in the developments of the future. In this process, the setting is not acting in a traditional sense; it is passive, yet positioned in such a way that it actively engages with the public. The museum offers a place of intra-action between matter, resulting in the social or the real. This involvement of the public is why bio artist Anna Dumitriu describes the “cultural space as the focal point of ethics”.¹⁹⁰ Especially in exhibitions such as *The Future Starts Here*, the techno future can be envisioned and speculated by people with different backgrounds and hopes for the future. Olga Remneva argues that this imaginative character of the mixture of “natural and technological, artistic and scientific” aspects of life, creates a space in which people can envision things in a speculative state much more freely.¹⁹¹ Resulting in an exhibition preparing for what she calls the era of ‘post-biology’ “where the boundaries between a living system and technological machinery are increasingly being washed out.”¹⁹² This washing out of boundaries is also present in this script analysis on the setting on display. The object-subject boundaries are blurred, and the mind is not the only space where knowledge-making is created, as the meaning comes into existence when mind and matter are interacting, resulting in the social. Which strongly relates to what Arjun Appadurai writes in the conclusion of the catalogue ‘Futures in the Making’:

“Thus, inevitably, the term ‘social’ is also changing its meaning, and no longer indicates contractually organised, permanent and well-defined groupings of individuals, but is now a constantly shifting array of individuals, who can briefly connect through technological devices, but who are no longer easy to unite in terms of such older categories as class, community, locality or ethnicity.”¹⁹³

With the term *dividual*, Appadurai refers to how humans have identified themselves in the past as: “temporary assemblages of matter and meaning”.¹⁹⁴ The temporary aspect of the assemblage fits the idea that the social is shaped in the momentum of gathering.¹⁹⁵ In the exhibition, this momentum can differ vastly per network of *dividuals* and makes the exhibition a suitable location in which the public and the technical experts can reflect on developments and whether or not these are desired. It can give agency to parties who enter the space without any knowledge or experience in the field of biotechnology, and as these *dividuals* will most likely also be affected by such developments, it is the setting’s presence that warrants ethical reflection. It acts as a moderator of ethical discussion through its position and location.

¹⁹⁰ Dumitriu 2018, p. 83.

¹⁹¹ Remneva 2017, p. 178.

¹⁹² Remneva 2017, p. 178.

¹⁹³ Appadurai 2018, p. 156.

¹⁹⁴ Appadurai 2018, p. 156.

¹⁹⁵ Yaneva 2009.

Conclusion

In this thesis, I analyse how the Bento Lab contributes to ‘the social’, using script analysis as a research method coming from Actor-Network Theory (ANT). My overall conclusion is that using script analysis to study the setting proves how layered the relation is between objects and humans. The introduction of new technological inventions, such as the Bento Lab, affects the social in various ways as I describe in the three chapters. The traditional steps of design theory – create a description of an object, analyse its use, and its meaning for society – is altered through the constant acknowledgement that humans and nonhumans affect one another.

Thus, script analysis steps away from the notion that humans can describe an object as if the traits are inherent to the object. Instead, the analyst has to position herself clearly towards the matter and understand that their position carries some weight in analysing how humans and nonhumans influence each other. I believe this will lead to a more inclusive and less static definition of ‘what is important’ in design theory because scholars are encouraged to relate to the matter in a personal way. This clear relating makes it possible to hold each other accountable for our findings and start a dialogue about the outcomes of the research. I hope this can open up narratives in design theory, focusing less on ‘fitting’ it into the existing discourses and resulting in a more object focused study. The study starts with the object and questions how it contributes to the social or the real. I chose to study the setting in three different contexts it is acting in ((inscribed, in use, and on display), through analysing and defining its script in those moments. This leads to identifying the affordances and allowances in its programmes of action, resulting in an analysis of the settings’ inscribed, subscribed, and displayed reality.

Throughout the thesis, I introduce feminist research as an addition to script analysis. I am interested in exploring the usage of feminist theory in object studies further in the future, as it grapples with notions of norms that are also present in ANT and any research methodology. I believe it can fortify existing discourses through opening up the relation between humans and nonhumans as a non-hierarchical one. ANT and script analysis make a start; feminist research practices can offer more tools to attempt to put all matter on the same level for analysis. I have not found such an application of feminist research practices so far and believe that it can be a fruitful addition to design theory.

When starting the research, I was hoping to touch upon the setting’s acting on a practical, socio-cultural, (bio)technical and ethical level. The setting has proven to affect all of these factors present in the social. I conclude that the setting’s convenience – both apparent in its slick design and the broad range of programmes of action – results in a wide subscription range. This wide range of

both programmes of action and subscription is prescribed with definitions of morality within ethical frameworks and often described as increasing availability. The availability is conflated with the idea of 'democratising' biotechnology or science. I believe these developments warrant ethical questions of how humans want the social to be impacted by this device. The introduction of new technologies, like the setting, and its connotation with democratising science, requires humans to define social justice and injustice.

The price of the setting, required knowledge to use it, and access to its social network are all part of its script and should be factored in when defining social justice. The V&A appears to be a suitable place to reflect on these issues, as the setting is acting as a moderator for this ethical debate. However, it is still a place with a script of its own, with specific subscribers and will thus provide a limited 'public'. New technologies and its future intra-actions should be taken seriously as they will affect the social in many different ways. The Bento Lab can spread the knowledge of DNA research to more levels than it is in now, potentially contributing to concepts such as Oxford Nanopore's 'internet of living things'. Thus, the setting is changing and shaping our definitions of what it means to be human and how we relate to our matter or DNA. These new technologies offer many novel opportunities and can be used in different research purposes, but whom are the people defining whether or not a type of research is benevolent for humanity as a whole? What DNA research helps humans create circumstances contributing to a life worth living? Who decides what is ethical concerning human DNA or the concept of DNA altogether? The intra-actions between the setting and humans as worked out in this thesis commend us to think, share, and congregate in order to discuss what (your) DNA means to you. I urge us all to participate in such a discussion because even though you might not think of it in the first place, this thesis proves the width of the network in which the setting acts and affects: You are part of the social.

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Addendum:

Vocabulary Script Analysis

Word	Meaning
Setting	“The object of analysis is called a setting or a set-up.”
Actant	“Whatever acts or shifts actions, [...] an actor is an actant with character (usually anthropomorphic).”
Description	“Usually by the analyst, is the opposite movement of the inscription by the engineer.”
Script	“The aim of the academic written analysis of a setting is to put on paper the text of what the various actors in the setting are doing to one another.”
Shifting out, Shifting in	“any displacement (movement) to another frame of reference that allows an actant to leave the ego. Hic. Nunc. (I, here, now) – shifting out – or to come back to the departure point – shifting in. For narrative there are three shiftings: actorial, spatial, temporal and for setting analysis material shifting through which the matter of expression is modified: shifting down: from sign to things: and shifting up: from things to signs.”
Programme of actions	“This term is a generalisation of the narrative program used to describe texts, but with this crucial difference that any part of the action may be shifted to different matters.”
Antiprograms	“All the programs of actions and actants that are in conflict with the programs chosen as the point of departure of the analysis; what is a program and what is an antiprogram is relative to the chosen observer.”

Prescription; proscription; affordances; allowances	“What a device allows or forbids from the actors – humans and non-humans – that it anticipates; it is the morality of a setting both negative (what it prescribes) and positive (what it permits).”
Subscription, or the opposite, de-inscription	“The reaction of the anticipated actants – humans and non-humans – to what is prescribed or proscribed to them.”
Pre-inscription	“The competences that can be expected from actors before arriving at the setting necessary for the resolution of the crisis between prescription and subscription.”
Circumscription	“The limits that the setting inscribes in itself between what it can cope with – the arena of the setting - and what it gives up, leaving it to preinscription.”
Conscription	“Conscription is the series of actors that have to be aligned for a setting to be kept in existence or that have to be aligned to prevent others from invading the setting and interrupting its existence.”
Interface or plugs	“The many gaps between preinscription, circumscription, and conscription are tentatively limited by plugs, sieves, ‘decompression chambers’ or more generally interfaces; when a setting is largely made of materialised interfaces, it looks like a network in the technological meaning of the word.”
Reinscription	“The same thing as inscription but seen as a movement, as a feedback mechanism [...] the choices made for the re-inscription defines the drama, the suspense, the employment of a setting.”
Redistributing competences and performances of actors in a setting	“The new point of departure for observation instead of the divide between humans and non-

	humans. [...] A setting is thus a chain of H(umans) and N(onhumans), each endowed with a new competence or delegating its competence to another.”
Ascription	“The attribution process through which the origin of the activity of the setting is finally decided in the setting itself”
Scribe, encripter, scripter, designer, or author	“Who or what is the designer of a setting is the result of a process of ascription or attribution; but this origin may be inscribed under many guises in the setting itself”
AND (syntagmatic, association, alliances); OR (paradigmatic, substitution, translation)	“The two fundamental dimensions following the re-inscription of a setting, hence its dynamic or history; the oral or written message [...] the front line between programs and antiprograms maps out the plot of a script and keeps track of its history.”

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