

MA Thesis

**Bioart interventions into the biotechnology discourses on
hormones**



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Introduction

The human endocrine system is being studied extensively to gain more understanding into the workings of the human body, as well as for the development of novel hormone-related technologies. As researchers in the fields of endocrinology and biotechnology are generally regarded as the experts on these topics, the discourses that they create strongly influence the understanding of hormones and hormone related technologies by the general public; they are also those who have the main say in the use and regulation of these technologies.

However, these technologies affect the lives and bodies of not just all humans, but also of other species and the environment. Therefore, it should not be merely biotechnologists – who of course have multiple stakes in the matter, as their research and livelihood depends on it – who get to influence development, policies and regulations. As biotechnology is such a specialized field, it is fairly difficult for others to gain access to it both practically and in terms of gaining a thorough understand of the matter. Humanities scholars therefore mostly only get to engage with technologies after-the-fact, when their development is already in progress or even completed, and regulations are already in place.

This does not only concern the concrete biotechnological developments that are made. The discourses that the scientists shape and perpetuate when documenting these studies are, because of their dominant position in the field, also highly influential on the way bodies, species and technologies are understood, as well as controlled. Therefore, in this thesis I want to look at both the discourses that are being created within the biotechnology research papers, and offer a strategy for critical feminist and anti-anthropocentric intervention that challenges the way science, gender and species are framed in the hegemonic discourses in biotechnology. The strategy that I introduce is bioart, an artistic practice that makes use of living or semi-living materials, and often uses biotechnologies in the process.

For this study, I have chosen to focus specifically on hormones and hormone related technologies, as they influence the lives of humans, nonhuman animals and the environment on many different levels. Hormones are often related to gender or gendered practices, such as reproduction. Also, there is currently much attention to the effects that hormones – particularly

xenoestrogens, present in industrial products such as plastics, but also in certain plants – have on other species and the environment. So, as I am interested specifically in discourses on gender and species, hormones make an interesting focus point for this research project.

To look at bioart as a critical intervention strategy into the discourse, I have established a research question and two sub questions, which I will aim to answer in this paper:

- Research question: How does bioart intervene into the hegemonic scientific biotechnology discourses on hormones?
- Sub question 1: How are hormones discussed in current biotechnology discourses?
- Sub question 2: How do bioartists address hegemonic biotechnology discourses in their works on hormones?

To answer these questions, I will start by providing a theoretical framework in Chapter 1, in which I turn to feminist science studies and new materialist scholars to establish a foundation on which to build the rest of my research. Then, in Chapter 2, I will answer the first sub question, by performing a critical discourse analysis on four recent research publications from the field of biotechnology, that deal with hormones and hormone related technologies: *in vitro* fertilization and hormone replacement therapy. In this analysis, I look at some of the topics that came up in Chapter 1, and I look at the way in which notions of objectivity, anthropocentrism, and sex and gender are dealt with in the research papers.

In the third Chapter, I turn to bioart as a way of intervening in the discourses. First, I look into the practice of bioart more broadly, discussing the different definitions as well as its potential to challenge biotechnology. I then analyze three bioartworks, Maja Smrekar's *K-9_topology: Hybrid Family* (2016), Mary Tsang and Byron Rich's *Open Source Estrogen* (2015), and Špela Petrič *Phytoteratology* (2016), and look at how different themes from the biotechnological discourses and practice are addressed in the works. I bring these two analyses together, and work towards an answer to my main research question in the conclusion.

Chapter 1: Framework

Before I start my analysis, I will build up the framework on which these analyses are founded. To do so, I start by highlighting some feminist ideas and interventions from the broader field of feminist science studies, and then narrow my path to new materialist theorizations of hormones and hormone therapies. Feminist science studies offer a broad analysis of many aspects of the scientific practice, from epistemological questions to histories of hormone research. New materialist perspectives are interesting in addition to this, as they challenge the focus on language and discourse prevalent in feminist works, and offer an analysis that takes matter into account.

Feminist perspectives on science

There is a long history of feminist critiques on science, coming from many different angles. Donna Haraway, the well-known feminist biologist scholar, points out the trouble with the way the scientist has historically been given shape. During the Scientific Revolution the image of the scientist as a modest witness, who is by definition male and European and inhabits an ‘unmarked’ category, was actively created as a new kind of dominant masculinity. This male scientist was framed as being able to conduct his research objectively, while other persons could never report objectively but always only on themselves (Haraway 1997). This image of the white male scientist lives on to this day, where in the laboratory still mostly men are doing the thinking, and women are caring for the nonhuman animals and cell lines (Weasel 2004), and the idea of objectivity as a disembodied view from above – the ‘god-trick’ – is still dominant (Haraway 1988). This idea of objectivity and neutrality continues into the technologies that scientists develop, but just as the scientist cannot separate his observations from himself, no technology can be created or put to use in a neutral manner. The historical and material realities of technologies need to be acknowledged, as these play a role in the way technologies are developed: an example of this being the history of the commonly used HeLa cell line¹ (M’Charek

¹ This cell line was taken from the body of Henrietta Lacks, a Black woman from Baltimore, and the development of this cell line is closely connected to Lacks’ position as a Black woman in the U.S.A. The cells were taken from Lacks without her consent, and

2014). At the same time, while history of technologies plays a role in the ways in which they can be put to use, normativities are not inherent to technologies per se. Rather, they are “located in practices where links are established between technology and society” (M’Charek 2008: 527). By pointing out these different issues, feminist science studies scholars challenge the neutral positions of both the scientists themselves and the technologies they put to their use.

Engagement beyond critique

While it is important to critique science and scientific discourses, this does not mean that science and biology should be seen as inherently problematic and therefore disregarded. Quite the opposite, in addition to these critiques it is important that we find alternative strategies for engaging with and doing science. Many feminist scholars work on devising such strategies. Elizabeth Wilson offers a transferential approach to science and biology, with which she challenges both the often anti-biologist tendencies within feminism, as well as overly simplistic determinist approaches of the biology practice. This approach takes both social and biological aspects of a treatment such as anti-depressive drugs seriously, viewing them as co-constituting and coexisting together instead of merely adding them up, making it possible to see how “the pharmacokinetic, psychological, and social realms both align *and* dissociate, how they are antagonistically attached” (Wilson 2015: 106, emphasis hers). In doing so, Wilson shows that the entanglement of material and social are what make up the lived, embodied experience, and should therefore be taken into account as a whole. Similarly, new materialist scholars Alaimo and Hekman (2008) challenge the way in which feminist scholars often distance themselves “from the tainted realm of materiality by taking refuge within culture, discourse and language” (Alaimo and Hekman 2008: 1), in this way maintaining the dichotomy between language and reality. They highlight that a focus on representations and discourse “excludes lived experience, corporeal practice and biological substance from consideration”, making it impossible to engage with science and medicine in any other way than by critique (Alaimo and Hekman 2008: 4).

she is not recognized for her contribution to scientific practice. See M’Charek 2014 for a more elaborate discussion.

Feminist epistemologies

In order to not only critique but also rethink scientific practices from a feminist perspective, feminist science studies engages with science on an epistemological level, coming up with new ways of knowledge production that move away from the god-trick and the modest witness without giving in to an entirely constructivist worldview. Clearly, the supposed objective position of the white male scientist is not disembodied or innocent, and does not automatically allow for objective knowledge production. Donna Haraway points out that this view from above is a highly specific perspective, and definitely not the only possible or relevant one. There is a view from other, subjugated positions as well, which has the potential to offer different, and highly relevant perspectives (Haraway 1988). However, this position does not in itself make for the production of better knowledge. Haraway therefore advocates for focusing on the embodiment of vision, be it technological or biological, and thereby for a vision and knowledge production that is embodied and situated, and explicitly not innocent. By taking technologies and positions of vision into account, we do not need to reject objectivity, but rather can work to improve it. This approach to knowledge production then not only focuses on the human viewer, but includes the object of knowledge as a material-semiotic actor, having an active part in meaning making. With this strategy, Haraway does not reject the goal of objectivity altogether, but rather aims to improve it by opening up and accounting for the position of the viewer – in this case, the scientist².

Feminist biology

Other strategies for engagement with science that go beyond critique come from feminist biologists, such as Celia Roberts. Roberts – in her work on endocrine disrupting chemicals (EDCs) – aims not to essentialize sex and reproduction, while at the same time not ignoring the biological activity of the EDCs. She highlights the importance of realizing that “the connections between sex, gender and reproduction are culturally and historically specific” (Roberts, 2003: 205), while still taking into account the effects that EDCs or hormones have on the production of bodies and particularly of sex. Clearly “it’s tricky being

² A similar intervention is made by Sandra Harding, who makes use of a feminist standpoint epistemology. See Harding 1991.

a feminist biologist”, says Lynda Birke, who shows another example of working on hormones from a feminist biologist perspective, in which she takes a contingent realist position (Birke, 2000). In this, she moves back and forth between a constructivist position and a realist one, explaining realism as the notion that “nature” really exists (Birke 2000: 588). By doing so, she does not frame materiality and the discursive as always already linked, as do Wilson, and Alaimo and Hekman who I discussed earlier. So, while Birke makes an important attempt at challenging the focus on materiality, she remains stuck in the material/discursive dichotomy.

From anthropocentrism to materialism

Not only is it important to draw the inherent connection between materiality and discourse, the taking serious of nature and matter also involves a rethinking of the central position of the human. The human body is always already an interspecies relationship, as the largest part of ourselves is made up of nonhumans such as gut bacteria. As the interspecies entanglements of our bodies, as well as our entanglements with science and technologies, become more clear and further developed, this already makes it impossible to stay with an anthropocentric worldview, as well as to stay committed to other dichotomous understandings (Åsberg 2011). An example of an anti-anthropocentric approach is Giffney and Hird’s use of queer theory “to challenge and break apart conventional categories pertaining to the ‘non/human’³, including the long-standing divide between ‘nature’ and ‘culture’” (Giffney and Hird 2008: 7). Another important scholar who challenges the nature/culture divide is of course Donna Haraway (Haraway 1991). Not only does challenging anthropocentrism require a rethinking of the human, but also a reconceptualization of nature, so that we can “account for myriad “intra-actions” ... between phenomena that are material, discursive, human, more-than-human, corporeal, and technological” (Alaimo and Hekman 2008: 5).

In order to break down the material/discursive dichotomy still kept in place in dominant – including poststructuralist – approaches, we need to study “the living and the agential, (un)ethical companionships and pluralistic

³ Giffney and Hird (2008) make use of the term ‘non/human’ to indicate that nonhuman and human are not fixed, binary categories, but rather are fluid, and that exclusion from the category of the human both shifts and has real, material effects.

coexistence as issues that cannot be contained within cultural, discursive, or human-centered domains of analysis” (Åsberg 2011: 222). This can be achieved through a posthumanist⁴ move, in which instead of fixating on categories such as nature and culture, human and nonhuman, it becomes possible to analyze how they are “entangled, productive to, and produced by material-discursive relations among both human and nonhuman agents” (Åsberg 2011: 225). If we aim to take matter seriously, as new materialist scholars do, a new account of biology is needed, not merely critiquing determinism, but taking biology into account as “actively producing variations in society” (Irni 2013: 41). It is not enough to add a material analysis to a discursive one, as the material and discursive shape and are shaped by each other and therefore cannot be considered separately, and Irni calls for an ontological move: “what “is” this “biology” we ought to bring in?” (Irni 2013: 42). Using Barad’s concept of indeterminacy, Irni points out that the nature of an entity is not intrinsically connected to it, rather, it only takes shape within the apparatus in which it is perceived. This means that for biology, “it is *not* the case that if biology were to have an *effect* in society, this would necessarily entail *determinism*” (Irni 2013: 43). A strategy for this is Karen Barad’s agential realism, in which she refuses to take phenomena as a combination of material and discursive factors, but rather views them as always already material-discursive (Barad 2007). In this way, she aims for a realism “without resorting to the ‘facts of the matter’” (Irni 2013: 45). Agential realism means not separating the ‘real’ from the discursive effects, but rather “determining the effects only *within a specific apparatus* that includes that which [in e.g. biology research] is called the ‘social’” (Irni 2013: 48).

Hormones, sex and gender

In this study, I am particularly interested in how hormones are framed by biotechnologies, and what feminist perspectives on this are out there. Nelly Oudshoorn provides a detailed history of the research on hormones and the development of hormone related technologies (Oudshoorn 2003). As Oudshoorn discusses, steroid hormones and particularly estrogen and testosterone are commonly labeled as ‘sex hormones’, even though the idea of estrogen as the

⁴ Two important scholars in the field of posthumanism are Cary Wolfe and Rosi Braidotti. See e.g. Wolfe 2010 and Braidotti 2013

exclusively female hormone and testosterone as the exclusively male hormone has long been refuted by endocrinology research. This misnomer is still in use to this day, and hormones and technologies or illnesses involving hormones are therefore easily connected to sex and gender.

I of course cannot continue a discussion of hormones, sex and gender without referring to Judith Butler, who describes gender as a performance, “an identity instituted through a stylized repetition of acts” (Butler 2003: 519). This by no means implies that gender is not real, or that we could stop doing gender at any given moment. It is very much real, and can only be performed or even imagined in a limited number of ways, that are related to our socio-historical positionings (Butler 2003). While gender and sex are separated in Butler’s analysis, and sex has to do with the physical body, she does not mean to say that gender is a performative layer placed over the physical reality of the sexed body, as this would play into the hand of the material/discursive dichotomy: sex, like gender, is performed and assigned by social convention.

These social conventions on sex and gender are actively being kept in place, and one way of maintaining them is through medical practices that naturalize the two-sex binary. This is very clear in transgender healthcare, where transgender people are being framed – and have to frame themselves – as still adhering to gender norms, but being ill, ‘in the wrong body’, and therefore needing medical interventions to help them align their body with their natural gender (Spade 2006).

A similar approach is seen in research and publications about endocrine disrupting chemicals (EDCs). EDCs – artificially produced hormones, other man-made substances such as paracetamol or the plastic BPA, but also substances naturally occurring in plants – are often described in sensationalist terms such as ‘gender-bending chemicals’ that are ‘threatening manhood’, and while they do have effects on the body, “the idea of gender-bending rests on many assumptions about both gender and biology” (Birke 2000: 590-591). While the effects of hormone treatments on transgender bodies can easily be explained within the natural two-sex binary system, as the effects of EDCs are not intentional, they could potentially affect any one of us and thereby threaten “the social and cultural basis of our allocation into binary sexes” (Birke 2000: 591). Birke warns us that as feminists, we should not only look at this sensationalist language, but

also take seriously the health risks – and especially the health risks for women, which are notoriously neglected in toxicology research – that EDCs might have. Also, this sensationalist focus on EDCs effects on sex and reproduction take priority over other, possibly more serious, health effects such as cancer (Ah-King and Hayward 2014: 14). Looking at the material effects that EDCs have on our bodies and on our reproduction specifically does not mean that we are giving in to the idea of a natural and fixed two-sex binary. Rather, EDCs provide a – material – example of the fluidity of bodies and sex in particular (Birke 2000: 595).

Materiality of hormones

Other scholars looking at the materiality of hormones take similar approaches. Celia Roberts, through her work on EDCs, points out that:

“‘biology’ is extremely flexible and open to intervention ... [yet] there are strong biological effects on our bodies and activities. We are not fixed biologically (there are no definite limits or biological laws constraining us), but we are strongly affected at levels that might be called ‘biological’. Sex, then, could be said to have a ‘biological’ aspect, but this is not one that is fixed or isolatable from other ‘non-biological’ aspects of sex or the body.” (Roberts 2003: 207)

Like Birke, she sees EDCs as an illustration of the fluidity of bodies and sex, a train of thought followed also by Ah-King and Hayward. They propose a novel understanding of sex, mediated by the disruptions of EDCs, as “a dynamic emergence with environment, habitat, and ecosystem, and made toxically so within the context of pollution” (Ah-King and Hayward 2014: 1). Not only is this a rethinking of sex, it also asks for a broader understanding of the vulnerability of humans as well as other animals, as our bodies are all “open to the planet” (Ah-King and Hayward 2014: 2). The body is no longer a closed system, but in direct connection and always under the influence of its surroundings. So, instead of trying to keep ourselves pure and our two-sex binary in place, this model invites to build resilience within this toxic environment.

Sari Irni also views hormones and hormonal change as intertwined with natural-cultural forces – and here there is no separation of the natural from the

cultural. When looking at hormone related treatments, Irni points out that while they actively work to regulate and maintain the two-sex binary, hormone therapies – like EDCs – can actually work to break this binary and create space for other bodies to exist as well. Using an agential realist approach, she defines hormone treatments as working beyond the biological body, as well as making the case that these beyond the biological effects are also real effects of hormones (Irni 2013: 46). As hormone therapies and EDCs highlight the modifiability of sex, it is particularly in the instances where hormone therapies are not used as ‘sex hormones’ per se that they are most provocative to the two-sex binary. In these instances, such as when steroids are used as performance enhancers in sport, or in hormone replacement therapy for menopause, provocations to the binary often get more attention than actual health risks. A clear example of this is the development of hormone replacement therapy (HRT) for menopause, where while the health risks of using testosterone are less than those of using estrogen, in the end testosterone based therapies were discontinued as their effects on sex characteristics that threatened the strict boundaries between the ‘two’ sexes (Irni 2016). This however is not an act of the steroids by themselves, they have this effect only within context. “Instead of independent molecules, steroids are, using Karen Barad’s terminology, “phenomena”, and steroids are nonindependent “parts” of apparatuses that include various nonhuman and human materialities and actions.” (Irni 2016: 524).

Hormone provocations controlled

Now, why is it considered so important to maintain the two-sex binary? The gendering of hormones and the maintaining of the two-sex binary are part of measures of societal control on who lives and who dies, and also what this life and death may look like. This is regulated through biopower, a measure of control that does not address individual behaviors, but rather takes place on the level of the population (Foucault 1982). There are different perspectives on how this biopower manifests itself today. Deleuze describes it as the society of control, in which the control is no longer exerted by placing people in institutions – such as hospitals, schools and prisons – but rather we are controlled in a seemingly less structured and less confining way, through neighborhood clinics and professional training programs (Deleuze 1992: 4). In

this way the control is just as strong, but more diffuse and therefore harder to locate exactly. Similarly, Preciado theorizes, on a somatopolitical level, our current state of being in the pharmacopornographic era (Preciado 2013). Within this mode of control, not only bodies but identities, sex, and pleasure are being managed and controlled, and are part of the global economy. This economy, according to Preciado, is dependent on technological interventions:

“Our world economy is dependent on the production and circulation of hundreds of tons of synthetic steroids and technically transformed organs, fluids, cells (techno-blood, techno-sperm, techno-ovum, etc.), on the global diffusion of a flood of pornographic images, on the elaboration and distribution of new varieties of legal and illegal synthetic psychotropic drugs (e.g., bromazepam, Special K, Viagra, speed, crystal, Prozac, ecstasy, poppers, heroin), on the flood of signs and circuits of the digital transmission of information, on the extension of a form of diffuse urban architecture to the entire planet in which megacities of misery are knotted into high concentrations of sex-capital.

These are just some snapshots of a postindustrial, global and mediatic regime that, from here on, I will call *pharmacopornographic*.” (Preciado 2013: 33).

So, the control in the pharmacopornographic era takes place very much on a technological level, and development of and access to technologies plays an important role in this.

In the control over development of and access to biomedical technologies, the distinction between therapy and enhancement plays an important role. This distinction differentiates between techniques that restore health, and are considered good, and techniques that alter or improve the ‘normal’ workings of the human body, and are considered undesirable (Karpin & Mykitiuk 2008: 415). Clearly, this distinction is based on what is considered to be ‘normal’ health and ‘normal’ bodily functions, and is therefore highly subjective. The maintaining of a clearly separated two-sex binary is a part of what is considered ‘normal’, and allowing for normal functions such as (heterosexual) reproduction.

Therefore, the reconfiguration of hormonally sexed bodies from biologically fixed to “unbounded, ... lacking coherence, and ... under globalized threat from the environment” (Roberts 2008: 46) also influences the control of

bodies and hormones on multiple levels. Governments and corporations are called on to take responsibility for what they produce and put into the environment, but it is not only them that are held responsible. As hormones are shown to travel, connecting species to each other as well as to their food and environment, this travel is also seen as preventable. Health can be achieved by correctly managing contacts and flows, thereby putting the responsibility onto the individual. This responsibility, to eat healthy, to live in a healthy environment, is placed especially on women and on mothers, not only for their own but primarily for the future life they (might) carry (Roberts 2008: 47). Interestingly, while potential future mothers are held responsible for the wellbeing of their eggs, men are not held to similar standards. For them, the focus lies more on the threat of emasculation than on taking care of their potential future offspring.

As the understanding of bodies and species, their boundaries and their 'normal' functions are shaped by and shape the biomedical discourses, it is important to gain an understanding of these discourses, as well as to come up with strategies to challenge them.

Hormone discourses

One way in which the issues that feminists point out in scientific practices and technologies become visible, is in the discourses that are created in the field of biology. While researchers are supposedly objective in their work and documentation, discourses are shaped by societal norms as well. Especially in processes that have to do with reproduction, this is visible in strongly gendered notions that affect bodies, body parts, molecules and even the processes themselves. As Emily Martin demonstrates, egg and sperm, as well as their production and behaviors, are described in highly gendered ways in both popular and scientific literature. The processes of egg production, ovulation and menstruation for example are generally described as wasteful, unproductive and passive, while sperm is ascribed masculine traits such as aggression and productivity. These descriptions do not add to a more accurate understanding of these processes; they merely perpetuate societal ideas on gender and should be described in more egalitarian terms. This gendering of bodily processes in turn reaffirms gender norms, and is therefore harmful beyond their influence on our

understanding of reproduction (Martin 1991). However, the gendered notions are not Martin's main concern. She points out that what is particularly dangerous, is the ascription of personhood to the gametes that (popular) scientific discourse reinforces, which is put to use in for example anti-abortion discourses.

Not only understanding of bodily processes and cells is influenced and perpetuated in gendered ways, the discourses on hormones are strongly influenced by societal perspectives on gender. The sex-dualistic model of steroid hormones, which assigns one hormone to one sex, has long been rejected by medical science: all hormones are generally present in all humans, regardless of sex and gender. However, in biology text books – that transfer knowledges to new generations of medical professionals and researchers – this model is still reinforced by describing steroid hormones as “sex hormones” and discussing them primarily in relation to sex and reproduction (Nehm and Young 2008). So while this is outdated from an endocrinological perspective, this understanding of steroids fits with socio-cultural ideas of a clear separation between men and women, and might therefore be maintained.

Gender norms also influence discourses on bodily processes, such as menopause. While the exact diagnostic criteria for menopause remain unclear, this process that is a fact of life for half the population is framed in medical textbooks as a “failure” of the female body that can lead to all kinds of diseases (Niland and Lyons 2011). As a solution to this apparent bodily failure, hormone replacement therapy (HRT) is brought up as a cure. This dominant biomedical discourse on menopause is not the only discourse available. In the Danish context Hvas and Gannik identify 7 discourses, in which the biomedical is dominant, and others are either in line with it – such as the ‘eternal youth’ discourse – or in opposition to it – e.g. the feminist and the alternative medicine discourses⁵ (Hvas and Gannik 2008). As these are the discourses available to people going through menopause, they influence their (self) image, as well as their views on therapies such as HRT. While there are multiple discourses

⁵ Hvas and Gannik (2008) identify seven different discourses: the biomedical discourse; the ‘eternal youth’ discourse, the health discourse, and the consumer discourse – compatible with the biomedical discourse; and the alternative discourse, the feminist/critical discourse, and the existential discourse – in opposition to the biomedical discourse.

available, and some of these are critical to the biomedical idea of menopause as a failure of the body, the biomedical discourse remains the dominant and most influential one. Even when self-diagnosing their menopausal symptoms, confirmation from a doctor is still very influential in alleviating stress and normalizing their experiences (Hyde et al. 2010). The discourses created and perpetuated by biomedicine are therefore very influential, which is why I focus on the biotechnological discourses on hormones in this study.

Current biotechnology discourses

To follow up this introduction into feminist science studies and new materialist perspectives on the scientific practice, I will continue by analyzing the discourses present in four research papers on the topic of hormones. For this analysis, I will use some of the important points that came up in this chapter. I will look at the themes of objectivity, anthropocentrism, and sex and gender, which came up throughout this chapter. In my analysis I am interested to see if, and how, these themes are present in the discourses in recent scientific publications. As I expect to see these themes come up in the articles in problematic ways – scientists framed as modest witnesses, or anthropocentric analyses of new technologies – I will then introduce bioart as a strategy for critical feminist and anti-anthropocentric intervention in this in Chapter 3.

Chapter 2: Biotechnology discourses on hormones

As I described in the previous chapter, there is much to be criticized and much to do differently in the natural sciences, and this is exactly what scholars in the fields of feminist science studies, posthumanism, new materialism, to name a few, are doing. The issues in biomedical science that they point out are present everywhere in the scientific process, in the design of the research, in the doing, and also in the reporting on it. As I have discussed already, the discourses that are created in the field of biomedical science are highly influential, as biomedical scientists are the experts in their field – as well as the only ones with easy access to their research, resources and information. The discourses that are created therefore are passed on within the community and to the general public, through research publications, popular science articles, educational textbooks, infomercials and TED Talks. In the previous chapter, I highlighted some examples of studies that look into the discourses present in textbooks, popular science, and information brochures, but I am curious to see how these discourses are also present in the research publications written directly by the biomedical researchers. These texts are supposedly written highly objectively and matter-of-factly, so already there one of the troubles with science comes up. I also expect that while researchers aim for an objective way of writing, many societal and scientific norms will be present in the writing.

In this chapter, I will use a critical discourse analysis to look at four research articles, written on the topics of hormone replacement therapy (HRT) for menopause, and hormone technologies to aid in in vitro fertilization (IVF). With this analysis I aim to provide an answer to the first sub question of this paper; ‘How are hormones discussed in current biotechnology discourses?’. To do so, I will first go into the method I use, and then introduce the articles that I analyze. I will then describe some of the main findings from this analysis.

Method

To analyze the research articles I have selected for this study, I make use of a critical discourse analysis method. Critical discourse analysis is based on a “dialectic relationship between theory and practice” (Lazar 2007: 145). This means that discourse constitutes social situations, institutions and structures,

and they in turn constitute discourse. Knowledge is not a neutral entity either, and what is considered knowledge and how this is produced is a discursive construction as well.

“Discourse analysts adhere to the basic social constructionist premise that knowledge is not a mere reflection of reality. It is a discursive construction, and different knowledge regimes (or epistemes) determine what should be accepted as truth or rejected as false. Different discourses establish different positions among which some hold the authority to speak decisively about what is true or false.” (Hvas and Gannik 2008: 160)

While knowledge about biology is often framed as factual and objective, it is still subject to discursive construction, something that is clearly visible when looking at who has the authority to make knowledge claims on this topic. Only scientists with a certain level of education, and using certain technologies to increase their objectivity and strengthen their vision, are able to make knowledge claims. Now, as knowledge is not objectively but socially produced, an emphasis is placed on the language that is used in reporting it. “Language is not separate from experience because the way it is understood and expressed is reliant upon it” (Frost & Elichaooff 2014: 44), and therefore, language is constructed by and actively constructs the experiences and knowledge of the scientists doing biological research.

Critical discourse analysis

As language and discourse actively shape and are shaped by experience and social norms, a critical discourse analysis “aims to understand how realities are constructed ... and to observe cultural and societal influences on subjective experiences.” (Frost & Elichaooff 2014: 46) Discourse has a part in reproducing and maintaining the social order, as well as in transforming it, and therefore, a discourse analysis looks not only at how power and dominance are produced, but also at how they are, or can be, resisted. (Lazar 2007: 149-150). A critical approach to discourse analysis cannot and should not aim at taking a neutral position, but rather lay bare and change discriminatory constructs within the discourse (Frost & Elichaooff 2014: 46, Lazar 2007).

So how can critical discourse analysis be used as a method? It is not a method of data analysis “in any simple sense” (Hvas & Gannik 2008: 162), it is more of a lens or an approach to questions that can be asked about a certain text, be it written or spoken. Hvas and Gannik, who use critical discourse analysis in their research of different discourses on menopause, describe it as “a way of thinking about the role of discourse in the construction of social and psychological realities [which] can help us approach research questions in new and productive ways.” (Hvas and Gannik 2008: 162). Frost and Elichaoﬀ similarly describe it as “not ... a method per se ... instead [it is seen as] an underpinning influence on all the questions” (Frost and Elichaoﬀ 2014: 46). In doing this, however, a critical discourse analysis is not merely descriptive. By showing the workings of power, and thereby drawing attention to possible locations for intervention, discourse analysis is a form of “analytical activism” (Lazar 2007: 145). So, in my analysis, I use the perspective of critical discourse analysis to formulate the questions that I aim to address.

Research material

To conduct this critical discourse analysis, I make use of research articles from the field of biomedical science. I have selected a total of four articles from different authors and research groups, all written in English, published after 2010 and in top ranking journals. While this selection will by no means provide a complete representation of the hegemonic discourses on the topic, I expect that articles that are published in the main, influential journals for this field both fit into and are influential to the hegemonic discourses represented in the field. Clearly I have to make a limited selection to adhere to the guidelines set up for this research project, but by choosing four works of different authors, coming from different research groups, I aim to cover a wide scope. I chose a combination of research papers and review articles, all focusing on hormone-related technologies and excluding papers that discuss research on the function of hormones. By taking these four articles as representative of the hegemonic discourses in the field, I illustrate some of the ways in which the troubles that I discussed in the framework are present in the current biology discourses, which shows the need for strategies for intervention.

In this way, I have selected the following articles for my analysis:

- "Continuous Combined Estrogen Plus Progestin and Endometrial Cancer: The Women's Health Initiative Randomized Trial." Written by Chlebowski, R. T., et al., and published in the *Journal of the National Cancer Institute* in 2016.

This article discusses the use of estrogen and progestin in menopause, and the associated risks on endometrial cancer.

- "Hormone replacement therapy enhances IGF-1 signaling in skeletal muscle by diminishing miR-182 and miR-223 expressions: a study on postmenopausal monozygotic twin pairs." Written by Olivieri, Fabiola, et al. and published in *Aging cell* in 2014.

This article discusses the effects of estrogen hormone replacement therapy in menopause on muscle composition.

- "Continuous high-dose estrogen controls serum FSH and LH levels: new treatment strategy for extremely low ovarian reserve patients, two case reports." Written by Honnma, Hiroyuki, et al. and published in *Gynecological Endocrinology* in 2014.

This article discusses two cases in which estrogen was used to facilitate IVF.

- "Cycle cancellation and pregnancy after luteal estradiol priming in women defined as poor responders: a systematic review and meta-analysis." Written by Reynolds, Kasey A., et al. and published in *Human Reproduction* in 2013.

This article reviews the use of estradiol to facilitate IVF.

Analysis

In this analysis I look at three topics that came up in Chapter 1, and see if and how they are present in the discourses in the articles that I selected. In this way, I want to show that these issues are not just theoretical, nor are they outdated. They are still present today in the way in which researchers report on their findings, and therefore still have an active part in shaping and being shaped by societal norms and ideas on hormones. I will address the following topics, and aim to elucidate the following questions that are based in critical discourse analysis:

- Objectivity

How do the researchers position themselves? Do they see themselves as modest witnesses making objective statements? Are they critical of their methods and technologies? Are they aware of the normativities that their perspective, their methods and technologies might bring?

- Anthropocentrism

What is the place of humans and others in the article? Are humans the main focus, and the most important? Are the effects on other organisms and the environment addressed? Do the researchers discuss how interspecies relationships may be altered by the technology?

- Sex and Gender

Are steroid hormones labeled as sex hormones, and are they connected to sex/gender? Are the hormones used to naturalize the two-sex binary? Are sex and the body seen as fixed, closed entities, or are they fluid and open? Does the research focus on the effects of hormones on reproduction or sex characteristics? Is there attention for other effects (e.g. on health) as well?

Now, I will show how these topics are discussed or come up within the research papers that I have selected.

Objectivity

The first point of analysis is how the question of objectivity comes up in the articles. As I mentioned before, this includes the position of the researchers, their methods and reliance on technologies. When taking a critical look at the selected articles, a few points stand out. First of all, the role of the authors is framed in different ways. In the Reynolds et al. article on IVF, the authors play an explicit role. They are responsible for selecting the articles used in the review, by “independently screening” citation lists, “manually [reviewing]” titles and abstracts, and “any disagreement between the three reviewers responsible for data extraction was resolved by discussion.”(Reynolds et al 2013: 2982) While it is made explicit that, after establishing the citation lists using a fixed search question, the researchers take on an active role, there is not much reflection on this. The authors do admit that “it is possible that [they] failed to include all

studies” (Reynolds et al. 2013: 2987), but their approaches in screening, reviewing and discussing the articles are not mentioned. It is stated who of the authors took on these tasks, but these authors are not positioned in any way. Therefore, the article makes an empty gesture of holding the authors accountable in the selection process, in which while it is considered relevant to name their involvement, they are still seen as modest witnesses who do not have an influence on the research outcomes.

In the text by Olivieri et al, similarly there is a description of the tasks that the different authors take on (Olivieri et al. 2014: 859). However, again they are not positioned beyond their university and conflicts of interest – none declined. Again, this seems an empty gesture. The other two articles make no mention of neither the tasks of the researchers, nor their influence in the research process.

Next to the researchers, there are other people and factors involved in the studies that may be influential. Some of the papers do mention this. In the study by Chlebowski et al, the role of the health care provider is briefly mentioned when the outcomes of the study are discussed: “despite this more active surveillance, fewer endometrial cancers were diagnosed in the estrogen plus progestin group.” (Chlebowski et al 2016: 7) However, this is a very limited mention, which does not do justice to the effects that interaction with a health care provider can have on the wellbeing of a patient (Di Blasi et al 2001) In the Reynolds study on IVF, the role of provider or patient bias is mentioned somewhat more elaborately:

“they may not have had a better response to [controlled ovarian hyperstimulation] but rather the [assisted reproductive technology] cycle was less likely to be cancelled. Because the bulk of the studies in our meta-analysis were observational, we do not know what role provider or patient bias may have played in the decision to cancel cycles in which LE priming was not employed.”

(Reynolds et al 2013: 2985)

Here, because the studies that are used for the review were observational, the authors put the data of these studies into question. In doing this they implicitly put more trust in data that is technologically measured, than in the observations made by the researchers and health care providers. Interestingly, the authors put

quite some attention to this possible bias, while they rather easily step over the role they themselves have had in the selection process in this study.

Trust in technology and measures to eliminate the influence of the researchers as much as possible are also visible throughout the papers. In the Olivieri et al study, the focus on technology is strongly present. In this study, the results are “*in vitro* [assay] confirmed” and “[validated] by quantitative PCR”, and inclusion criteria are set based on detectability by microarray assays, all techniques making use of elaborate laboratory technologies that provide a simple read out (Olivieri et al 2014: 850-851). Of course, use of technologies to make certain data is often useful or even necessary, as many observations cannot be done by the human eye. So, I by no means argue that the use of these technologies is problematic. However, just as the role of the individual researchers, health care providers, patients, and other human players should be acknowledged and positioned, so should the technologies. How are they developed, what are their histories? Also, the use of technologies versus observations appears to rule out the influence of the person who is using them, and the norms and ideas that they might bring with them in their use and interpretation of the technologies. None of these aspects are in any way addressed in these papers, and they thereby perpetuate the idea of technologies as value-free and objective.

To make one more observation on the topic of objectivity, the study by Chlebowski et al also works to maintain an idea of objectivity by including certain measures into their study protocol. These measures are quite standard in studies with human participants, namely random assignment of the treatment (e.g. drug or placebo) to the participants, and a double-blinded structure in which the researchers nor the participants know to which treatment they are assigned. Just as the use of technology, it is not my intention to challenge the use of these methods by themselves. While the pros and cons can be discussed from many different angles, I merely want to point out that the use of these strategies again adds to the idea that observations by humans are inherently flawed and biased, and therefore not usable in scientific research, and that we therefore need to take measures, such as blinding, randomizing and use of technologies, to minimize the observational – human – bias. Also, this is in line with my earlier observation, that while the researchers themselves are seen as objective, modest

witnesses, this does not include the health care providers and the patients themselves. Therefore, these measures seem to be implemented to protect the researchers' objective work from the bias that these other parties bring in.

Anthropocentrism

While the researchers and other humans involved in the studies are not very visible in the articles, even less visible are the other animals that are involved. Ecologists and popular science magazines may be interested in the effects of steroid hormones on other animals and the environment, this does not come up in the articles at all. The only way in which other animals come into play – and barely so – is in the research materials. All of the studies make use of estrogen. In the papers by Olivieri et al. and Reynolds et al., the source of this estrogen is not mentioned, so it is unclear if it is of human, animal or synthetic origin. Honnma et al. and Chlebowski et al. are more explicit, and both studies make use of equine estrogen. This equine estrogen is extracted from the urine of pregnant mares. However, the articles make no mention of this process, or the way the lives of these horses are affected by it. Similarly, the study by Olivieri et al. makes use of several techniques that make use of human and nonhuman animal materials, such as human myoblast culture and mouse muscle cells – for both of which fetal bovine serum, coming from slaughtered calves, is used – and antibodies from donkeys and rabbits (Olivieri et al 2014: 850). The human myoblast cells are taken from a newborn child, and the mouse muscle cells are taken from male mice, but other than that, none of these humans and other animals is mentioned in the article. So, while there is a role for animals in the research process, they are kept out of view in order to maintain an anthropocentric focus. Other than the brief mentions of the animals as research materials, effects of the studies on other species, relationships or environments do not come up at all, showing the researchers' interest only in the risks and benefits that their work may bring to humans.

Sex and Gender

Still quite common in popular science articles and the like, is the use of the term 'sex hormones' to refer to steroid hormones, even though endocrinologists have long realized that these steroids are neither exclusive to either men or women, nor do they affect only reproductive processes. Therefore,

I am interested to see if this terminology is still used in research papers. Most of the articles do not make use of this term at all, however it does occur – only once – in the text by Olivieri et al, when discussing the changes happening during menopause: “several muscular risk factors culminate at menopause, when dramatic changes occur in sex hormone status” (Olivieri et al 2014: 855). It is interesting to see this terminology in this paper, as it otherwise does not refer to effects of steroids on sex characteristics or on reproduction. As I discussed in Chapter 1, steroid hormones are at times discussed mostly in relation to sex and reproduction, thereby working to naturalize the two-sex binary, whereas actually steroid hormones have many different effects on the body (Oudshoorn 2003).

As two of the articles discuss IVF technologies, it is to be expected that they make the connection between steroid hormones and reproduction. In the study by Reynolds et al, the effects of the treatment are only connected to pregnancy. While I find it interesting that no other effects are included, this does fit the goal of the review article, and most likely more information is available in the studies that are included in the review. In the Honnma et al study, there is a strong focus on pregnancy as an outcome, though there is also mention of “individual risk factors associated with each patient”, when the applicability of the treatment is discussed (Honnma et al. 2014: 343). No explanation of this statement is given, and therefore interpretation of which risks this includes, and what is considered acceptable in the light of increasing the chance of pregnancy, is left to the reader. Thereby, the authors frame pregnancy and reproduction as possibly more important than other effects that estrogen may have on the body. The other two studies focus on menopause, and therefore leave more room for discussion of different effects of steroids. However, both articles keep their discussion of the effects entirely to their main topics, cancer and muscle strength (Chlebowski et al 2016, Olivieri et al 2014). Therefore, I do not read them as perpetuating the idea of steroids as sex hormones.

Bioart as intervention strategy

As I have shown with this analysis of four recent research papers, there is still much to be challenged within the biotechnology discourses. The idea of the scientist as modest witness is still present, as well as the reliance on technologies

as value-free observers. While hormone technologies clearly affect more than just humans, the research is still very much anthropocentric, with other animals only present as research techniques. On the other hand, I did make a somewhat positive observation on the topic of sex and gender, as there does not seem to be an excessive focus on sex or reproduction in the discourses. However, there is also no explicit disconnect, and therefore it is quite possible that this is merely due to the focus and brevity of the articles.

As there is still much left to challenge, I now continue my research in the next chapter with offering bioart as a strategy for critical feminist and anti-anthropocentric intervention, and showing its potential by looking at three recent bioartworks.

Chapter 3: Bioartistic interventions into biotechnology

In Chapter 2 I have illustrated that many of the troubles in biology brought up by feminist scholars are still present in the current biology discourse. Now, I will offer a potential strategy for critical feminist and anti-anthropocentric intervention in these discourses: Bioart. I will first give an introduction to bioart, and then illustrate the potential of this upcoming artistic approach by analyzing three art projects. The projects that I analyze are Maja Smrekar's *K-9_topology: Hybrid Family*⁶ (2016), Mary Tsang and Byron Rich's *Open Source Estrogen*⁷(2015), and Špela Petrič's *Phytoteratology*⁸ (2016). By showing the ways in which these artists challenge, or at times perpetuate, norms from biomedical discourses, I aim to offer a transformative strategy that moves beyond critique.

What is bioart?

Bioart is a relatively new field, which is not clearly defined, and not all bioartists agree on a definition or shared approach (Vita-More 2007). There is no consensus definition, nor is there an established manifesto. This makes it difficult to speak of something like a bioart movement, and Beyerly and Chong propose two opposing positions: "bio art cannot be an art movement because it does not have a manifesto; bio art is an art movement as represented by a cohesive community." (Beyerly and Chong 2015: 207) However, while there is no clear consensus, and maybe not even a movement as such, artists and scholars do attempt their own definitions of bioart.

Natasha Vita-More defines bioart as being "concerned with art practices that work with living organisms [and] the manipulation of mechanisms of life" (Vita-More 2007: 174), and through her interviews with several bioartists, comes to the conclusion that "it has to be a living medium wherein the art is produced" (Vita-More 2007: 175). This is in agreement with the definition of the director of the Experimental Art Foundation, Melentie Pandilovski, for whom "BioArt cannot be image-based, text-based, dead biomaterial, or solely software

⁶ Majasmrekar.org/blog

⁷ maggic.ooo/Open-Source-Estrogen-2015 and www.byronrich.com

⁸ As this is a new project, it is not yet available online. See spelapetric.org for info on the artist, and previous projects.

actions that resemble biological actions.” (Vita-More 2007: 175). However, Vita-More is also skeptical of such a narrow definition, and invites a reading of bioart as an umbrella term with a “malleable and hydrated membrane to flourish and evolve”, that may also allow for the inclusion of body art (Vita-More 2007: 175).

In other definitions, the focus varies. Some highlight the material, by defining bioart as “a genre of art in which artists use biomaterial such as live tissue, blood, genes, bacteria or viruses as their ‘canvas,’ is literally teeming with life” (Zylinska 2014: 191), “works of art made from living and semi-living materials” (Beyerly and Chong 2015: 197), or using “‘wet’ media like living plant and animal tissues, human and animal bodies and ecological systems.” (Kelly 2016: 2). Others include also the techniques that artists employ in order to differentiate bioart from other artistic practices. Marietta Radomska draws a strong connection to scientific techniques and practices, defining bioart as “a form of hybrid artistico-scientific practice” which uses “biological materials (living elements: cells, tissues, organisms) along with scientific procedures, protocols, and tools” (Radomska 2016: 13). Similarly, van den Hengel includes both the use of living material and the use of biotechnologies when defining bioart (van den Hengel 2010: 46).

The biotechnologies used in bioart are myriad. “A current list of biomedias include, but are not limited to, genetic engineering, cloning, hybridization, selective breeding, transgenesis, cell and tissue culture, bio-robotics, bioinformatics, xenotransplants, neurophysiology, homo-graphs and self-experimentations.” (Vita-More 2007: 177) Other authors define ranges of techniques used in bioart. Beyerly and Chong bring this down to three types of works, working with transgenic forms, tissue culture engineering, and “live hybrids, which are associated with breeding ornamental plants, [and] represent the lower technical end of the biotech industries.” (Beyerly and Chong 2015: 201) This way of characterizing different strategies also brings in a hierarchy between them. Bioartist Eduardo Kac similarly distinguishes between the coaxing of biomaterials into particular shapes, the unconventional use of biotech tools and materials, and the invention or transformation of living organisms (Radomska 2016: 44). Radomska offers an important critique on this hierarchical view on the use of biotechnologies in bioart.

“Firstly, such a division implies a specific progress narrative with regard to the technologies employed in the projects: it distinguishes between less advanced medical and surgical techniques used by artists such as Orlan, who focus on body modifications, and the more developed biotechnologies, such as tissue or genetic engineering, employed by Kac and [The Tissue Culture and Art Project] Secondly, approaching this distinction as though it were a sharp one would suggest that there is a substantial difference between human and nonhuman bodies and materialities. This is not true, since ... human bodies are always already nonhuman. Finally, there are projects that involve the modification of an artist’s body by means of biotechnological techniques, such as Stelarc’s *Ear on Arm* (a bioengineered ear implanted on the artist’s arm) or [Art Orienté Objet]’s *May the Horse Live in Me*. These projects blur the boundary between the two categories and refuse to remain contained within either of them.” (Radomska 2016: 44)

As these hierarchies between technologies, bodies and species are exactly what bioart can intervene in, it would be counterproductive to institute these hierarchies within bioart’s definition. Therefore, for this project I take on the broad, inclusive definition proposed by Beyerly and Chong, of bioart as made from living or semi-living materials.

Interestingly, while not all bioart projects have a feminist goal or perspective, bioart does have roots in feminist art, Home Economics and recipe art. Lindsay Kelly reads bioart as “a practice informed by feminist and ecofeminist methodologies” (Kelley 2016: 11), and emphasizes that even without an explicit feminist aim, it takes “advantage of the spaces opened up by the feminist art movement while simultaneously working to politicize locations that are only beginning to be critically interrogated from a feminist perspective” (Kelly 2016: 7). So, with this history and in challenging locations such as laboratories, kitchens and factories, bioart can be a strategy for pursuing feminist goals, but how does this work? How does bioart challenge dominant discourses and practices?

Bioart as a critical practice

The field of biotechnology is rapidly advancing, but as access to knowledge about and experiences with these technologies are difficult to attain

for scholars from the humanities, it is mostly scientists who are able to engage with bioethics and decision-making. Humanities scholars are only able to engage with new technologies after-the-fact, so when their development is completed or well advanced, and regulations are already established (De Sena Cortabitarte 2015: 51). This makes for a rather one-sided perspective on novel technologies, while most of these developments will have a widespread influence, on the general public, society, and environment. The field of new materialism engages with these technologies, but also mostly after-the-fact, and, as Robert Zwijnenberg discusses, with “little potential for use in daily life” (Zwijnenberg 2014: 139).

De Sena Cortabitarte and Zwijnenberg both offer (bio)art as a way to include different perspectives in this discussion. As an addition to a theoretical, new materialist approach, Zwijnenberg sees bioart as a strategy to gain a deeper understanding of the ambiguities and complexities that come with new developments, as it is “able to seek a more tangible encounter [than new materialism] with the many issues concerning biotechnology” (Zwijnenberg 2014: 140). This tangible encounter is what makes art so interesting to Zwijnenberg:

“art can confront us with these issues in an embodied way, and it can thus provide us with an experience of these issues that is marked by ambiguity, complexity, disturbance, unsettlement and imbalance. It is my contention that art – from its own artistic specificity – can add something to our understanding that cannot be found or experienced in books or articles” (Zwijnenberg 2014: 141)

From this artistic perspective, bioart can therefore bring something to the table that neither biotechnology itself nor new materialist or otherwise critical theoretical engagement with biotechnologies can bring.

How can bioart provide this critical, embodied engagement with biotechnologies? While scientists use technologies with a certain goal in mind, bioartists focus on the process, on disruption, clashes, unexpectedness, unproductive actions (Radomska 2016: 48). They can work outside of or on uncomfortable terms with the disciplines of visual arts and biotechnology, as

well as with the research and art institutions (Beyerly and Chong 2015: 212), and bioart “lacks the pragmatic imperative of many science and technology projects, whereby innovation and economic growth frequently overshadow any non-goal oriented agendas” (Zylinska 2014: 194). In this way, there is the opportunity for a critical engagement, open-ended questions and representations that stands in opposition to the dominant view.

By working *with* the biotechnologies, as opposed to working about them, bioartists create a hands-on engagement that is “subject to the same rules and procedures, and using the same materials and techniques ... to explore and expose the ethical and aesthetic limits of this practice, the hidden desires, the fears and expectations.” (Zwijnenberg 2014: 145). By using strategies such as hands-on engagement, but also the use of humor, bioart has the potential to “move beyond the more normative, rationalized moralism of academic discourse and embody multiple, or even paradoxical perspectives simultaneously.” (De Sena Cortabitarte 2015: 50)

Bioart does not only provide a critical perspective to biotechnology, it has the potential to make much more fundamental interventions. Bioart can take on a posthumanist approach, “[exploring] the issues of the boundaries between the living and non-living, organic and inorganic; the relation between the human and nonhuman; as well as various thresholds of the living.” (Radomska 2016: 13-14) Bioart does not aim to redefine these categories, but rather to explore and enact them differently, opening them up. “These possibilities are not just visual but also material, and thus we may say, ontological: they concern the very nature of existence in time, and of what we understand by the seemingly self-evident concepts such as duration, emergence, reproduction and being alive.” (Zylinska 2014: 192) Bioart can pose ontological rather than epistemological questions.

To ask these questions and not perpetuate the dominant discourses, bioartists must be aware of the technologies they are using and the possible traps this comes with. As bioartists often use laboratory technologies and materials, these are of course not neutral (Zwijnenberg 2014: 144, M’Charek 2008). An awareness of their histories, uses, and possibilities is necessary so as to apply them in a critical manner. Therefore, the artists need a certain level of understanding of the technologies, and certain skills to be able to work with them. As this knowledge and experience is often hard to attain, artists are in

danger in falling into two main traps that Robert Zwijnenberg lays out. First, the “Dazzled by Science Trap”, in which the artist is not able to keep up with the developments and therefore cannot critically apply the technologies (Zwijnenberg 2012: 8). Second, the “Complicity Trap”, in which the artist “becomes instrumental in appeasing the public to unquestioningly embrace new developments” (Zwijnenberg 2012: 8–9) So, while bioart does have the potential for critical engagement, it is not the artistic engagement with technologies in itself that provides this. Joanna Zylińska similarly points out that many bioartworks are not that interesting or critical. However, although rare, there is the possibility for “transformative bioartistic events” (Zylińska 2014: 195) that make bioart so interesting from a critical, feminist and anti-anthropocentric perspective.

Method

Now that I have discussed bioart and its potential in theory, I will look at three bioartworks to show their critical feminist and anti-anthropocentric potential in practice. To do so, I first turn to previous studies on bioart for methodologies. As I want to focus on the artworks, I look at studies that analyze those directly, instead of using other strategies such as interviews. In a study looking at Orlan’s *Harlequin Coat*, Baykan explores the aesthetic, ontological and philosophical aspects of the artwork by modeling it through the concept of *becoming-other* (Baykan 2015: 17). Here, the author looks at how “different species are put into contact through biotechnological means and the impact of these entangling processes on the understanding of human subjectivities and bodies” (Baykan 2015: 17). To discuss this, Baykan closely examines both the artwork and Deleuze and Guattari’s elaboration on *becoming-other* in their work *A Thousand Plateaus*, to unpack the ontological questions of species and bodies that the work puts forward. This allows for a focused, but thereby also narrow reading of *Harlequin Coat*.

Similarly, in analyzing the Art Orienté Objet artwork *Que le cheval vive en moi (May the Horse Live in Me)*, Leon J. Hilton turns to Deleuze’s writings on art and sensation as athletic, asking “how this performance allows us to frame athleticism as a sensational, intense, and intensive mode of embodiment, capable of producing unanticipated forms of intimacy and affiliation beyond the

precincts of the human.” (Hilton 2013: 490) So, as does Baykan, Hilton uses a focus on a specific theoretical concept as a basis for the analysis, and uses this to provide insights into questions of species, embodiment, and bodies.

While this focus on a specific theoretical concept in the analysis of bioartworks shows to be very interesting, I want to focus on a broader reading of the artworks in order to see how they can provide a critical feminist and anti-anthropocentric intervention into dominant biotechnology discourses. An example of such a broad approach is van den Hengel’s analysis of Orlan’s bioartwork *Harlequin Coat*. He approaches this analysis by posing clear questions, in order to see what the feminist potential of the work may be, and in doing so, approaches the work as a theoretical object (van den Hengel 2010: 46). For van den Hengel, this means that the artifact not only is subjected to theoretical analysis, but also generates theoretical questions itself (van den Hengel 2010: 46-47). He poses a number of questions that allow for a nuanced feminist interpretation, such as what is the role of gender and race/ethnicity in the artwork, and what is represented, included or kept out of view in the work. He also emphasizes that this can only generate one viewpoint on the artwork, and that it is important to keep in mind that it is the ambiguity of the artwork, the space for different perspectives and meanings, that make it so conceptually interesting (van den Hengel 2010: 46-47). A similar broad approach is taken by Kelly Ann Rafferty, who looks at how the spectator’s experience of interactivity in Critical Art Ensemble’s performance *Flesh Machine* influences a critical engagement with assisted reproductive technologies (Rafferty 2010: 44). In this analysis there is a focus on the questions, which aim to elucidate the role of the bodies of performers and spectators, instead of working from a specific theoretical concept.

In my analysis, in order to gain a broad understanding of the potential of the artworks, I do not start from a specific theoretical concept. Rather, I take the different concepts that I introduced in Chapter 1, as well as the observations on the discourses that I made in Chapter 2 on the themes of objectivity, anthropocentrism, and sex and gender, and see how the artworks address, subvert, perpetuate, complicate these.

The artworks

In this analysis, I look at three different artworks: *Open Source Estrogen* by Mary Tsang and Byron Rich (2015), *K-9_topology: Hybrid Family* by Maja Smrekar (2016), and Špela Petrič's *Phytoteratology* (2016). I have selected these artworks because of their relation to the biomedical discourses on hormones, which I have discussed in the previous chapters. All artworks deal explicitly with hormones and biotechnologies, and their critical bioartistic engagement with the topic gives them the potential to make critical feminist and anthropocentric interventions into the dominant discourses. First, I will provide a brief introduction to the three artworks, and then I will follow with the analysis.

- *Open Source Estrogen* – Byron Rich and Mary Tsang (2015)⁹

In *Open Source Estrogen*, Rich and Tsang aim to develop an open source Do-It-Yourself (DIY) protocol for estrogen synthesis, and conceptually place this practice in the domestic sphere, in the housewife's kitchen. Through this project – that is currently a work in progress – they aim to “create a non-institutional portal to birth control access and hormone therapy to the transgender community, and raise discussion on the ethics and politics governing our bodies”¹⁰.

- *K-9_topology: Hybrid Family* – Maja Smrekar (2016)¹¹

Smrekar manipulates her body into lactation, in order to become surrogate mother of a dog, “*becoming-she-dog*”¹², using the hormonal process of lactation as a way of establishing interspecies relationships.

- *Phytoteratology* – Špela Petrič (2016)¹³

In this work in progress Petrič uses biotechnologies to extract steroid hormones from her own hormones, and investigates what their effects are on other organisms – sea urchins and plants – in

⁹ maggic.ooo/Open-Source-Estrogen-2015 and www.byronrich.com

¹⁰ www.byronrich.com

¹¹ majasmrekar.org/blog

¹² majasmrekar.org/blog

¹³ As this is a new project, it is not yet available online. See spelapetric.org for info on the artist, and previous projects.

order to highlight the interspecies responsibilities that come with technological and medical developments.

Of these three artworks, I look both at their online performance – being all of the material that is made available by the artist themselves on their website – and the live performance that I hosted as a part of my work at Waag Society, during the first session of the Do-It-Yourself Human Enhancement Clinic¹⁴. There is an overlap between these online and live performances, as they deal with the same projects, make use of some of the same materials, but there are also some different elements. The online performances consist mostly of written text, complemented by images and, in the case of *Open Source Estrogen*, a video. There is no space for interaction between the viewer and the material, and the performance is fixed. In the live performances, there is an active role of the participants, the location and the environment. Also, in the live performance the three projects are brought in contact with one another, while the online performances do not relate or refer to each other in any way. I will not go into an in depth analysis of the differences (and similarities) between online and live performances. In my analysis I will focus on the elements that are interesting to the aim of intervening into biotechnology discourses, and I use both online and live performances to get a broader view of the artworks. With this analysis, I aim to elucidate my second sub question; ‘How do bioartists address hegemonic biotechnology discourses in their works on hormones?’

Analysis

When looking at the three artworks, several themes come up. They all deal in some way with objectivity, with the use of Do-It-Yourself (DIY) techniques, space, gender, and interspecies or environmental relationships. Rather than addressing the artworks separately, I structure my analysis around these themes, to show the different strategies used by the artists. While these themes do not completely overlap with those I discussed in the analysis of the research papers in Chapter 2, they are closely connected, and I will refer back to

¹⁴ I worked at Waag Society (waag.org/en) as part of my internship for the Gender Studies program at Utrecht University. Here, I worked on the Do-It-Yourself Human Enhancement Clinic, under the supervision of Lucas Evers. One of my tasks was the organizing of the first public event for the project.

my observations from the discourse analysis throughout my discussion of the artworks.

Objectivity

As I discussed in the analysis of the research papers, the researchers themselves are still mostly absent from the documentation on their work. This maintains the idea of scientific research as an objective way of looking at the world, and thereby revealing facts about it. It continues the image of the researcher as a modest witness, who does not bring their own ideas or experiences into the work, but merely documents observations. This understanding of science as objective and factual is something that all three of the artworks address in some way.

In *K-9_topology: Hybrid Family*, Maja Smrekar makes several interventions in this. She provides an in depth online documentation of her process, but not as a research paper. She explicitly frames this documentation as a “blog” and a “public journal”, in which she discusses different aspects of the project (Smrekar 2016). She elaborates on the background of the project, bringing up family history, family photos, and more recent anecdotes. She includes theoretical considerations, bringing in authors like Foucault, Deleuze and Guattari, and Haraway. She includes mythology and poetry, and many personal accounts of feelings and thoughts and moods and emotions. Not only does she bring in all these different aspects, she also invites art critic Jens Hauser to engage in a written dialogue with her, further exploring the process from a mostly theoretical angle (Hauser in Smrekar 2016). In using this method of documentation, Smrekar challenges the norms of scientific documentation. Instead of aiming for an objective, disembodied write-up, she documents her process with her own body, history, and experiences at the center. She does choose to rationalize some of her experiences, such as when she is traveling and breast pumping in the car (Smrekar 2016). By making the decision to write in a more rational and disengaged manner about some of her experiences explicit, she challenges ‘objective’ scientific writing as a norm.

Not only does Smrekar challenge the position of the scientist in the research and documentation process, she also challenges the distinction between technology and nature. In her project, Smrekar does not make use of

hormonal or other medical treatments, but rather induces lactation through diet, supplements and breast pumping (Smrekar 2016). This approach is not clearly a biotechnological one, although it does affect the body in similar ways as a hormone treatment might. By combining biology and humanities research, a strong focus on personal experience and affect, and modification of the body in this not typically technological manner, Smrekar blurs the dividing line between technology and nature.

In the performance, she has the nursing tea she used in her project – a standard herbal blend available at most supermarkets and health food stores – served to the participants, initially without any explanation. When later in the performance she brings up this tea, and reveals that the audience has already been drinking it, she deals another blow to this dividing line. By making it not only visible, but tangible and experiential to the participants what her body modification ‘technologies’ entail, she brings an embodied experience of the blurring of this division between technology and nature to the audience. This relates closely to the use of Do-It-Yourself (DIY) practices, which I will discuss in relation to the other artworks later on.

In *Open Source Estrogen* (Rich and Tsang 2015), objectivity and the role of the scientist are addressed in a different way. Where Smrekar challenges objectivity by creating a very personal piece, Tsang and Rich use a more theoretical analysis to point out the troubles in biotechnology. They frame their project explicitly as an activist work, in which they bring in biopolitics and biopower, Preciado’s concept of the pharmacopornographic, and a critique of access to hormones through institutions. They do this both through a discussion of the themes, both on their website as well as in their live performance, but also in their use of DIY methods, and the aim of developing a DIY protocol for estrogen production (Rich 2015, Tsang 2015).

Do-It-Yourself

Both *Open Source Estrogen* and *Phytoteratology* make use of DIY biology as a method. DIY biology, the creation of open source, low-cost, community based knowledge and technologies, is particularly interesting for critical interventions into the dominant biotechnology discourses, as it gives the artists the possibility of working outside of the main scientific institutions, such as

research or development laboratories and universities, allowing for independence from “Big Bio” (Delfanti 2012: 171) as well as demystification of science. This demystification, also listed as one of the goals of the *Open Source Estrogen* project, means that science gets taken out of the ivory tower, and becomes accessible and understandable to the general public. Also, when DIY biology tactics are used in a performance that allows for hands-on engagement of the audience, the participants experience the technologies in an embodied and visceral manner, which aids in both the demystification and the understanding of the science by the participants.

Byron Rich and Mary Tsang make use of DIY methods in their exploration of estrogen production, for example by working with the TransHackFeminist! (THF!)¹⁵ collective, a DIY space in Calafou, Spain. During their live performance, they were at the THF! space, introducing the audience to some of the DIY projects going on. Here, DIY is really a combination of laboratory protocols and equipment, and everyday tools such as wine bottles and jars. This use of everyday items in their biomedical projects, next to its practical benefits, works to demystify the scientific practice. It takes the practice out of the confines of the laboratory, where only highly trained professionals have access to it, and makes it available to be used and thought about by a larger audience. Not only does it take the science out of the lab, it also places it into the kitchen, thereby reappropriating this domestic – and hegemonically feminine – space, which I will discuss more later on. While Tsang and Rich did not use hands-on DIY strategies this time, as they were present digitally only, this is a strategy that they use in many of their other live performances, thereby closing the gap between the participants and the biotechnologies even further.

Špela Petrič also makes use of DIY strategies, both in her work and in her live performance. For this project, she makes use of DIY strategies and laboratory protocols to isolate steroid hormones from her own urine. Especially interesting is the use of hands-on, DIY biology as part of the live performance. Here, the participants get to isolate steroids from their own urine. However, the performance did not reach the full potential of a DIY workshop. To start with, throughout her presentation Petrič brings up information that ‘research has

¹⁵ <https://transhackfeminist.noblogs.org>

shown'. However, she does not seem to take a critical look at this research, and in this way perpetuates the idea of scientific research as an authority on knowledge production in the field of biology. Then, in the introduction to the DIY part, her presentation became highly scientific. Rather than making sure this information was understood by the participants, Petrič went through it quickly, and mentioned not expecting it to be understood or remembered. Also, at the start of the DIY part, she positioned herself in front of the group in lab coat and safety goggles, explaining the process in a very frontal manner while the participants were seated and could not participate yet. In both these parts of the introduction, Petrič placed herself in the stereotypical role of the scientist, perpetuating the idea of science as inaccessible and thereby maintaining the gap between her and the 'lay people' in the audience. This gap is somewhat decreased when the participants are then invited to wear the safety gear themselves, and work independently on their experiment, but in this way the artist does not make full use of the critical interventional potential of DIY biology in her artwork.

Space

In *K-9_topology: Hybrid Family*, Smrekar makes use of the transformation of spaces to emphasize the transformation of her relationship to Ada, the puppy, facilitated by the breastfeeding. In her online performance, she shows the transformation of two spaces that are important to her project: her car, and the apartment/performance space that she rents in Berlin. Smrekar writes about her travel by car to pick up Ada for the first time, driving and continuing to breast pump every three hours. At this point, she makes the decision to rationalize the experience. So here, on the way to pick up her new family member, she turns her car into a kind of research laboratory, where she performs her experiment on her body and tries to register the results rationally (Smrekar 2016). At the same time, she is overcome with emotions and the recurring boosts of horniness that the breast pumping brings. She again blurs the lines between research and the personal, emotional, as she does throughout her project.

Similarly, she changes the performance spaces, both the apartment in Berlin in which she lives with the dogs, and the space at Waag Society, creating a space where they can all live together: Maja, Ada and the older dog Byron, and

the participants. This space is not centered on the human experience, but rather aims to facilitate the living together of the three in their hybrid family. As shown in the photos that are displayed on the website, the space is furnished mostly with blankets, so that all three live on the same level (Smrekar 2016). There are furs and skulls placed in the room, referring back to Smrekar's family history, in which she has always formed strong, familial bonds with dogs. In this space, Smrekar both symbolically and practically strengthens her relationship with the two dogs, turning it into a hybrid nursery that is not simply her human domain but an attempt at a space where dog and human live together, as a family.

Smrekar decorates the performance space at Waag Society in the same way, but the history of the room makes this hybrid nursery especially interesting: it is a former public dissection room. This public dissection room is an important part of the history of both medical science as well as art, as the dissections facilitated breakthroughs in medicine, as well as served as inspiration for famous paintings such as Rembrandt's *The Anatomy Lesson*. Transforming this particular space into a hybrid nursery therefore holds additional meaning, as the space is historically associated with science, rationality and objectivity, as well as with art in a more traditional sense, as opposed to Smrekar's bioartistic disruptions of the hegemonic scientific practices.

Also focusing on the reappropriation of space is *Open Source Estrogen*. Especially in their online performance, Tsang and Rich put a focus on the space of the kitchen, referring back to the cult of domesticity, which defines it as the domain of the housewife. By developing a DIY protocol that would allow the production of estrogen in the kitchen, the project empowers women – the main target of many estrogen therapies, such as in IVF or HRT for menopause or as gender affirming therapy – to know and produce the hormone on their own terms and in their own space (Rich 2015, Tsang 2015). In this way, the project relates to a history of feminist art on food and the kitchen, such as Martha Rosler's *Semiotics of the Kitchen*¹⁶. Lindsay Kelly identifies these feminist art projects as an important part of the history of bioart (Kelly 2016), and notes that many bioart projects now make use of hybrid spaces that are at once kitchen, lab

¹⁶ Go to <http://www.moma.org/collection/works/88937> for more information on the artwork, or watch the video work at <https://youtu.be/Vm5vZaE8Ysc>.

and garden (Kelly 2016: 3). These “art labs’ ... instigate ruptures, especially around labour and gender, as art labs often collapse feminine domestic interiors like kitchens and dining rooms with the more traditionally masculine sphere of the research laboratory” (Kelly 2016: 9), just as Tsang and Rich’s DIY kitchen space.

Gender

Not only do Tsang and Rich reappropriate a traditionally feminine space into a hybrid kitchen/lab, they challenge gender norms in other ways as well. *Open Source Estrogen* explicitly includes transgender people in their project, for instance by discussing the use of estrogen for gender affirming therapies, and by using a transgender actress in the video on their website (Rich 2015, Tsang 2015). Also, in their discussion of the project during the live performance, it becomes clear that they do not subscribe to a binary notion of gender, and by working on a DIY protocol for the production of estrogen, they aim to increase bodily autonomy for transgender people, thereby working on the depathologization and demedicalization of transgender identities, and allowing them to make their own decisions on hormone use outside of the restrictions that institutions currently enforce. In doing this, they work against a naturalized idea of binary gender, which is still prevalent in biomedical discourses and practices today – although not so much present in the research papers I analyzed in Chapter 2. And, while they do focus their project on reproduction and gender, they do not fall into the trap of relating steroid hormones solely to these effects, but take into account broader consequences on for instance the environment, and biopolitics as well.

However, it is interesting to note that while Tsang and Rich make broad connections with their project, such as to the cult of domesticity, contraception and gender identity, they do not move beyond an analysis of gender, and apparently fail to take on an intersectional reading which takes race/ethnicity into account as well. This is a missed opportunity, as much has already been written about Black women’s exclusion from the cult of domesticity¹⁷, and their struggle against forced sterilization and contraception as opposed to white

¹⁷ See e.g. Deborah Gray White (1999) for a discussion of the cult of domesticity in relation to enslaved women in the U.S.A.

women's struggle to attain these methods¹⁸. Unfortunately, these topics are not addressed by any of the artworks included in this analysis.

Maja Smrekar comments on gender in her work by rethinking the concept of family, through building a hybrid family with her dogs, to include other species as well. This is a strong statement against the dominant biomedical discourses, in which reproduction and pregnancy are valued highly, sometimes even seen as more important than other adverse health effects that hormone treatments may induce. By building a family with her dogs, Smrekar challenges pregnancy as the main goal for a woman to attain.

For Špela Petrič, her work on hormones shows that gender, body and species are not fixed. Hormones make it possible to change bodies, and even reproductive structures. In her presentation, Petrič puts a strong focus on the effects of hormones on sex and reproduction, and thereby risks falling into the trap of naturalizing gender and connecting steroid hormones primarily to reproduction. However, in her work on sea urchin larvae, Petrič shows no focus on reproduction at all, and rather looks at morphology as a whole, thereby disconnecting steroid hormones from reproduction. While the idea of sex hormones is mostly still present in popular science and less so in research publications, I did still find the use of this term in one of the papers in the discourse analysis, and so a critical feminist intervention into this remains of importance.

Species and Environment

The final theme that I wish to address is that of species and environment, one that is quite prominently present in all three of the artworks. For Maja Smrekar, her project focuses on the idea of the interspecies, hybrid family, where dogs and humans live together. She thereby challenges the human – nonhuman dichotomy, in which humans are placed higher in the hierarchy, and makes a posthuman move against the centrality of the human. This is present in her aim of building a hybrid family, but also in the way she organizes the spaces she uses, and also in her use of language: when she introduced Ada and Byron in her live performance, she introduced them as her coperformers, not as merely her dogs.

¹⁸ See e.g. Angela Davis (2003) 'Racism, birth control and reproductive rights'.

Similarly, in her blog she does describe Ada as 'her dog', but makes clear that Ada is only 'her dog' in the way that she herself is also 'Ada's human' (Smrekar 2016).

While Smrekar focuses on the relationships and hierarchies between species, both Tsang and Rich and Petrič look at hormones in the broader context of the environment. For Tsang and Rich, hormone pollution and human hormone use are ways of 'molecular colonization', biopolitical strategies that work to control human and environmental bodies (Rich 2015, Tsang 2015). By aiming to provide increased bodily autonomy through the use of DIY protocols, *Open Source Estrogen* intervenes in the institutional control that lies on the production and use of these hormones.

For Špela Petrič, this is not so much a matter of control or colonization. Rather, she sees the influence of hormones on bodies, species and environment as part of a process that has always been there and is simply continuing today. She notes that since chemical communication and hormones were already developed before plants and animals went their separate evolutionary ways, this is in fact a direct way of communication that still exists between the species. She also introduces an example of a novel technology, with which organs made up of human cells can now be grown in the living bodies of other animals, such as pigs. Her point here is, that both hormones and biotechnologies already are doing the work of blurring the species boundaries. Petrič is just bringing this to light, by illustrating the interspecies communications made possible by hormones in her project.

With this analysis I have shown some of the ways in which biomedical discourses are addressed in bioart, thereby illustrating 'How bioartists address hegemonic biotechnology discourses in their works on hormones?' In the next part, I will bring the analyses of the research papers and the bioartworks together.

Conclusion

In this paper, I have shown some of the issues regarding scientific knowledge production, and the way they become visible in biotechnology discourses. I illustrated with a critical discourse analysis that these issues are indeed still present in the current discourses within the field of biotechnology. Then, as I want to emphasize the need not only for critique of hegemonic discourses but also for critical feminist and anti-anthropocentric interventions and new ways of doing science, I offer bioart as a strategy to make these interventions.

In order to offer a critical feminist and anthropocentric intervention strategy into the hegemonic biotechnology discourses, I have identified a research question and two sub questions, with which I have guided my research for this thesis. The overarching question was, 'How does bioart intervene into the hegemonic scientific biotechnology discourses on hormones?' As this question is too broad to answer at once, I first looked at the sub question 'How are hormones discussed in current biotechnology discourses?', by performing a critical discourse analysis on four recent biomedical research papers, on the topics of in vitro fertilization and hormone replacement therapy for menopause. Then, I followed this up by going into the second sub question; 'How do bioartists address hegemonic biotechnology discourses in their works on hormones?' For this part of the research I looked at three bioartworks, and analyzed both their online and live performances. Now, to round this all off, I will highlight some of the observations I made, and then take a closer look at the overarching issue. To this end, I will outline my perspective and final arguments about how bioart can be used as an effective critical feminist and anti-anthropocentric strategy to challenge hegemonic discourses in the field of biotechnology.

Hormones in the current biotechnology discourse

When looking at four recent research papers from the field of biotechnology, it becomes clear that many of the issues brought up by feminist science studies scholars are present in the discourse, and that studies are not presented as value-free and factual as science's image makes us believe. These issues are not only present in popular science texts or advertisements, where a

translational step from research to the general public is made, but rather, they are perpetuated as well as shaped by the scientists themselves.

I have provided an in depth analysis of these research papers, focusing on three main topics: objectivity, anthropocentrism, and sex and gender, as these are important issues in biology that feminist science studies, posthumanist and new materialist scholars have paid close attention to. Here, I want to mention some important findings.

Analyzing the claims of objectivity that these papers produce and perpetuate, it is clear that the idea that the scientist is an objective 'modest witness' is still very much present (Haraway 1997). The role of the scientists in the research process is hardly mentioned, and when it is described in somewhat more detail there is no discussion of their influence on the research outcomes whatsoever. Moreover, not only are the researchers framed as modest witnesses to the research process, there is also a strong reliance on technologies, which are framed as neutral and objective as well (M'Charek 2014), and are also in no way under discussion.

In these papers, it is not only what is said, but also what is left out that is of interest. The roles of nonhuman animals are almost entirely left out of the documentation, even though all studies deal with materials from nonhuman animals in their protocols in some way. While some of these animals are at least made visible in the descriptions of methods or materials, the papers make no mention at all of effects or risks of the treatments on nonhuman animals or the environment. It is remarkable that such an anthropocentric position is taken, as many studies and popular science articles are now bringing the environmental effects of steroid hormones under the attention of the public (Ah-King and Hayward 2014, Birke 2000, Irni 2014, Roberts 2003).

Finally, I was glad to see that – possibly because of the strong focus and brevity of the papers – there was no emphasis on steroid hormones as 'sex hormones', or as otherwise having mainly to do with sex and reproduction (Oudshoorn 2003). I was surprised to find the use of the term 'sex hormones' once, but otherwise the articles all focused on their effect of interest, without drawing unnecessary connections to sex characteristics or reproduction. While of course, a selection of four research papers can provide only a limited view, it is possible that this connection really is no longer emphasized within the field of

biomedical science and is now mostly present in popular science texts. Still, this analysis confirms there is much to be challenged in the biotechnology discourses. To do so, I have offered bioart as a strategy for these interventions.

Biotechnology discourses in bioart

To show the potential of bioart as a strategy for critical feminist and anthropocentric intervention into the biotechnology discourses, I analyzed three bioartworks that deal with hormones and biotechnologies: Maja Smrekar's *K-9_topology: Hybrid Family* (2016), Mary Tsang and Byron Rich's *Open Source Estrogen* (2015), and Špela Petrič *Phytoteratology* (2016). In analyzing them, I focused on five themes that relate to, but do not completely overlap with the topics I used for the analysis of the research papers. I analyzed the artworks on their relation to objectivity, Do-It-Yourself (DIY) biology, space, gender, and interspecies and environmental relationships. Again, I want to summarize here some of my findings, in order to illustrate the potential of these artworks for making critical feminist and anti-anthropocentric interventions into the hegemonic biotechnology discourses.

The artists address the themes in different ways. Maja Smrekar, of the *K-9_topology: Hybrid Family* (2016) project, subverts the idea of objective, disembodied reporting of science in her practice, by documenting her process in a highly personal 'public journal', filled with family photos, dialogue, theory from both biology and humanities scholars, and Smrekar's personal, emotional, and physical experiences. She firmly positions herself and her motives in the work, thereby subverting the demand for disembodied objectivity. Rich and Tsang also address the position of the scientist, but take a more theoretical approach, by bringing in a discussion of biopower and biopolitics.

The use of DIY strategies is interesting in both Petrič's *Phytoteratology* (2016) and Tsang and Rich's *Open Source Estrogen* (2015), but in the latter it does more than simply take biotechnology out of the institutional context. Tsang and Rich focus on the reappropriation of the kitchen, specifically, and DIY biology is a tool that they put to use in reforming this traditionally feminine space. By placing a transgender actress using the DIY technology in the kitchen, while making numerous references to the cult of domesticity, cooking shows and feminist performance art, they offer a rich critique and subversion of gender

norms, both inside and outside of biotechnology. By aiming to provide a DIY protocol for estrogen production as the outcome of their project, they take this even further by providing a tool for increased bodily autonomy, outside of institutional control.

Finally, I want to highlight Petrič's subversion of human–nonhuman and environmental relationships, moving away from the anthropocentrism that is still central in biotechnology discourses, and rather visualizing this connection as always already open, fluid and in communication. By using DIY technologies to show the interspecies effects of hormones, and making clear that this is not an issue of individual use, but always already present in nature, though also increased through industrialization processes, Petrič highlights both the connectedness of species and environment, as well as the fluidity and openness – rather than being closed and fixed – of our bodies.

Bioart interventions into biotechnology discourses

With these two analyses, I have illustrated both the issues still present in biotechnology discourse today – and thereby the need for interventions – and some of the ways in which bioartists address these issues in their works. Now, to come back to my main question, 'How does bioart intervene into the hegemonic scientific biotechnology discourses on hormones?', this paper has offered several ways and strategies. As I discuss in Chapter 3, bioart holds an interesting position of being outside of the discipline of biology, but instead of many other approaches that work only *about* biotechnology, bioart actually works *with* it. Bioartists get to know and use the biotechnologies that their works reflect upon, but as they are not pursuing the goals of research institutes or industry but rather artistic ones, they hold a unique position from which to critically approach the technologies and its goals. On top of this, the bioartworks also work to bridge the gap between the science and the audience, by packaging it in a more accessible way, by making points of tension or critique explicit, or even by making the technologies available for both visual and even embodied, visceral exploration. Taking into account that most people will never set foot into a research laboratory, already the displaying of the technologies in the more public space of a gallery, museum, or of course the Internet, allows for a closer interaction with it.

As I have illustrated with my analysis of the artworks, the actual interventions can take many different shapes. Some points are addressed explicitly by the artists in their documentation or presentations, while others get challenged more implicitly or practically, such as Smrekar's approach of using a public journal for her documentation, or Rich and Tsang's use of a transgender actress in their video art.

Regardless of the actual strategies, with this paper I have shown that bioart can indeed offer critical feminist and anthropocentric interventions into the biotechnology discourses, and that these interventions are still very much needed.

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