1 Introduction: Biotechnologies, Bodies and Biomakers

> Dr. Eli Mays: "I am a biohacker. We're about the democratization of science. The CIA is not."
> Agent Hannah Wells: "For a reason. Bioengineering in the right hands, great, In the wrong hands…"
> Dr. Eli Mays: "Exactly. You know gene editing is listed as a weapon of mass destruction, right? You guys aren't focused nearly enough on bioterror."
> Agent Hannah Wells: "That's what I have been working on."
> Dr. Eli Mays: "Mutually-assured destruction is passé. Now it's a biorogues' world. If you don't hold people to account, shit will happen. You need to be monitoring everyone. Like I do."
>
> *(Designated Survivor, #privacyplease 3.02, 19:00-21:31)*

The third season of *Designated Survivor* (Netflix, 2019) saw a new threat to the safety of the American nation: bioterrorism, and not just any kind. Rogue scientists, making use of the growing do-it-yourself (DIY) biology movement and CRISPR technology, had engineered a virus designed to target only people of color in an effort to sterilize them – biologically engineered racism and voter suppression. Agent Hanna Wells, who in the previous seasons was uncovering a variety of terrorist plots against the US, seeks out Dr. Eli Mays, a DIY biologist, and starts to work with him to uncover this dark scheme. Their search leads them into the DIY biology movement, its secret and not-so-secret labs, practitioners and practices – discussing questions of access and democratization, threats and dangers, regulation and safety – until in "#scaredsh*tless" (Episode 8) the president is notified of this imminent danger and it becomes a political

crisis. Bioterrorism of this kind, he and his staff note, is nothing they had to deal with before because the technology simply did not exist: "Until now. For a couple of thousand bucks, an amateur scientist can produce a plague that could wipe out all of humanity" (Ep. 8, 04:10-4:17). Of course, the threat is prevented, the suspect apprehended, and the political plot uncovered, but not before the "rogue biologist" was able to upload his design in DIY forums for all to access. The only way to contain such threats in the future, the "DIY guy" (12:15) Mays notes, is to regulate the sale of deadly genetic sequences and hire scientists like him to advice and work with the government. Genetic engineering, "CRISPRed" bacteria and viruses, unregulated science in and outside of registered laboratories here is turned into the stuff of nightmares – an imminent threat to the safety of large parts of the American population.[1]

This plot, however, is not the only way in which DIY biology and the contexts of its formation enter the narrative: genetic testing for disease and heritage and its repercussions – even a secret DNA test without the person's knowledge or consent – form an important part of some of the storylines, while the Opioid Crisis, high drug prices and a fight against 'Big Pharma,' as well as differences in access to healthcare are dealt with as political issues.[2] This cultural representation demonstrates how ubiquitous and contested practices of DIY biology and medicine have become. But more than merely inserting them into the narrative, *Designated Survivor* also discusses some of their drawbacks and limitations: the repercussions of access for all, potential abuses of technologies, differential distribution of resources, slippery slopes into racism and eugenics, the need for regulation, the power of (pharmaceutical) companies and the real-life experiences of many Americans. It demonstrates that some of these practices have become mundane and expected – genetic testing for example – while others are new and dangerous – the hacking of and tinkering with DNA. The series lets us know: Biohacking, in different guises, is omnipresent in American culture and society.

In August 2020, another show, *Biohackers,* opens with a similar fear of bioterrorism: The first sequences show a train compartment full of passengers who collapse one

1 CRISPR/Cas-9 (from Clustered Regularly Interspaced Short Palindromic Repeats), often also called 'gene scissors' in colloquial use, is a technology that allows scientists to cut DNA at any desired location, so that they can edit in new strands of DNA, thereby inserting new information into the genome. When first developed and used (2012-2015), CRISPR represented a minor revolution in gene editing technology, earning scientists Emmanuelle Charpentier und Jennifer Doudna a *Breakthrough Prize in Life Sciences* 2015.

2 One character's wife is in and out of rehab for her fentanyl addiction, leading him to start a political campaign against the manufacturers of the drug, forcing them to provide their newest invention – a drug to counter the effects of addiction – to addicts for free. The high prices for insulin and the resulting lack of treatment or rationing of doses by people with diabetes is targeted in Ep. 3 ("#privacyplease"), inserted into the narrative also via clips from real-life Americans that talk about their problems, reflecting real-life issues in fiction. A political opponent's DNA is taken from a spoon and analyzed without his consent and the results, a high likelihood of Alzheimer's disease, leaked to the press. One political advisor tests herself for cancer mutations to learn whether she is likely to develop cancer like her mother. The communications director has done a genetic test to find his birth parents and finds a child he fathered as a sperm donor because his genetic data are in the company's databases. In one episode a refugee child's medical treatment in a US hospital highlights the difference in access to and quality of medical care between the US and Guatemala.

after the other – without apparent reasons. Later on, we learn that genetically engineered mosquitos were released on that train.[3] And those mosquitoes were the result of illegal and unregulated experiments in private laboratories. The mini-series, a German production published world-wide on the streaming service *Netflix* in August 2020, introduces the viewer to the world of DIY biology through the eyes of a young medical student, Mia Akerlund, whose personal history lets her investigate the well-known biologist Prof. Dr. Tanja Lorenz. The story is a revenge and coming-of-age plot set in a backdrop of biohacking and synthetic biology.[4] Science that is and cannot be performed in universities is in this series performed in home- and private laboratories. This includes at home in a shared flat, in a DIY lab with second-hand equipment, or at a high-tech personal lab. In these spaces, *Biohackers* represents a plethora of DIY biology practices in different guises. The more 'high-end' biohacking portrays in the show are self-made genetic treatments for Huntington's disease and the aforementioned synthetically engineered mosquitos. At the same time, subplots also explore others forms of DIY biology and those are often more 'flashy' science: fun tinkering with biological materials is used to create fluorescent marihuana plants or a bio-piano; bloody examples of body hacking with crude devices portray a form of biohacking focusing on the human body and its potential for optimization.[5]

If these two examples sound too abstract, too much like (science) fiction, consider the following: In June 2019 Sigal Samuel published an article on *vox.com*, in which he answers nine questions about biohacking "you were too embarrassed to ask." His article is one of a series of articles online that aim at explaining the phenomenon of biohacking to their audiences.[6] Samuel writes:

> Even if you haven't heard the term "biohacking" before, you've probably encountered some version of it. Maybe you've seen Twitter CEO Jack Dorsey extolling the benefits of fasting intermittently and drinking 'salt juice' each morning. Maybe you've read about former NASA employee Josiah Zayner injecting himself with DNA using the gene-editing technology CRISPR. Maybe you, like me, have a colleague who's had a chip im-

3 Of course, the heroin of the story is able to save everyone, but still: In the face of a global pandemic, the vivid images of collapsing people and doctors in hazmat suits was probably one of the reasons why *Biohackers*' release was pushed back from March 2020 to August 2020.

4 A review for the journal *Science* concludes that – while sometimes compressed for dramatic purposes – the science itself is mostly portrayed accurately and offers insights into biological and scientific processes (Greenbaum). It also highlights that *Biohackers* delves into some of the ethical, legal and social concerns around biohacking and could thus be used as a "pedagogical vehicle." Greenbaum summarizes that based on what is shown in the series, regulation might not be a bad idea – and in fact, the biology that is represented here would be illegal under German regulations, at least in spaces in which it is performed.

5 This creative side of biohacking is mostly represented by the protagonists two roommates – whose characterization, however, primarily consists of being stereotypical 'nerds' or 'geeks,' with one of them embodying practices of bio-art and the other a *Dave Asprey*, *Dangerous Things*-type of body-hacker when he inserts chips and magnets into his own body or creates eye-drops that let you see in the dark (for more on Asprey's *Bulletproof* Franchise, see Ch. 6; the biohacking company *Dangerous Things* is analyzed in Ch. 9).

6 Similarly, Jewell and Weatherspoon provide an overview of the many practices for *Healthline*, Jan. 2019.

> planted in their hand. These are all types of biohacking, a broad term for a lifestyle that's growing increasingly popular, and not just in Silicon Valley, where it really took off. (Samuel, "How Biohackers")

In Samuel's enumeration we see how 'biohacking' or 'do-it-yourself biology' has become a cultural phenomenon – the media report on it, TV shows use it, "cultural heroes" and celebrities endorse it. This prevalence makes it an "increasingly popular lifestyle" (Samuel, "A celebrity biohacker"). Most people, as Samuel writes, have come into contact, if not with the term, then with one of the many biohacking practices out there. Most likely, in fact, we have all engaged in some form of biohacking, for example by changing our diet or lifestyle, taking up yoga or meditation practices or taking supplements to increase our feeling of health and wellbeing.[7] This ubiquity, however, has made it notoriously difficult to define what counts as DIY practices, to delineate their boundaries, characterize their actors and expose their politics.

The Biological Maker

Since the turn of the century, the media hype around molecular and synthetic biology, most popularly the Human Genome Project (HGP) and advances in genetic engineering, has led to the spread of biomedical knowledge out of the domain of expertise and into the public sphere. This popularization increased the knowledge of lay populations and with it their eagerness to participate in the dialogue and decision-making processes. People became not only actively engaged in the discussions around biotechnology, but also in the practice itself. Starting in the mid-2000s, we can witness an increasing rise in commercial and private initiatives that aim to make knowledge about oneself or the biological world more readily available: do-it-yourself (DIY) Biology and Medicine. Taking inspiration from the do-it-yourself ethos in American culture and its latest rendition in the maker movement, community workspaces and laboratories have started to pop up around the US (and world). These spaces allow experts and interested lay people to experiment with biological materials. Such experiments can range from creating new and cheaper tools and technologies, to hacking yoghurt, creating fluorescent organisms, or sequencing one's own DNA. Similar tendencies can be observed in commercial or mainstream (medical) markets: direct-to-consumer genetic testing, medical home health tests, body hacking and self-tracking all emphasize a self-reliant, proactive and curious patient-consumer.

Positioned on the crossroads between biology, medicine and culture, these DIY initiatives are the subject of this book, both as practices and through their cultural representations. The diversity of practices that are considered to be forms of biohacking or DIY biology, however, has made it hard to pinpoint their exact meaning – especially

7 By using 'we' in this book, I do not seek to speak for all Americans, which I as a German national, residing in Germany, of course cannot. I do, however, want to point out that, even though my analysis is located in German American Studies, the DIY trend in medicine and biology is not an exclusively American phenomenon. The 'we,' therefore, is an attempt to signal community and continuity, to signal that some of the concerns I address can also be translated into a global perspective.

because both terms are often used interchangeably in cultural representations and publicly available knowledge. Likewise, academic inquiries into biohacking do seldomly end with a concise and clear-cut definition of what these practices are. Rather, they tend to focus on their ideological origins and underlying values, among them knowledge sharing, a community orientation, rebellion, access, participation and openness (Delfanti, *Biohackers;* Keulartz and van den Belt; Kelty); the spaces and places of its practice (Meyer, *Domesticating*); their experimental approach (Delgado and Callen; Delgado) or their relations to other, similar movements or social and economic institutions (Delfanti, "Do-It-Yourself"; Keulartz and van den Belt; Aguiton and Tocchetti).

To reflect the diversity of practices, I have chosen to employ a broad definition: I use the rather long phrase 'DIY biology and medicine' as an umbrella term that includes the 'hacking' and tinkering with biology, the experimental, activist engagement with biology, as well as more mundane and commercialized alternatives. As these wide-ranging practices already show, one of my hypotheses is that we should view them as intrinsically connected, as going back to the same ideas and basic propositions. While some DIY techniques are concerned with biology in the wider sense, others deal with the human body more closely. What connects them are a focus on openness and curiosity, education and (scientific) literacy, self-direction and competence, as well as a view of biological life as plastic. They all require some element of personal agency and autonomous decision making on the part of the patient-consumer. This self-directed nature draws on some of the core values of American culture: individualism, autonomy, choice. In a culture that sees individuals as responsible for their own situation in life and values self-reliance and initiative, the figure of the maker, the active shaper of their fate, serves as a cultural ideal. It is this self-directedness, as I will argue, that makes this case special: DIY, while seemingly giving authority to people, in truth subjects them to another, new ideology that is so persistent because it relies on basic American cultural values, heightened to an extreme.

These 'DIY techniques' are at one and the same time cultural, social, political and material: They regulate human action and behavior, shape the construction of (new) subjectivities, create new forms of authority and agency, give rise to new methods of social control, and last but not least shape contemporary body concepts and material bodies – they directly impact on (human) biology and leave their traces on the body. By doing so they take part in several ideological projects: knowledge transfer, patient empowerment, medicalization of society, government of bodies and communities, enhancement, and consumerism, all of which will play a role at some point during the course of this book. The reach of these DIY biology and medicine projects, however, is still hard to gauge, if we follow Morgan Meyer, because as an emerging phenomenon it takes place in more shielded spaces (*Domesticating* 7). But DIY biology is not just private – less visible in its domesticated, un-institutional spaces – but also highly public – visible in the media, through outreach activities, and the open philosophy of its community spaces (Meyer, *Domesticating* 7). It is this public, visible side that receives most of my attention.

Somatic Society and the Molecular Body-Project

As the examples in this introduction have shown, biohacking is in the "zeitgeist" (Hins): Not only is it an accepted and expected lifestyle and consumer fashion (Hins' more colloquial use of the term), but more abstractly it is an expression of its time and place that is very much situated in the American cultural mentality and political climate. As such, it is no wonder that biohacking is shaping and shaped by some of the dominating cultural phenomena, debates and problems of today, some of which I want to briefly point out in this introduction.

Underlying my examination is a distinct understanding of how knowledge 'travels' in the public sphere: Originating in the lab (to follow Latour and Woolgar), it arrives in popular discourse where it is inserted into culture (with its narratives, images, symbols, and so forth) and ideology, which then influence the behavior of people individually and collectively.[8] The desire to participate in biological practices and decision making is merged with a general trend towards DIY already present in popular culture. Following this observation, DIY biology and medicine can be read as being dependent on existing cultural narratives of (biotechnological) progress as well as ideologies of perfection, which in turn feed into and are sustained by some of America's core values. Cultural practices and cultural representations, in literary or more broadly 'textual' form, then perpetuate biohacking's ideology and promise, thereby contributing to the formation of a (new) politics of life, characterized by self-directed interventions into the body in order to evaluate and enhance its performance.

Making the already good 'better than perfect' is deeply embedded in American culture and has been made easier in the past centuries through the rapid advancements in medicine and biotechnology – now going beyond transformations through hard work, surgical intervention or changes of the body surface, towards optimizations on a molecular scale. The transformations in biotechnology during the second half of the 20th and the first decades of the 21st century have created new techniques of "penetrating, viewing, and controlling bodies" and by doing so "exponentially intensified debates about what it means to be human" and to have a body (Wegenstein, *Getting* 87). The body today is no longer seen in its totality, but has become fragmented and molecularized, imagined as a collection of parts that can be repaired, replaced and improved. The most meaningful parts of biology today are not tangible, or even visible to the naked eye. Rather, they are hidden deep inside the cells of the body. To reach them, we need to "get under the skin" (Wegenstein, *Getting* 79). Molecular biology, genetics and biochemistry culturalized the body in new ways (Braun 7) and changed the ways in which we make sense of it, on an increasingly molecular scale.[9]

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8 cf. for example, Dorothy Nelkin's *Selling Science* (1995), Sharon Friedman's *Communicating Uncertainty* (1999), or Mcinerney et al.

9 Biotechnology in one way or the other always depends on the wish to understand and control processes on the molecular level. This desire for conscious molecular control and manipulation encourages scientists to find ever newer techniques and tools to "read, edit, and rewrite the molecular mechanisms of biology" – DNA, RNA, proteins, immunoglobins, lipids, polysaccharides, vitamins, hormones, neurotransmitters, metabolites, all the small molecules that play a role in biological processes (Stevens 16-19). See also Ch. 3.1.

This molecularization has miniaturized the targets for biological control and transformation: It is no longer only the surface of the body that has to be known and shaped but also its molecular make-up, which gives rise to (DIY) technologies aiming to establish a (molecular) status quo. While for a long time, the body was constructed as a biologically given, more recently it came to be seen as both culturally constructed – as giving and making meaning through its performance – but also as a possibility, a malleable entity that can be shaped to fit the desired performance. People can and even are expected to shape their bodies inside-out according to their liking, reaching from weight and shape, to cosmetic products and elective surgeries, to modifications and tattoos. The body becomes a medium for the expression of the self (Rose, *Politics of Life* 8). Human life, human embodiment becomes not a mere given, but a *project* – a process of enhancement, modification, tinkering, active intervention – that is realized not just in biology but also in society and culture.[10]

We live in a "somatic society" (Turner) in which the self and the body are governed in new ways (Wegenstein, *Getting* 4). The ideology of healthism and the ritual of self-surveillance are meticulously observed in this body-centered society (Chrysanthou 472): People try to make their bodies transparent, to access their interior landscape through (self) screening and diagnosis, to conquer uncertainty and contingency through a healthy lifestyle and 'responsible' choices, subjecting the body to a new, all-encompassing clinical gaze – *their own*. When consumerism and market ideologies dominate the health care system, health is commercialized, knowledge becomes a commodity and the patient a consumer. Active participation in health care is regarded as a cultural imperative for (neoliberal) subjects, shifting responsibility and blame for their physical condition to the patient, for example when they do not take up this role. In this setting, knowledge of the self, of the condition of the body and state of health becomes the foundation for informed, responsible decisions. This knowledge is no longer only generated in cooperation between health care professionals and patients, but also by patients themselves. Shifting power relations and the trend towards patient empowerment and autonomy have turned them into the ultimate authority over their bodies and health interventions. In his study of biopower, biopolitics and the medicalization of human life in the 21st century, *The Politics of Life Itself* (2007), Nikolas Rose argues that amongst others the molecularization of life and the strive for optimization have transformed the Foucauldian notion of "biopolitics" in the 21st century. In consequence human life processes are today not only subordinated under government control ("bio-power") but are inextricably intertwined with identity politics and (bio-)economics. In this new "politics of life itself" techniques of self-control and management of the body – in line with neoliberal bio- and body politics – become increasingly important, power relations are consolidated (as in the role of expertise) and reshuffled (as in the increasing agency and autonomy of patients), new forms of life (the person at risk, the susceptible self) and new forms of community (biosociality) emerge, and molecular rationales determine the governance of bodies, selves, and society (Rose, *Politics of Life*).

10 Incidentally, the notion of the human body as a 'project' reflects the language used in other DIY areas. For the body as a project, see Ch. 3.3.

Promise and Plasticity

What these considerations go back to is a deep-seated believe in the malleability of biological particles and life itself, as well as a growing desire to control these processes, to make use of them to shape the development of our own bodies and our biological surroundings. Hallam Stevens delineates *plasticity* – the ability of life to be manipulated – and *promise* – biotechnology as a future-oriented, promissory science connected to hype, expectations, or fears – as important themes in biotechnological research and development. These two concepts, promise and plasticity, have worked their way into my analysis in different shapes and shades because much of the discourse around DIY biology and medicine revolves around their duality. Promises are a central feature of the cultural engagement with biology: how bio-medical-technologies are talked about, how they guide individual and collective actions, how they are used is shaped by promissory narratives in the media, in texts, films and advertisements. These promises give hope, create desires, a yearning for change, development, transformation – but they also have their dark sides: Promises can be broken, they can be misleading, they can be false. As such, promises are part of the affective structure behind biology in general and its self-made companion more specifically.[11] These promises can define our understanding of our own life, our bodies and biology. They are both an opportunity and a form of oppression.

Plasticity, on the other hand, is a rather new concept that, after originating in biological research on cells and brain development, is now taken up more and more often also in cultural inquiries – or rather, that is named explicitly, when previously it had been present unannounced. Plasticity cannot just be used to describe the cultural condition of our time (requiring constant openness to change and flexibility, cf. Malabou) but also the very much material precondition for DIY biology and medicine: It requires us to see life and the body – from individual cells to the whole complex system – as a malleable entity in and of itself, as always able to change, as constantly adapting to new environments and requirements (changing both to stimuli from the outside but also on its own accord). The duality of promise and plasticity, thus, combines both nature and culture, politics and materiality.

There are transhumanistic (with a lower-case t) undertones, in the way biotechnology here seems to shape culture, creating a new cultural (and possibly in the future also human) condition (Tirosh-Samuelson). These new biological possibilities destabilize the given, the biological substance of the body – what humans for centuries have taken for granted, had to work in tandem with to achieve their goals – and create new ways of living and being in the world. A somewhat overused phrase from Marx and Engels comes to mind: "All that is solid melts into air." Famously utilized by Marshall Berman to describe the experience of modernity with its constant fluctuation between creation and destruction, unity and disunity, disintegration and renewal, it lends itself to capture some of the uncertainty but also creative potential that comes with biotechnological and

11 Fear and anxiety can be considered as the 'negative' counterparts to hope and promise. They similarly guide our understanding of and responses to biotechnological innovations or biological threats.

medical advancements. The body, its mental capacities and physiological condition, are no longer a given or limit. Instead, in these new "regimes of living" (Collier and Lakoff 23, 34) individuals through self-surveillance, self-management, and (self-)enhancement turn their bodies into possibilities. This certainly is a future-oriented process, driven by the wish to conquer and control the last great unknown ("What will happen to me in the future?", "Will I get sick?", "What will my children be like?") and replacing it instead with an ostensible certainty, centering around what the body can do, how it will look like. This certainty is only spectral. There are so many contingencies in human life, that they are impossible to control (at least in free societies, dystopian versions can be found aplenty in fiction). But DIY also carries with it transformative potential for processes of knowledge production not just of its application to human bodies. The success of DIY can also lead to an epistemological shift, in which hacking and tinkering – as *epistemological practices* – are blueprints for a new form of creating knowledge and a *rebellion* against outdated systems of power, differential ascriptions of competence, and exclusive restrictions on access to technologies, goods and knowledge.

An analysis as widespread as is attempted in this book shows not only the cultural and material effects of recent biotechnologies but also the high personal, social, and political stakes of these technologies. 'Do-it-yourself' creates a new cultural politics of life centered around self-reliant individuals as both decider and executer, diagnostician and practitioner, subject and object, observer and observed, taking their health, their lives, their biology literally into their own hands. The questions guiding this examination mirror the multi-leveled nature of the project: What are the social, cultural, and indeed material effects of DIY as field of practice, a "technique of the self" (Foucault)? What is its reality as embodied phenomenon; as object of desire and hope; as form of governance; as generator of capital? What is its culture, what are its politics? How can DIY biology as part of the promissory economy of biotechnology effect transformations in how we produce knowledge, approach bodies and indeed 'life itself'? How does it shape the understanding of the self and biology? What kinds of conflicts are embedded in DIY biology? What are the ways, means, and forms in which DIY biology and medicine are inserted into culture? What is the potential of this cultural trend, what are the negative side effects and how are they discussed in the public sphere? What narratives, metaphors, images are used in these discussions? These are only some of the questions that will be addressed in the following chapters.

Representations of Biohacking

The terrain covered in this book is a field of study that has only reached the disciplines of Cultural Studies and American Studies in the past decades, fueled especially by advancements in biotechnology and possibilities of medical intervention that caused major turning points in fundamentally cultural and social questions, such as identity, heredity, race, gender and so forth. With some of these up for re-negotiation, cultural theorists have taken up the challenge to provide criticism of regimes of knowledge production, laboratory practices, or the ways and means through which scientific information and concepts are carried into and debated in the public sphere. Such approaches,

what Lennard Davis and David Morris in 2007 have termed "biocultures," instead of limiting their scope to either side of the 'biology vs. culture'/'natural sciences vs. humanities' debate, argue for a continued dialogue between these fields of specialization. As Davis and Morris maintain, looking at "the biological without the cultural, or the cultural without the biological, is doomed to be reductionist at best and inaccurate at worst" and therefore we need to re-think culture with its relation to biology in mind and vice versa (411).[12] In my arguments, I focus on the culture of DIY biology, or rather, how culture intersects with DIY biology.

I aim to explore how those techniques are represented and negotiated in the public sphere, to consider the politics of DIY through their representations in order to expose the connections between the material practices and their social, cultural, and political dimensions. Situating the emerging discourse of DIY biology and medicine in a historical, political and cultural context, allows me to examine the underlying beliefs, discourses, and ideologies behind the current turn to DIY technologies as well as the new imperatives, narratives and politics created by them. This focus on representation can expose the biological and cultural imaginaries (cf. Steinberg) created by DIY biology and medicine; show how people debate, criticize, re-imagine interventions into the human body; elucidate the fears, longings, fantasies, desires connected to such technologies; and investigate how personal and political meanings are created about them and how they subvert and reinforce dominant ideologies.

Essential, here, is the *cultural imaginary of biology*, the "dominant cultural metaphors, symbols, images, and representations" of a given culture (Mackenzie 125), in this case in their relation to biology. With broad reference to Winfried Fluck, culture is understood as a medium for the (fictive) expression of such imaginaries, through which we can supersede our own lived reality and imaginative horizon, on a trial basis (12-13). Through imaginary representations, we can 'try on' different identities, different types of embodiment, different social and political systems in fiction – give expression to thoughts, feelings, experiences and fantasies without fearing immediate consequences (cf. Fluck 15).[13] Cultural representations show how meaning is attached to practices,

12 While Davis and Morris' seminal argument about the need for "biocultural" scholarship has been formulated more than a decade ago – and could thus be considered outdated – younger scholarship still addresses the continued relevance and need for such engagements, cf. Pitts-Taylor, "Mattering" (2016).

13 The cultural imaginary can also impact our experience of embodiment. Here, the notion of a cultural imaginary acquires a meaning apart from its descriptive use as an umbrella term for all sorts of cultural productions. Especially the latter part of the term takes on a more literal meaning. Catriona Mackenzie argues that norms and cultural fantasies are enforced and perpetuated through metaphors, symbols, and visual representations (125). But how do these cultural metaphors, symbols, images and representations affect the experiences and self-concepts of individuals? The suggestion Mackenzie develops is that the availability of images and representations can constrain our imaginative possibilities: our ability to imagine ourselves (otherwise) draws on the cultural repertoire of images and representations (126, 143). The available images and representations determine what imaginative possibilities we see for ourselves and narrows our options for imaginative explorations of alternatives. The cultural imaginary, thus, also influences how we can see ourselves and construct our identities – what we can*imagine* ourselves to be. This can affect how we view and experience our bodies, in sickness and in health.

bodies, and forms of life: What is represented can be imagined, what is imagined can find expression in representation (without the consequences of the real). Representations of DIY do not only shape how the public (and scientific-medical community) sees and evaluates these techniques, but are also the results of the shared meanings, desires and values of a society, which highlights the dynamic relationship between representations, technologies and the public. But representations can also, and crucially in relation medicine and the human body, have material impact. In her study of Andean imagery, Deborah Poole introduced the term "image world." She employs this concept to describe the material and social nature of images, arguing that how we see and represent the world decides "how we act upon that world and, in so doing, create what that world is." Seeing and representing, thus, are "material" because they create ways of intervening in the world (7).

Some sociological, ethnographic and natural-sciences work has already been done on DIY biology, biohacking, the Quantified Self, and genetic testing.[14] Topics in this research include biosecurity, its political nature and mode of activism, its tools and spaces, the relationship between experts and amateurs, its norms and ethics. But so far not so much work has been done on DIY biology and medicine's cultural manifestations and representations. But culture (art, literature, performance, or popular) and its academic analysis can make available new perspectives not just on topics dealt with in the work of 'art' but also on 'scientific research' in general. As Stefan Beck claims, science and humanities need to work together to coproduce new conceptual instruments, a new language and vocabulary, to facilitate social and cultural engagement with and understanding of biomedical "in(ter)ventions" as well as reflexivity about the process of knowledge production (18). Literary and cultural studies can contribute a great deal also in the field of (natural) science: "the influence of language, narrative, and images on public attitudes toward science," means that "scholars who are experts in interpreting cultural matters" are uniquely equipped to take part in the discussions around the development and use of scientific knowledge and technologies (Wald and Clayton x).

More than that, such scholarship can make available different, distinct forms of knowledge. The importance of such research, therefore, also derives from the fact that humanities enquiries come from a different disciplinary background, have different philosophies of life and different approaches to how scientific research should be conducted: the same questions can lead to new insights when research is framed in another way or distinct categories are applied; new ways of collecting, organizing, processing and interpreting "data" can lead to unforeseen hypotheses and conclusions that are then transported to the public in a new way (Wald and Clayton x). Most of the time, what is needed is also a broader understanding of 'data' that moves beyond 'hard facts' and acknowledges that texts, narratives, images, metaphors and so forth can also be used to draw conclusions about the meanings created in specific social formations.[15]

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14 cf. among others N. Fox; Roosth; Meyer ("Build"); Meyer ("Hacking"); Delgado; Delfanti (*Biohackers*); Delfanti ("Users and Peers"); Lupton (*Quantified Self*).

15 The task of cultural critique, however, is not primarily to assess the viability, even desirability or morality, of these current trends. While ethics will, to a certain degree, always be present in this

The sources used in the following analysis reflect exactly this approach to 'data.' The new bio-medical and -technological trends and possibilities are negotiated in public culture by utilizing materials, scripts, narratives, imaginaries already available in the cultural archives but also by creating new ones. They give representation to how the possibilities of biotechnology are experienced, interpreted, and made public – how they make meaning in the public manifold. Cultural artefacts become favorite sites for the negotiation and (re)production of meaning; and this meaning is debated in diverse sites ranging from practices – in laboratories, court rooms, hospitals, and domestic spaces – to texts – in mass media, textbooks, legal cases or science fiction. Using interpretative research methods and textual analysis, I want to explore the rise of the DIY movement and its ubiquity by touring its sites and texts. As Lawrence Grossberg writes, the starting point of cultural studies is always an assemblage, never a single event, text, genre or medium (223). Looking for shared discourses, repetitions of themes and conceptualizations I will use the 'texts' under consideration as entry points into their context and background, to connect them to broader social, economic, political, cultural situations, to map their configurations and contradictions. I will therefore analyze the examples not as stand-alone practices but in their assemblages, situate them in a wider network of practices, relations and affects.

Given the impact of mainstream and popular treatments of these topics on public perceptions (Wald and Clayton xi), these 'texts' are not restricted to complex and ambitious literary works, images, and cultural productions, but instead primarily encompasses those considered to be pop-cultural. These include 'subcultural' texts like magazines, websites, or individual and collective self-definitions by the DIY community but also their perception in mainstream culture. What is crucial, furthermore, is that the sources are not limited to a particular domain, such as only visual or only textual. Instead, they encompass all the resources used to make sense of the changing relationships between bodies and technologies: (social) media, journalism, popular science writing, images, films, narratives, commercials, (science) fiction.[16] This broad range is chosen consciously in order to engage different configurations in which biological knowledge is turned into cultural practices but also to account for the higher proliferation of DIY in pop-cultural formats due to their reliance on contemporary, social media. The diversity of practices and cultural representations, I would argue, is not so much a problem but rather a strength because it demonstrates how wide-spread DIY logics are employed in biology and medicine. It is not a singular phenomenon but one that is pretty much ubiquitous and spreads into all sorts of everyday (cultural) practices. At the same time, the diversity allows me to distill the common concerns and problematizations, to examine the underlying values and future potential. All the objects and practices studied here reflect central debates that are (or need to be) held about the changing configurations of technology, biology and human agency.

This project has "reshaped" itself as I went along, included new texts and contexts, new problems and conjunctures (cf. Grossberg 1). But as with any academic analysis, at

examination, I want to move beyond addressing questions of desirability or morality and move to more complex questions and fundamental issues.

16 More information on what guided my selection can be found in the introduction to Part III.

some point I had to draw a line. For me, this line was somewhere in early to mid-2019. I have included newer developments in footnotes where appropriate, but as a field that is still in constant flux some of them might not be addressed. Moreover, that biotechnology changes at an unprecedented pace – and with it the possibilities of self-intervention – might mean that such a study could become outdated once it is finished. This is a valid concern that needs to be addressed. It might be true that some of the techniques under examination here might get 'old,' both in the sense of becoming routinized and in the sense of getting outdated by newer technologies. It is, however, not so much the individual techniques that count but the values and ideologies that underlie them, the visions of the future created by them and their (fictive) narrativization in culture. These basics will remain relevant even if the perspective on and evaluation of DIY techniques changes.

Little Strokes and Big Oaks

Our understanding of life – both its biology and embodied practice – is continuously transformed by the introduction of new concepts and ideas, patterns of knowledge and ways of thinking. Changing the prevalent "ways of thinking" has transformative potential. With a new approach and perspective, what seemed unthinkable suddenly becomes possible, desirable, even necessary, so that epistemological shifts can lead to cultural shifts. Transformations during the 21st century have, according to Rose already led to new configurations of knowledge, authority, technology and subjectivity (*Politics of Life*, 104). These new configurations both serve as a basis for DIY techniques and are continuously transformed by them.

I am here following Rose's line of thought in suggesting that all these shifts are not epochal, drastic changes, but incremental developments. The changes brought about by biotechnology are not a rash rupture or sudden change, but a slow and steady move – a process of ever new inventions, a process of normalization of what was thought to be unthinkable and undoable (Rose, *Politics of Life* 5; 252). As Karen-Sue Taussig claims, transformations do not "just happen", "[n]ew ways of thinking about the world do not simply seep into the collective unconscious" and "new social and embodied practices [do not] emerge from nowhere;" rather, transformations only have an effect when they "have some basis in material reality" and are "taught, learned, and experienced" (193). In *The Politics of Life Itself*, Rose argues that it is important to show that we live in the middle of "multiple histories," that many futures are still possible. It is not a singular narrative from here to the "posthuman future" – that some desire and some dread – but a complex web of contingent pathways, which together will create something new (5). Once they are in widespread use, even daringly radical innovations will become routinized and appear normal, the changes will be "gradual rather than revolutionary, incremental rather than epochal" (*Politics of Life* 5, 252). The gist of what Rose is arguing here is that we always need to keep in mind that also the accumulation of small, seemingly not so drastic or even disparate changes can create something unprecedentedly new; even apparently small changes in the ways we think and perceive the world can open the door

for more radical ways of configuring life and should thus be examined critically before they become routinized.

Because these are slow, repetitive processes, it is always useful to look at the past, to analyze the harbingers of future developments, in this case, older strategies of self-managed, self-directed intervention and optimization. Contemporary transformations have not come about in a vacuum, but rather have been prepared by and depend on prior processes; they have a long history that they cannot be understood without. That there is nothing really new or fundamentally different about these developments – apart, of course, from the techniques employed and their far-reaching consequences – can be shown by pointing to historical examples, precursors, and the underlying values, desires and debates (Rose, *Politics of Life*). Looking at the historical continuity of recent phenomena tells us that they are here to stay, that they are simply old and deep-seated desires and fears played out on new playing fields. These desires and fears shape how both the practices and their representations are negotiated in the public manifold. Culture and society – in all their differing shades, forms, and shapes – play a crucial role for the perception of science, technology and medicine in society and thus become increasingly important for a full discussion of contemporary and future uses of biotechnology, for an assessment of personal and communal responses to and valuations of them, for meaningful debates about how (or whether) to regulate them.

What to Expect

To account for this complexity, the argumentation in this book will need to address multiple levels, reflected in the overall outline of the project. Chapter 2 "Biology and Culture" provides an overview of the directions that humanities enquiry into topics broadly understood as 'biological' has taken but also an introduction of the most important concepts needed for my analysis, such as the constructed and communicative nature of biology; the importance of bodies and materialism, affect theory, promise, and plasticity; discourses of governmentality, responsibility and citizenship. Part II *Background* is split into two chapters: Chapter 3 "The Promise of Small Things" takes up the idea of molecular biology as cultural and engages with biology as a (pop)cultural phenomenon. It illustrates how the cultural presence of molecular biology and biotechnologies is also a central component of DIY biology because it resources (utopian and dystopian) fantasies of perfected bodies and creates pervasive discourses that influence how humans think about their biology, transforming it from a certainty into a possibility and (life) project. To do so, I follow a trajectory from the molecularization of biology and life, via the signifying qualities of molecules – primarily as promises of enhancement and symbols of vulnerability – towards the fantasy of perfected human bodies. Richard Powers' novel *Generosity: An Enhancement* and the imaginary engagement with *SuperHumans* provide narrative and cultural examples.

On this basis, Chapter 4 "With My Own Two Hands" grounds DIY biology and medicine in American cultural values and ideologies as well as material realities. It traces the rise of 'do-it-yourself' as a cultural practice and imperative, looking both at its historical development and transformative potential. I discuss some of the founda-

tional (American) values that influence DIY until today, including but not restricted to individualism, a belief in progress, enhancement, and perfection (Chapter 4.1). A historical trajectory of DIY from its early days of home improvements to its newest renditions in the maker movement and citizen science (Chapter 4.2) as well as a discussion of the DIY patient in the context of medicine (Chapter 4.3) demonstrate that the 'newer' examples are not fundamentally new but grounded in long traditions. DIY biology and medicine are, essentially, old practices in a new guise, continuations of foundational American myths of innovation, entrepreneurship and self-reliance. New technologies, new possibilities, new visibility gives them a new quality and have turned "life itself" into a hackable entity.

Part III, *'Hacking' Life Itself*, brings the previous chapters together by showing, through readings of DIY texts and practices, how life is 'hacked' in contemporary times. Drawing on academic and pop-cultural sources, Chapter 5 attempts to find a definition, or at least a common understanding, for the terms and practices I consider under the umbrella term 'DIY medicine and biology.' The following five chapters, then, introduce many different DIY techniques both as practices and through their cultural representations. Primary texts for analysis are representations of DIY biology that circulate in culture, including popular non-fiction science writing (such as Marcus Wohlsen's *Biopunk*), instructions and guidebooks (the 'self-help' sector, such as James Lee's *Biohacking Manifesto*), corporate public relations material and self-descriptions, as well as media coverage. In each chapter, introductions to the chapter topic and main themes are followed by two case studies that shine a different, sometimes contradictory, light on DIY practices in that respective sphere: Chapter 6 "#iambulletproof" looks at biohacking as a form of self-optimization. Based on print and online examples, it demonstrates how these self-help resources further a rhetoric of responsibilization, in which (following the logics of neoliberal capitalism) the individual is responsible for their own health and wellbeing. In the guise of translators or mediators of knowledge, self-help gurus rise to a new status as "experts of the soma" (Rose, *Politics of Life* 5-7).

Chapter 7 "A Pill for Every Ill" contrasts the rising stimulant 'epidemic' of ADHD drugs and nootropics on campuses and in the workforce with a consideration of DIY medications and drug hacks for cheaper, universal access to lifesaving medications. In a culture focused on constant competition, availability and performance, stimulants are no longer only used to treat medical conditions but also for DIY projects of optimization. Drug hacks like the "DIY EpiPencil" from the *Four Thieves Vinegar Collective*, on the other hand, promise to provide access to medications to those who cannot afford them in a commercialized healthcare system faced with rising prices and low solidarity. In a similar fashion, Chapter 8 "Test Yourself" looks at commercially available tests and their opposite: creative, subversive and personal 'hacks.' DTC gene tests and molecular health tests by commercial providers are marketed as tools of self-knowledge – promising individuality, opportunities for optimization and a sense of community. Kay Aull's *self-made* DNA test has become famous in the DIY scene and has been a focal point of non-fiction reporting on biohacking as well: Even though this is an emancipatory act, Marcus Wohlsen's portrayal in his non-fiction book *Biopunk* embeds it into a similar discourse of self-knowledge and self-enhancement.

Chapter 9 "Homo Technologicus?" traces the changes technology has brought to age-old practices of self-reflection and introspection: It contrasts those technologies tracking from the outside (e.g., the Quantified Self movement) with endeavors that seek to embed technology *into* the human body to create DIY cyborgs (grinding). These practices have immersed themselves in daily life also through media reports, cultural artefacts and transhumanist thinking. Chapter 10, "The Human Need to Fiddle", highlights practices in the realm of DIY biology and medicine that proceed open-ended, community-oriented and participatory and thus might have the biggest potential for true democratization. On the one side, it looks at spaces, tools and technologies that have been created in the DIY biology scene (through the lens of self-descriptions and Wohlsen's framing in *Biopunk*). Those tools aim to provide access for all who are interested, reduce barriers of access and offer cheap materials for (more or less playful) experiments with biological materials. On the other side, it closely analyzes the discourses created around open-source, DIY technologies already in use in a medical setting: DIY continuous glucose measurement devices (here, the *Nightscout* project) and open artificial pancreas projects. In these cases, self-made technologies are used to monitor and even modulate the biological functioning of the human body.

Part IV, *Reflections*, then untangles what the consequences of the many different but related practices and representations of DIY biology and medicine are (or might be). The discussions in this final part reflect on questions of access, participation and democracy (11.1); the effects of consumerization and security concerns (11.2); discourses of empowerment and their counterpart, heightened vulnerability and precarity (11.3); and the risks of social stratification and the nascent sense of collectivity (11.4). In each of these subchapters, overarching themes from the previous analyses are discussed, abstracted and brought into dialogue in order to carefully deliberate positive and negative aspects of this not-yet-fully-formed trend. After having reconstructed the discursive formations and contexts in the previous chapters, I identify sites of struggle and potential, the promise and politics of 'DIY biology and medicine.'