9 Homo Technologicus? – The Technological Self, Inside Out

Self-tracking technology has taken the consumer market by storm during the past few years. Used to 'track' or 'monitor' the self, these tools promise unprecedented access to the individual body, possibilities for self-improvement and new forms of bio-sociality. The wearable tools of the quantified self are emblematic of how humans interact and connect with technology. They are increasingly integrated into one's sense of self and the surface of the body. In the visions of an enthusiastic community of body modifiers as well as global tech corporations, similar technologies will soon be incorporated *into* the body.[1] At the moment these practices and visions of technological immersion – human-machines, turning Homo Sapiens into 'Homo Technologicus,' where self and body are thought of in technological terms – are still primarily practices of DIY.

Such visions, however, are not particularly new. The impulse to track, to modify and merge with technology has preoccupied human imagination for centuries. Observing ourselves has always been a concern for humans, self-reflection and introspection have been practiced from the old Greeks to the Puritan settlers of America. As many scholars of the "Quantified Self" have argued, today's forms of tracking the self go back to older forms of keeping track of parts of our lives: diaries, body measurements, household books, personal budgets have all been used to record, plan and analyze everyday life (Lupton, *Quantified Self* 4; Abend and Fuchs 6). These analogue, language-based forms of "keeping track" were soon supplemented with measurements and numbers. In this sense, we have always been quantified to a degree, the technologies, tools and possibilities however have changed. The rise of computing and digitization have made possible new forms of tracking that allow for a detailed, minute and automated monitoring of

1 For example, *Neuralink*, a company founded by Elon Musk, aims to develop brain-machine interfaces. Other examples of global tech corporations' involvement include some concept studies for future tracking done by *Google*, including contact lenses that measure the blood sugar level of diabetics or the use of iron nanoparticles, attached to molecules in the bloodstream and analyzed with magnetic wristbands, to monitor the progression of diseases (cf. Hodson). The contact lens-based glucose meter, however, was discontinued in 2018, because glucose levels in tears do not adequately represent the blood glucose levels of the user.

the body and life (Lupton, *Quantified Self* 4). In this process, introspection was replaced by technologies that penetrate even deeper, not only into the mind but the body: trackers, sensors, blood tests, that can give – even daily – insights into its status quo; external monitoring of quantifiable data.[2] But also visions of cyborgs and man-machine hybrids have been part of the cultural imaginary since at least the 19th century – for example in Edgar Allen Poe's "The Man That was Used Up" (1843) – and automata, complex, sometimes humanoid machines, have sparked people's imagination and inventor spirit since Greek mythology. While tracking the self has been part of everyday practices, cyborgs, hybrids, androids, on the other hand, have for a long time primarily been the subject of (science) fiction.

In its most common understanding, self-tracking refers to practices in which people use apps and gadgets to create (self-)awareness of their lifestyle and improve it in almost all areas that influence life quality and health. The most common technology used to do so are wearables such as activity trackers and smartwatches that are based on (nowadays cheap) acceleration measurement and optical sensors (Schumacher 40-42). These tools range from simple trackers that count steps or quantify a day's physical activity to those for health issues such as glucose levels, blood pressure or heart rate; for meals and calories; more specialized applications such as tracking of ovulation and menstrual cycles, quantification of sexuality and pregnancy apps; the tracking of environmental factors, geolocations, personal encounters and work productivity; to the recording of emotions, moods and affective states. Some of these tools are worn on the body, while others are digital tools and apps that require manual input or track automatically. The plethora of tracking technologies – together with the rise of the "internet of things" – shows that today we are embedded in an "ecosystem of smart devices" (Bietz and Hayes 84) that could potentially "monitor" all aspects of our daily lives: what we do, where we go, what we eat, whom we talk to, how we feel, and what our bodies do at any given moment. As these trackers become even more pervasive and embedded in people's daily lives, chances are high that their acceptance will rise even more and tracking the self becomes a normalized, even routine and required part of daily life. 'Monitors' could become our daily companions, outside and inside the body.

According to Lupton, mobile digital tracking technologies produce a "spectacular body," make internal workings visible. They attempt to penetrate the "dark interior of the body" in the name of security and stability: by making it visible – as graphs, lines, and data points – they attempt to make it knowable and manageable ("Self-Tracking Cultures" 5-6; *Quantified Self* 54). In so doing, tracking also promises control of the 'untamable,' the unruly biological nature of humans through its conversion into objective, neutral, manageable data. Abend and Fuchs argue that the data generated by self-tracking technologies are "framed as direct access to a truth about the self," the promise that

2 Many scholars of quantification point out that data are perceived as objective and (value-)neutral: a higher authority (Lupton, *Quantified Self* 56), unaffected by human failings (Bietz and Hayes 82), more reliable than instinct and physical sensation (Lupton, "Self-Tracking Cultures" 5-6). Some of this perception comes from their foundation in 'objective' systems of knowledge production. In science data are seen as 'hard' facts, the truth, devoid of the researcher's interpretation or cultural influences.

collecting, interpreting and comparing data enables us to access our true self (12). Our material body, our biology, here becomes a source, an access point to a deeper understanding of the self. Numbers and data are seen as providing a "route to personal insights and self-knowledge" (Bietz and Hayes 82). Chrysanthou argues that such techniques alleviate uncertainty by moving from risks and probabilities derived from the general population to evidence from one's own biology (474).

As such, data can, according to Lupton, be seen as productive, they generate new knowledge and new means of managing populations through individual bodies (*Quantified Self* 41-42). The tracking technologies used to gather these data can be considered as "disruptive technologies" (Coupette) – technologies that reach a high prevalence in society in a short period of time. Those carry with them the potential to challenge institutionalized rules of society and destabilize the "cultural matrix" by, for example, creating new social selection criteria and new principles of valuation and organization (Selke 54). Technologies, thus, can also have social and cultural effects. And in deed, the technologies, the devices used to track and monitor, are a crucial part of this contemporary amalgamation of bodies and data. Self-tracking is one of the easiest, pain-free, commercially widely available, and socially sanctioned forms of integrating technology into everyday life and the human body (cf. Lupton, "Self-Tracking Cultures").

This chapter looks at quantification technologies as part of the DIY biology and medicine movement. Not only does self-quantification offer new possibilities for the DIY patient, it is also part of citizen science endeavors and techniques of self-care. At the heart of self-tracking, Selke argues, is the belief that data are the basis for informed decisions: only with sufficient information – meaning data – people can actively shape their own future (56). In the logics of the quantified self, data lead to pattern recognition that leads to changes in behavior and lifestyle – an automated process of collection, recognition, change that constantly repeats itself. Self-trackers "attach" hard data to many aspects of their personal life; at the same time, self-tracking puts the power over them in the hands of the individual so that the self becomes a "manager" of those data (cf. Moore 402). A prerequisite for this trend is the idea that individuals can and should manage and enhance the self, their performance and productivity. It is also in this sense that self-tracking can be considered a commercialized, mainstream DIY activity, much like the DTC tests described above: In some cases, tracking becomes a DIY solution to fix a perceived gap in health care provision, inaccessible doctors, or lack of technology; in others, tracking is a means of gaining self-awareness to improve the self; in others yet tracking becomes a tool for self-study and DIY citizen science experimentation (cf. also Sharon 103). DIY experimentation, moreover, is also the primary concern of those body modifiers that seek to integrate technology into the body: They experiment on and with their own bodies and/or self-made technologies.

The case studies chosen for this discussion each look at how we as humans integrate technology into our lives and bodies, not by force or coercion but by choice. Case study VII focusses on the quantified self, commercial forms of tracking the self and the body with technology. My sources here include media representations such as a feature on Chris Dancy, "the most connected man," or personal descriptions by self-tracking journalists, but also commercial websites for tracking gadgets. These sources combine perceived neutrality with affective appeals. Case Study VIII, on the other hand, looks

at hacked and tinkered approaches, many of which embed technology not on the body but *into* the body: 'Grinders' use technology to upgrade their bodies, using hacked solutions to also track the body from the inside. Sources for this case study are common and more extravagant 'hacks,' the self-descriptions of some key players in the scene as well as their representation in online media reports. What is interesting is that in cultural discourse these two types of using technology to track and upgrade the body are often thought together. For example, an episode of the TV show *Dark Net*, that looks at the dark web, technology and internet culture (*Showtime*, Jan 2016-May 2017), includes tracking with wearables and sensors as well as grinding into its consideration of how people "Upgrade" their bodies in the digital age (Jordan). While the former is a commercial, external form of interaction with technology, the latter is niche and invasive.

Case Study VII: Quantifiably Me – Hacking the Body with Numbers and Data

Tracking the self – for data, for knowledge, for change – has become a contemporary lifestyle. This lifestyle change, it seems, shares some of its most fundamental premises with the maker movement or DIY trend more generally: they rely on smaller, more advanced, portable technology and computing; network and sharing culture; active participation and access to tools and knowledge; a playful engagement with materiality; and a keen interest in the improvement and optimization of one's life, body and wellbeing. In this case study, I want to show that self-tracking is part of 'DIY biology' efforts, potentially even its most mainstream and widespread version. A variety of academic scholarship has already been written about self-quantification and its practitioners, amongst others as a practice of self-hood, biopolitical strategy and contemporary form of surveillance, or hopeful vision of future medicine.[3] Dealing with it on a few pages will therefore necessarily seem incomplete. That is why I specifically aim to illustrate the connections between the quantified self and DIY biology.[4]

What interests me are not so much the users or devices, but how they are represented. Advertisements and popular accounts shape how those tools and techniques are used and perceived. For example, Dave Eggers' *The Circle* is one of the most prominent examples of the last years, book and movie, in which not just the integration of technology and sharing into contemporary life are taken to an extreme, but also tracking

3 Some sources include: Lupton (*Quantified Self*); Lupton ("Self-Tracking Cultures"); Abend et al.; Majmudar et al.; Schüll; Schumacher; Sharon.

4 I am here dismissing the distinction between the "Quantified Self" as organization and self-tracking more generally because they rely on the same principles of quantification, self-knowledge, improvement and sharing. The 'original' Quantified Self community and organization was set up in 2007 by Gary Wolf and Kevin Kelly in the San Francisco Bay Area, after encountering more and more people who engaged in some form of self-measurement, as they claim (Quantified Self Labs). The Bay Area provided fertile ground for the early forms of self-tracking because due the start-up culture and Silicon Valley it was populated with enough hip technophiles exhibiting the right culture of performance and play. Now there are chapters of the QS community in many parts of the world, QS meet-ups organized by different people in a variety of cities. The Quantified Self organization can serve as an example of the broader social movement, which is why I also sometimes use quantified self as a description of the whole phenomenon.

becomes an important part the Circle's corporate culture: Employees all wear wrist monitors and as part of their corporate health plan swallow a sensor that tracks their health from inside their bodies. The dystopian outlook in this book seems to criticize contemporary fascination with quantification. In other popular accounts and advertisements, on the other hand, Tamar Sharon observes that self-tracking is positioned as leading to "unique insights about oneself" and by doing so promises to alter the relationship individuals have with their own health, bodies and selves (103). Also Abend and Fuchs argue that especially advertisements for wearables promise knowledge of the self as much as a route to its improvement (11). Some of this promissory discourse has been reflected in media representations as well, while in other cases coverage has been more cautious and critical. This critical media coverage, however, does not seem to undermine the use of and enthusiasm about self-tracking technologies. In any case, representations can give us insights into some of the more controversial issues of the self-tracking phenomenon while also demonstrating its inherent connection to other practices of DIY biology and medicine: Self-knowledge and self-enhancement, access and democratization, literacy and knowledge production, and individualism versus collectivity are some of the concerns that demonstrate the similarities between the practices – and I will discuss each of them in turn.

As many popular accounts demonstrate, the quantified self is positioned as an old practice in a new guise. "Extreme navel-gazing is probably as old as staring at the stars," notes Kashmir Hill in *Forbes*. "If this sounds weirdly narcissistic," she writes, we should keep in mind that the precursors of this movement – essentially old linguistic means of knowing and recording the self – have "a forebear in a quintessential American: Benjamin Franklin, the founding father of self-tracking" (n.p.).[5] Self-tracking as a form of self-knowledge, thus, does not only have a long history of use and acceptance but also goes back to some of the core American ideals and values I have discussed in Chapter 4. Quantified Self founder Gary Wolf writes in the *New York Times*: "From the languor of the analyst's couch to the chatty inquisitiveness of a self-help questionnaire, the dominant forms of self-exploration assume that the road to knowledge lies through words. Trackers are exploring an alternate route. Instead of interrogating their inner worlds through talking and writing, they are using numbers" ("Data-Driven," n.p.). Both authors position self-tracking as part of a long line of techniques used to interrogate, express and 'know' the self: The difference, according to them, is the medium – from language, inherently subjective and affective, to numbers, objective and neutral.

This neutrality seems to endow data with a new authority: self-knowledge is 'scientified.' "Self-knowledge through numbers," used by Wolf and Kelly as the motto of the QS community, became the 'mantra' for self-trackers around the world (Quantified Self Labs). Data are often positioned in a positive light, as a force to be reckoned with. For example, in an interview feature with Chris Dancy – who has become famous as "the most connected man" because he wears or uses between 300 and 700 tracking and lifelogging system at all times – Samantha Murphy asks herself whether she might "miss

5 Franklin, she says, "kept a daily ledger in red ink of 13 virtues, from temperance to humility" to record his progress towards "moral perfection" (Hill).

out" on "unleashing [her] own vault of data" by not using as much tracking technology (n.p.). "Unleashing" tracked data, it is implied, allows them to productively work for you. Lupton uses the concept of "lively data" to "denote the manifold ways in which personal digital data…are vital." This vitality, productivity, for her takes two forms: For one, they are vital in themselves by influencing people's behavior, sense of self, social relationships, life chances and opportunities. Moreover, being fundamentally about the lives of people, their bodily functions, behaviors, moods, emotions, relationships, "[d]igital data generate new forms of knowledge and new insights into people's bodies and selves" (Lupton, *Quantified Self* 5). By tracking the self, people become scientists and experimenters on their own bodies, their own "lab rats" (Lupton, *Quantified Self* 69). They plan, conduct and evaluate their own experiments, a DIY approach to knowledge production. Instead of solely being consumers or recipients of (scientific, biological) knowledge, self-trackers are actively engaged in the production of knowledge (Sharon 100), about the self and human physiology more generally.

Part of this quest for self-knowledge is also a prevalent discourse of awareness and mindfulness of one's body and mind (cf. Nafus and Sherman 1789). Self-knowledge is coupled to self-care. In the self-tracker's claims of "personal evolution, self-improvement and self-awareness," the quantified self seems to be a modern way of fulfilling the "Greek tenets of 'knowing yourself' (*gnōthi seautón*) and 'taking care of yourself' (*epimelēsthai sautou*)" (Abend and Fuchs 9). This is visible already in the title of an article written by Gary Wolf for *Wired* in 2009: Self-tracking also for him becomes an answer to the old paradigm of "Know Thyself." Tracking is framed as a valuable tool for understanding and managing the self. As such, self-tracking can be argued to go back to other forms of taking care of the self, communally and individually. A means of "performing, presenting and improving the self" (Lupton, *Quantified Self* 140), self-tracking can be understood as a Foucauldian "technology of the self:" They can be used to take care of, work on or play with the self, depending on the context and attitudes of their users (Abend and Fuchs 9).[6] Like other techniques of DIY biology and medicine that I have discussed in previous case studies, self-tracking is a way of gaining awareness and knowledge of the self, of taking care of yourself in a more immediate and intimate way than previously possible. The body, this biological organism, is perceived as intrinsically connected to the sense of self, a form of biological determinism brought about by the penetrating glance of technology.

A crucial part of this, of course, is access to technology, data, the body. In this sense, self-tracking, like genetic and molecular testing, can be considered as a new way to peer inside the body, to make visible what previously was invisible or simply to arduous to

6 In fact, according to Lupton self-tracking is in agreement with the four types of technologies Foucault identified: technologies of production – people generating data on themselves – technologies of sign systems – the manipulation and communication of "symbols, images, discourses and ideas related to their own data" and the devices – technologies of power - voluntary participation in strategies of power designed to impose certain forms of conduct – and technologies of self – "performing, presenting and improving the self" through self-tracking practices (Lupton, *Quantified Self* 142).

track and monitor. This new access to tools translates into access to more specific information about one's body. Instead of being granted access by medical professionals, through self-tracking individuals gain authority over their data and, maybe crucially, their interpretation (Lupton, *Quantified Self* 94-95). Self-tracking, thus, can allow people more authority over their own bodies: In the interview with S. Murphy Chris Dancy refers to the ways in which all of our data are already tracked today, such as credit cards, smartphones, GPS systems, as "Big Brother." In contrast, "[w]hen you take control of it yourself, that's Big Mother, and that relationship is nurturing, kind and not controlling" (n.p.). Instead of being "surveyed" by corporations and government institutions, self-tracking allows *you* to use tools of data gathering for your own individual purposes and grants you control over your own data – data used to "take care" of yourself. Similarly, Gary Wolf emphasizes that self-tracking allows you to reclaim some of the power over your data ("Data-Driven").[7] It is no wonder then that empowerment and "taking control" are some of the main imperatives in tracking, also perpetuated in advertisements and on websites (Sharon 97). Similar to other DIY techniques, thus, self-tracking is concerned with control, access and authority. The self is at the center of the decision-making processes around their body, health and lifestyle, or so it seems. But also the opposition to elite and closed-off systems, that is discernable in Dancy's idea of "Big Mother," relates self-tracking to the hacker ethos of DIY biology.

In contrast to this appeal of control and authority, Hill describes her own inability to translate or use her collected data productively: "When I attend my first Quantified Self Meetup, I discover that other members share my excitement and perplexity: They don't know what to do with their data" (n.p.). The masses of collected data need be made sense of, need to be transformed into something that we can easily understand, that provides meaning for us, that we can use to act on the body. What is lacking also in parts of the quantified self movement, it seems, is data literacy, the knowledge of how to evaluate and use (their) data. Representing the tracked data, simplifying them, putting them into a visual, easily understandable form is necessary to make those data truly accessible also for lay users. As Wolf writes, "messy" data need to be translated into meaningful information through mathematics and computers ("Data-Driven" n.p.). Florian Schumacher argues that only with reappraisal and interpretation the measurements that form the basis of all data applications "make sense:" "through abstraction, interpretation, and representation data are turned into information, which can be developed into knowledge" (43, my translation). Only after this process of 'translation,' individuals can truly use this knowledge about the body. That, however, means that there always has to be an interpreting "authority," be it a human or machine (Schumacher 44).

Self-tracker Wolf acknowledges that in order to collect and use "neutral" data about the body we have to rely on machines: "We lack both the physical and the mental ap-

7 I have to stress that this of course is a somewhat optimistic view, one that can be countered by many arguments about data privacy and corporate control over collected data. Even though many companies emphasize their focus on data privacy and individual control, the tracked data are also embedded in a larger network of value production, sometimes even without the knowledge of the consumer. Data collection becomes a form of digital, free labor – for more on this see e.g., Till, "Exercise as Labour" – similar to the one performed by DTC testing consumers.

paratus to take stock of ourselves. We need help from machines" ("Data-Driven" n.p.). For him those older techniques seem to have left us with incomplete pictures of the self, simply because we lacked the right tools to access the knowledge buried deep in our biology: "We don't have a pedometer in our feet, or a breathalyzer in our lungs, or a glucose monitor installed into our veins" (Wolf, "Data-Driven"). This is a discourse of *deficiency* in which the biological, material body on its own is framed as in need of technological intervention to reveal its secrets. The self, the (plastic) body are positioned as "deficient" and "improvable" (Abend and Fuchs 11), reinforcing the lack/lack rectified structure of self-help discourses. In this context the DIY approach might lose some of its power: the process of translation is often, especially in this commercialized, mainstream form of self-tracking, not done by the individual themselves. Instead, people have to rely on companies and machines to provide visualizations, representations of the masses of data the trackers collect. They gain access but might in the process relinquish some of their authority over the interpretation. From a critical point of view, thus, authority does not necessarily lie with the individual but with the machines that analyze the data or the companies that write the algorithms. Similar processes are discernable in DTC testing and through the new "experts of the soma" in body hacking as well.

As with many of the DIY techniques I discuss in this book, self-enhancement is also somewhat inherently connected to self-tracking – in its motivational matrix as well as in its cultural representation or promissory discourses. Measuring is often connected to some idea of improvement (Hoy 95). For example, "Know yourself to improve yourself" is used on the website of the famous fitness tracker company *FitBit*: "Fitbit motivates you to reach your health and fitness goals by tracking your activity, exercise, sleep, weight and more," they write (Fitbit, "Fitbit Official Site"). The basic framework seems to be that knowledge necessarily leads to improvement, or at least the realization of one's individual fitness goals. In her report on self-tracking, Hill writes that "[i]ts adherents believe that gadgets can help organize torrents of personal data that can help turn us all into happier, healthier, wealthier and more productive human beings" (n.p.). These goals, however, are either inherently subjective – such as happiness – or seem to conform to a neoliberal ideal of productivity. This is also reflected in other media accounts: Data, it is implied, have helped Dancy to change his self into a more "productive," efficient one, writes S. Murphy (n.p.). The goal of tracking, thus, always seems to be some sort of improvement of the self or the body. Self-tracking technology, Abend and Fuchs claim, is marketed as a "productive method of self-engineering," in which a malleable body can be shaped in reaction to the numbers collected from measuring its functions (11). Lupton discerns the entanglement of bodies, technologies and selves as an important dimension of the quantified self: technologies are "incorporated" into notions of embodiment and selfhood, extend and enhance them. As they have become digital, smaller, easier to wear, "it becomes less obvious where the body ends and technology begins" (Lupton, "Self-Tracking Cultures" 4-5). Devices have become extensions of ourselves. In effect, self-improvement as a goal of self-tracking means that the technologies and techniques that are used can and will have material effects on the body: changing its physique, its molecular make-up, its outside impression. What tracking *promises*, thus, is knowledge, control, optimization.

Self-knowledge, authority, control, optimization – all these features of self-tracking cultures point to the strong emphasis on the self and personal experience in the self-tracking community (Lupton, *Quantified Self* 65-66). This is visible not only in the common name 'quantified self' or 'self-tracking' but also in the overall approach of individualized, personalized experiments and technologies. The self, on the first glance, seems to be the center and focal point. Some of the fears, doubts and reservations about the increasing quantification of life also hinge on this strong support for individualist thinking. Already in her subtitle S. Murphy points to the potential for negative side effects of the hyper-awareness fostered by self-tracking, a "lonely self-awareness." In the interview, Dancy admits that sometimes he feels lonely because behind all the data it is hard for him to connect to people: "'Being aware is not for the faint of heart,' he says. 'I think aware people live alone on a mountain'" (n.p.). As a price for the connection to himself, it is implied, he has paid with connections to other people. Individualism trumps community. Apart from her fascination with Dancy's approach, S. Murphy finds this story terrifying as well: "Is a truly aware and connected life one that will make us isolated in a pool of our own data?" (n.p.). Murphy draws on common fears of depersonalization in the face of seemingly neutral, anonymous masses of digital data.

This hyper-individualization, on the other hand, seems to be in tension with the community-orientation of self-tracking enthusiasts. "Quantified Self" founder Gary Wolf insists that self-tracking is "not particularly individualistic," but that there is a "strong tendency…to share…and collaborate," to collectively create a new type of knowledge about human bodies and selves ("Know Thyself" n.p.). This sharing ethos is probably one of the most prevalent evocations of community in self-tracking (cf. N. Fox 137). Collecting data is often intimately linked to communicating data to others (Lupton, *Quantified Self* 111). Hill acknowledges the social nature of tracking as one of the reasons it intrigued her: "For another, I'm a social creature; I like to hang out with people online and offline, and sharing data is a great way to do it" (n.p.). This approach to social sharing is part of the network culture of the 21st century: "Personal data are ideally suited to a social life of sharing. You might not always have something to say, but you always have a number to report," writes Wolf ("Data-Driven" n.p.). For example, *FitBit* evokes a community of "Fitbit users" one can join for tips, inspiration and more: "Now you can connect, share and compete when you want, with anyone you want" (Fitbit, "Why Fitbit"). Even if it sometimes appears "narcissistic," Wolf claims, self-tracking encourages new (types of) connections as well: "We leave traces of ourselves with our numbers, like insects putting down a trail of pheromones, and in times of crisis, these signals can lead us to others who share our concerns and care enough to help." ("Data-Driven" n.p.). Numbers and data become a medium and means of communication.

Indeed, this connection to and care for others is highly visible in one of the affective dimensions of self-tracking, the tracking of moods and emotions to know and control them. Tools like "MoodPanda," a mobile and web app that allows you to track your mood on graphs and calendars and get support and advice from the "MoodPanda" community, or the similar "MoodScope" make it possible to effectively track feelings and emotions, thus quantifying more aspects of wellbeing and (psychological) health. But more than that, they consciously embed the tracking individual in a community that is created through the tracking itself, one that is meant to provide support and words of encour-

agement in times of need – the data trail Wolf references. Critics Bietz and Hayes write that the "sociality" of self-tracking is one of its major benefits: Sharing data becomes an opportunity for motivation, social support and friendly competition (83). Instead of focusing on the individual, a multitude of communities are built around self-tracking, which always takes place in social situations (Neff and Nafus 3). It becomes clear that apart from being a "technology of the self," self-tracking is also a "technology of the social," not only based on monitoring the individual but on sharing self-data with others (Lemke, "Beyond Foucault"). Self-tracking, thus, is as much a 'do-it-yourself' as a 'do-it-together' activity.

In the commercialized setting facilitated by the mainstream reliance on corporate hard- and software, personal data are gaining commercial value, constituting a new form of "biovalue" (Waldby).[8] Nevertheless, there is also resistance against this consumerist, market-driven ideology that is to a degree also part of the communal aspect of self-tracking. According to Tamar Sharon some trackers enact their own autonomy by defining and tracking their own parameters and analytical categories or by hacking, dismantling and repurposing their tracking devices (109). In what Sharon calls "high-tech counterculturalism," digital technologies are used as "subversive tools of resistance:" Self-trackers often also tinker with their hard- and software or refuse to use proprietary software and data platforms. This type of resistance against surveillance and governance by corporations configures them "as active users, rather than passive consumers of technology" (Sharon 110-11). Self-trackers can also represent "a different way of knowing what data is, why it is important, who gets to interpret it, and to what ends:" This can according to Dawn Nafus and Jamie Sherman be a challenge to dominant big data practices and thus a form of "soft resistance" (as they call it) to the approaches of companies, firms, and data collectors (1785). This type of soft resistance, Abend and Fuchs summarize, means "that even within authoritative data structures, practices emerge that challenge the basic building blocks of the structure not by introducing alternatives but by playfully engaging with the technology in ways unintended by the industry and policy makers" (10). This is a tinker's approach not just to the technologies themselves but also the social and regulatory structures in which they are embedded.[9] These resistant, counter-cultural moves by self-trackers – hacking and tinkering their way to individual devices and software – position them closer to the practices under consideration in the next case study.

Case Study VIII: Real-Life Cyborgs – Grinders, Implants and Technological Immersion

Tracking technology that is currently merged with the body from the outside, many scholars, futurists and pundits predict, might someday be integrated into the body.

8 Targeted advertising is one way of how personal data are used to generate commercial value. For example, some fertility and ovulation apps track data, which are then connected to Social Media profiles, allowing more targeted advisements for e.g., maternity and baby products (cf. Schechner and Secada for the *Wall Street Journal*).

9 For more on 'tinkering' cf. Chapter 10.

Majmudar et al., for example, write that future sensors "will be ingestible, implantable, or subcutaneous" (154). Similarly, Neil Harbisson, a self-described "cyborg," thinks that more invasive uses of technologies will become normalized: Once wearable technology is accepted and we have moved on to implants, merging human and technology will become completely normal (Weller). This type of integration not just with but into the body, of course, also takes hold of the biotechnological and cultural imaginary, elicits enthusiasm and worry as well as speculations about the future of the human species. This case study deals with people who are on the forefront of this development: 'Real-world' cyborgs, grinders and technological self-experimenters. Here I extend the idea of technological interaction with the body to a movement that seeks to integrate technology into the body in individualized projects of extension and enhancement.

My sources for this discussion are pop-cultural representations of biopunk modification, media articles as well as self-descriptions of grinder companies and communities. More specifically these include *Dangerous Things. Custom Gadgetry for the Discerning Biohacker*, a biohacking online shop and information source, and *Grindhouse Wetware*, a biohacking community in Pittsburgh, Pennsylvania.[10] Founded by Amal Graafstra, himself a famous figure in the grinder scene, *Dangerous Things* has made it its mission to sell biohacking equipment and increase the safety of the products people put into their bodies.[11] The technologies sold by *Dangerous Things* represent the two most common forms of integrating technology into the body, techniques that have become more and more widely used in the last years also due to their perceived low risks and easy implantation. They include RFID (Radio Frequency Identification) and NFC (Near Field Communication) transponders as well as biomagnets for sensing and lifting small objects, hearing and interacting with technology. *Grindhouse Wetware* is an open-source biohacking start-up, which has received media attention through a feature on "Cyborg America" for *The Verge* (Thonis). This group, as journalist Cameron Coward writes, was "born out of the biohack.me forums" (n.p.) and built on ideas of community and collaboration but also frustration with sweeping visions that were never carried to fruition. The devices they experiment with range from aesthetic updates of the body to potential medical applications: What they share, *Grindhouse*'s members say, is that they are "built by cyborgs for cyborgs" (Thonis). One project is the "Northstar," an LED device that can be implanted under the skin. Coward describes it as "purely aesthetic," "a circuit board containing LEDs that can be lit up and seen through your skin" (n.p.), an aesthetic update that resembles bioluminescence (Melendez).[12] Another of their projects

10 Other famous grinders include Lepth Anonym, who has made a name for herself through her reports on her own extreme body experiments – inserting magnets into her fingers with crude tools in her kitchen, for example – and Prof. Kevin Warwick, Professor of Cybernetics at the University of Reading, UK, who had a microchip implanted into his arm to control a robotic arm.

11 Amal Graafstra is one of the first people to use the technology on himself. He started his own 'journey' of augmentation in 2005 with an RFID tag: Taking inspiration from pet RFID tags, he found a programmable alternative that he had implanted in his hand to work as a door key card (Coward).

12 For *Grindhouse Wetware* the most likely application of such a technology is, for example, the potential of adding lights to tattoos. This device, it seems, is very much built by and for the body modification community.

is a technological implant, "Circadia," that in their vision will be able to track medical data from inside the body. Their self-descriptions allow these niche practitioners to voice their own goals and concerns, while media reports on them and other 'cyborgs' might shine a more critical light on those practices and bring them into more mainstream discussions as well.

'Grinders' consider themselves a subgroup of the wider biohacker community: They are a small group of DIY biologists who use implants and synthetic materials to modify their bodies – essentially creating 'do-it-yourself Cyborgs.' On the first glance, grinding seems to be the most extreme form of biohacking, though on closer inspection it might actually be the result of following those other forms – body hacking, molecular modulation, DIY and DTC testing, tracking – to their logical conclusion. Bodies in the grinders' view become just another 'system' to be hacked, with the goal of transcending the natural body and human physical limitations. A definition given by the "biohack.me" Wiki, an online forum where the self-proclaimed "self-biohacker community" meets, defines grinders as follows:

> Grinders are passionate individuals who believe the *tools and knowledge of science belong to everyone*. Grinders practice functional (sometimes extreme) *body modification* in an effort to improve the human condition. We hack ourselves with electronic hardware to extend and *improve human capacities*. Grinders believe in action, *our bodies the experiment*. (biohack.me Wiki, my italics)

A prerequisite for this movement is the ubiquity of bodily modifications: Tattoos and piercings have become mainstream, also brandings and scarring are not as unusual as they used to be. The body has become a playground of experimentation that individuals can form according to their liking. Combined with transhumanistic philosophies of chosen evolution and transformation through science as well as more affordable and available equipment and access to information in the 21st century, people began to tinker around with technology and their bodies. Grinding, thus, is the result of a convergence of a DIY ethos, hacker culture, and the open science movement with increasing enthusiasm for bodily modifications.

Here, a DIY ideology is used for a more direct and invasive way of modifying the body by merging it with technology. In such a disputed field the 'DIY way' is often the only avenue towards realizing cyberpunk visions or testing out new, self-built technologies. While most people would assume human augmentation technologies would come from medical or technology companies, instead, "we're seeing augmentation begin in the basements of hackers and in the back rooms of piercing studios" (Coward). These informal spaces, we have learned, are typical settings for DIY biology and medicine. Fittingly, of course, grinding shares many features and topics with other practices of DIY biology and medicine: their hacker ethos and bottom-up approaches; democratization, open source and open science; sharing of and access to information; plasticity and malleability of the human body; self-directedness, self-experimentation and self-education; the urge to take control, action and frustration with the pace of technological innovation. Traces of all those can be found in self-descriptions and media representations. Since I have discussed most of them at length in previous case studies, here I want to focus on thematic complexes that build upon these foundational prin-

ciples and values of grinding: the role of the cultural imaginary and structural overlap with older techniques of body modification, post- and transhumanist visions of extension/enhancement, hybridity and cyborg identity, as well as vulnerability.

Like few other examples in my discussion, this type of DIY biology is influenced by science fiction imaginaries and cyberpunk fantasies of human-machine hybrid bodies. The long-standing cultural preoccupation with technologically-transformed bodies sparked the imagination of people and made body–technology integration seem worth striving for. Grinders are makers that turn conceptual considerations and cultural fantasies into reality. These roots are reflected also in Cameron Coward's feature on body modification, augmentation and grinding: To the "average geek," the idea of augmentation is "at least somewhat intriguing" because most "have already been exposed to the idea through science fiction," he writes (n.p.).[13] Despite the niche concentration of grinding as a practice, human augmentation is a widespread concern in mainstream cultural representations. A famous example of cyberpunk body modification is the character of Molly Millions in William Gibson's cyberpunk novel *Neuromancer* (1984). Molly Millions sports not just razor-blade prosthetic fingertips but also has artificially enhanced vision and a modified nervous system. This character exhibits body modification as an "endless process of customizing and upgrading," as Victoria Pitts argues (151). In this narrative universe, body modification is not dictated by biomedicine or cosmetic surgery experts but rather a "quotidian and populist project of survival and success"– adaptations are a necessity in that high-tech, cyber-universe (Pitts 151).

A more contemporary example can be found in *Netflix*'s techno dystopian science fiction show *Black Mirror.* In an episode titled "Arkangel" (2017) a mother decides to have the eponymous neural implant placed into her daughter's brain, allowing her to track her whereabouts, see through her eyes, monitor her stress level and medical status, or even block out potentially disturbing images and audio. Initially working successfully, it becomes a hindrance as her daughter grows up, letting her feel frustrated and cast out. A child psychologist diagnoses that the – by then controversial, soon-to-be-banned – Arkangel is responsible for her emotional immaturity and recommends turning it off. *Black Mirror* is known for taking on controversial or commonplace topics and technologies and thinking them to a dystopian conclusion, thereby presenting the viewer with a glimpse into possible futures and providing incentives for public discussion. Based on existing technology, in this episode it takes up ideas of implanting devices into the human body for the monitoring of medical data and psychological wellbeing, but also ties issues of surveillance and privacy into the discussion. These are only two examples that demonstrate the pervasiveness and long history of our cultural fascination with technological extension. The appeal of grinding is very much influenced by such science fiction visions of human bodies and their interconnection with technology. The strong influence of cultural representations on a very much material practice shows

13 This limitation to "average geeks" is for one due to his presumed audience – readers of the webpage "Hackaday" – but also points to the limited range of people that today are actively involved in the project of grinding. Grinding is still a niche market. Moreover, there is a kernel of truth in his limitation: Most grinders today are white men, a possible concern when it comes to diversity and access.

how entangled practices and representations are and once more emphasizes that we need to take (pop-)cultural representations into account as potentially transformative influences.

Orphan Black (2013-2017), a Canadian-American production running on Space in Canada, BBC America and Netflix, brings us closer to the real-world ideological basis of grinding (Manson and Fawcett). The series features "neolution" as an ideology and representation of contemporary cyberpunk artists and body hackers, espousing not just physical modifications of the human body, a tail for example, but also more sophisticated techniques such as cloning.[14] "Neolutionism" is a fictional ideology or philosophical outlook that pursues human "directed evolution" and encourages scientific advancement through active modification (Orphan Black Tumblr). The goal is to improve the human condition, to carry forward human evolution through science. Such ideals position "neolutionism" as a fictive examination of transhumanism. Transhumanist and posthumanist ideologies often form the backdrop for cyberpunk body modifications. I do not want to go into a diversified discussion on the philosophy of transhumanism, but a brief introduction of some of its core concerns should suffice to provide some context for the underlying belief structures of much of the grinder community. Max More, a leading figure in contemporary transhumanism, describes acceleration of evolution, improvement of the human condition, enhancement, overcoming of (biological) limitations, and a focus on science and technology as some of the central themes, values and interests of this group of philosophies of life (3). "By thoughtfully, carefully, and yet boldly applying technology to ourselves, we can become something no longer accurately described as human – we can become posthuman," More writes (4). Post- or transhumanism, thus, can be summarized as an ideology that emphasizes progress, personal freedom and action, reason, science and technology – all with the end goal of directing human evolution into something 'more than human.' *Dangerous Things* adheres to this ideology when they proclaim that biohacking will lead the next phase of human evolution. The end goal of grinding, it is portrayed, is human enhancement, supplementing, augmenting the human body to become better, stronger, faster. Wohlsen includes such strategies in his account of *Biopunk* and also Mark O'Connell's *To Be a Machine* (2018) and Adam Piore's *The Body Builders* (2018) can serve as popular science representations of this type of transhumanist thinking that capture the cultural appeals and imaginaries as well as the skepticism and concerns.

The goal of human augmentation is to extend the human body and its capabilities into more than is possible today. For example, a mini feature video for *The Verge* called "Biohackers: A Journey Into Cyborg America" opens with the following words: "How much can I push the human, how much can I consciously evolve the human body to

14 The plot of *Orphan Black* revolves around a group of female "sister clones" who have found each other – sometimes by accident, sometimes through meticulous searches – and have now banded together to try to lead a self-determined life without the influence of the powerful biotech company that created them. A dominant theme is the creation and control of human life (through technological progress) as well as cloning and its effects on identity. In 2016, *Orphan Black* received the 68th Primetime Emmy Award for lead actress Tatiana Maslany, who plays all of the female clones featured in the series. It has also been nominated for and won a plethora of other Canadian and American awards.

do more, to do it better, to do it faster, to do it stronger? I just wanna see how far I can push the human" (Thonis, 0:22-0:31). Conscious evolution and human enhancement are, from the beginning, positioned as the main imperative of biohacking, or grinding more specifically. One of the more common hacks in the grinder scene fills this idea of extending the human with life: Small magnets implanted into the finger "allow users to sense the presence of electromagnetic fields, to diagnose electrical problems like faulty wiring, and even to pull small metal objects like paper clips and bottle caps toward you, making you into something of a low-rent Magneto" (Melendez).[15] They are a common, already realized way of giving the human body something like an extra sense, an extra ability.

To achieve this extension Graafstra and *Dangerous Things* count on the structural overlap and cooperation with body modification professionals and culture. They are positioned – and positioning themselves – as bringing order and safety into a widely unregulated scene. This safety is produced through training piercers and body modifiers in the safe and sterile handling of the equipment and by providing easy access to tested materials and technology. With body modification artists the grinder community has found collaborators that do not only share their interests but that as specialized "experts of the soma" (Rose, *Politics of Life*) can help to maximize safety and minimize the risks associated with such invasive procedures. But also ideologically, body modification culture and grinding follow similar goals and concerns. Cyberpunk body modification, Victoria Pitts claims, frames the body as a "limitless frontier for technological innovation" and exploration (13, 153). Body modifications for Pitts are embodiments of controversy and of social rebellion through the body (2), turning it into a (material) site of transgression and boundary blurring with symbolic potential. The cultural politics of body modification, thus, for many body modifiers is connected to authorship over their identity and symbolic meaning changes through alterations: they aim to change the significance their bodies have for them and others (Pitts 16-17). Changing one's physical appearance, here, becomes a means of shaping identities, of giving the body a new (cultural and political) significance as a site of fluid experimentation.

The new form of sensing promised by magnetic implants, *Dangerous Things* implies, allows us to attach a new label – a new identity one could argue – to people with implanted magnets: "magnetically augmented humans." This new possibility for self-identification turns the individual into a human-magnet hybrid, a low scale cyborg. Paul Atkinson claims that DIY, in the traditional sense, "allows a more individual aesthetic" than that produced by mass-production and consumption (1). This idea, I would argue, can be extended to DIY body modifications. They too allow for a more "individual" aesthetic and feel of the body. DIY frees grinders not just from dependence on corporations and consumerism but also allows for a more tailored, individualized approach that combines fun tinkering with the scientific exploration of new technologies. Modifying the body becomes a means of expressing identity and subversion as much as an

15 Note both the inclusion of "Magneto," part of the *X-Men* universe, as a cultural reference, as well as the description "low-rent" that points towards make-shift, improvised solutions. In fact, popcultural references are commonly used to describe the concept of cyborgs for broader masses of people, often by using Superhero characters, such as Tony Stark/Ironman (cf. Chapter 3.3).

exhibition of technological progress. These techniques are also featured in *Dark Net*'s "Upgrade" episode in the form of two biohackers who either already have a chip implanted or are getting one implanted during filming: The integration of technology into her body – "tech" becoming a "part of you" – is highly fascinating for one interviewee, a self-defined "tech nerd." During the filming of the episode, she has a chip implanted into her hand: For her the idea of connecting with another device is a "cool feeling" and she seems to accept the chip as part of her self (Jordan, "Upgrade"). The common discourse is that this type of technology can be seamlessly integrated not just into the body but also the sense of self as a technologically-augmented human, or technology-human hybrid.

Grinding here promises to make true long-standing visions of human-machine hybridity: A fleshy, real-life cyborg. Hybrids, Stevens writes, are "mixtures, crosses, or chimeras" that are disruptive in their transgression of social and cultural boundaries. Biotechnology, he argues, creates many kinds of crosses, between animal and human, animal and plant, living and nonliving (144-45).[16] In the future, this type of hybridity might blend into the 'natural' body even more seamlessly. What is created is a *cyborg*, a "hybrid of machine and organism" as Donna Haraway defines it in her seminal text on cyberfeminism, "A Cyborg Manifesto" (5). In this text Haraway argues against the prevalent dualism in Western societies that construct binary (and from a feminist standpoint problematic) oppositions between for example body and mind, animal and machine, female and male, nature and culture. By blurring boundaries and borders the concept of the cyborg for her can be a way out of these dualisms (Haraway, "Cyborg Manifesto" 7,67). Referencing Haraway, Pitts summarizes that such a "cyborgian consciousness" "raises cyberfeminist hopes for a culture free of gender and further, for the deconstruction of all binary oppositions naturalized in the body" (159-60). In this cultural application of the concept of the cyborg, hybridity paves the way for an ongoing, fluctuating, and flexible play with bodies and identities. This playfulness and malleability find their materialization in the actual integration of technology and synthetic materials into the physical body itself. The result is a model of the cyborg that is both symbolic and real, material. A fleshy signifier of deconstruction and possibility, a science fiction figure brought to life and, in its transgressiveness, the embodiment of rebellion and non-conformity.

This image of the cyborg is often evoked in media representations. An example that has been widely reported on is Neil Harbisson, who had an antenna implanted into the base of his skull. Harbisson became famous in 2004 when he had his antennae implanted at 21 years of age. He is commonly described as a "real world cyborg" or alternatively the "world's first cyborg" in many media publications: Journalist Chris Weller, for example, writes that "[t]here is a name for people like Neil, who are part human and

16 An already realized example of this type of boundary defiance are medical devices and technologies that integrated into the patient's body take over vital functions, such as ventilators, kidney dialysis machines, or cardiac pacemakers, as well as prosthetic limbs that today can be interfaced with a patient's brain. These kinds of configurations "challenge the boundaries between body and machine and between animate and inanimate" (Stevens 144-45).

part machine. Neil is a cyborg." (n.p.)[17] Cyborgs, Weller describes, strive to alter their senses and bodies:

> Generally speaking, cyborgs want to experience a heightened reality. Some put microchips under their skin to replace lock-and-key entries of their homes and cars. Others use brain stimulation to improve their focus. Neil, a British-born, Catalan-raised musician and activist who now lives in New York City, has decided his antenna — known as an Eyeborg — will be his ticket to higher planes. (n.p.)

Neil Harbisson was born color-blind and had his antenna installed in order to transform color into sound waves that his brain can decode. "Neil still can't see color, but he says the antenna lets him hear and feel it" (Weller). Though his primary concern was to overcome a congenital limitation, he has 'upgraded' his antenna during the past decades: In 2013, for example, he augmented his antennae with Bluetooth connectivity that now lets him hear and feel color also via the Web. But Harbisson *self-identifies* as a cyborg as well, this identity is not only ascribed to him by the media. For him, there no longer is a distinction between his body and his technology, rather he feels like he *is* technology. His antenna is not only surgically sutured into his body but has become a naturalized sixth sense, an extension of his body.

A more experimental project by *Grindhouse Wetware* wants to move away from the sphere of playful augmentation and into the realm of medical application: The aim of their DIY micro-computer "Circadia" is to collect medical data inside the body. While not completely functional, during first tests for limited periods of time "Circadia" has successfully managed to collect and transmit temperature data.[18] It is this implant that has drawn the most attention. Tim Cannon, a leading member of *Grindhouse Wetware*, had "Circadia" implanted into his forearm in late 2013 in Essen, Germany, by a well-known body modification artist. "A lump of electronics the size of a deck of cards," Dan Sung writes in his article, this experiment successfully turned Cannon into "part human, part machine" (n.p.). Sung quotes Cannon as saying:

> 'I think a lot of people saw the size and the Frankenstein stitches. I understand why that makes people think what we've done is dismissible.…This was not meant to be for the masses. This was for a test.…We were just looking at if it was possible. What nobody

17 Neil Harbisson is not just a self-identified cyborg. He is also part of a cyborg movement lobbying for cyborg rights. One goal of this group is to start a conversation: "In 2010, Neil co-founded the Cyborg Foundation with fellow cyborg Moon Ribas. Moon has a seismic sensor implanted in her elbow that connects to online seismographs. Whenever an earthquake strikes around the world, a vibration lets Moon know. Neil admits the Cyborg Foundation's stated goals — of helping people become cyborgs, defending cyborg rights, and promoting cyborgism as an art movement — are still in their infancy." (Weller)

18 For the future, *Grindhouse Wetware* envisions a Circadia 2.0 that can track more vital signs like blood glucose, heart rate, and oxygenation levels (Sung; Melendez). Sung describes this vision as a chemical tracker of the self, integrated into the body – the cyborg version of a wearable tracker. Melendez, however, points out that these potential uses might catapult *Grindhouse Wetware* out of the domain of self-experimentation and into that of FDA regulated medical devices, carrying with it problems that they want to circumvent with their open source and access for all ideology (Melendez).

> knew was whether things could be implanted safely, and used, and charged. Now that we've proved we can do it safely, we can do it smaller.' (n.p.)

In this passage Cannon refers back to one of the main aims of *Grindhouse Wetware*: To demonstrate the feasibility of technical implants. "Circadia," as Cameron Cowards acknowledges as well, shows that such implants are 'doable.' At the same time, this quote highlights the extreme approach to self-experimentation in the grinder community. It underlines what Tim Cannon stresses in the *Verge* feature on biohacking as well: Grinders like them take the pain, literally, now to make such technologies possible for the masses later.

Sung's account of *Grindhouse Wetware* is also, it seems, the most honest one. In it, Cannon opens up about the "psychological trauma" he experienced through wearing the "Circadia" for the 90-day test period. Even his own involvement in "bio-proofing" the device – keeping the electronics contained and making it as safe as possible – could not "stop the psychological trauma of carrying around a battery and circuits under your skin" (Sung). Sung quotes Cannon as experiencing "really bad panic attacks" for roughly a month after the implantation: "'Every little tingle felt like the battery was bursting and I'd convince myself that the poison was entering my system. There were moments when I thought I'd crossed the line but I wouldn't be doing something bold if it wasn't a little scary.'" (n.p.) This perceived vulnerability, one could argue, comes from his new experience of cyborg embodiment, of carrying around a 'foreign' object in his body.[19] What this representation makes clear it that technology might not be as "seamlessly" integrated into the body as grinders might wish. The "Frankenstein stitches" described by Cannon serve as a visual representation of this predicament.

To Summarize

Analogue self-inspection, these case studies have shown, today is no longer enough to satisfy human curiosity – and the demands for enhancement and optimization. These age-old techniques are supplemented with technologies that penetrate deeper into the body and provide instant feedback on the body's current status, potentially quite literally as the "Circadia" project has shown. As Lupton rightly detected, already the quantification of the self has enabled a further integration of technologies into bodies and selves, increasingly obliterating the boundaries between body and machine ("Self-Tracking Cultures" 4-5). While self-trackers are usually worn *on* the body, grinding aims at embedding technology *into* the body, which takes the integration of technology one step further.

Technological implants that are used to restore form or function have been socially accepted and widely used, some of them already for decades. Cardiac pacemakers, implantable defibrillators, brain pacemakers, cochlea implants, retina chips, sophisticated

19 Even more "extreme" than the Circadia, Sung writes that *Grindhouse Wetware* also has abstract plans for an Open Heart Project, an optionally replaceable heart. This OpenHeart Project, might, in fact be the most obviously transhumanist project of *Grindhouse Wetware* because here the technological augmentation is not done out of aesthetic considerations or (individual) curiosity but as a means to enhance the self, extend its lifespan with mechanical devices without medical necessity.

prosthetics, contraceptive implants and glucose measurement devices are mainstream forms of human-technological hybridity (cf. Lupton, "Self-Tracking Cultures" 4). They are nothing new or extreme but have become accepted as part of human 'nature' in a technologized society. As we can witness today, tracking technology is moving into a similar direction. Grinding takes this form of technological integration to a new level of 'outside' innovation, makeshift solutions, and open approaches. Their tools and technologies are not restoring function but simple aesthetic modifications, extra senses, or new means of tracking physiological data. As such, they seem to represent a new form of transgression between the boundaries of humans and machines, living and nonliving entities. They are perceived as more extreme, bloodier, more experimental, a niche movement of DIY enthusiasts and technical tinkerers.

What needs to be stressed is that as of now many of these techniques are still "in [their] infancy" (Coward): Biomagnets, chips and bioluminescence give just an inkling of future possibilities. Nonetheless, as other technologies have shown, widespread adoption of new technologies is often faster than we would imagine – think of smart phones, DTC genetic testing and fitness trackers as examples. What seems niche and extraordinary today might lay the foundation for future technologies and a more widespread acceptance of technological enhancements. The DIY techniques of today, thus, might through processes of normalization become commonplace applications of technology tomorrow. Self-tracking technologies worn on the body can be considered as a stepping stone towards this development. Cultural discussions will be necessary to decide to what extend such technologies truly are desirable and under which conditions.

Technological innovation will in the future make technological implants smaller and easier to do; their potential medical uses will attract the attention of the usual players in medical markets, start-ups and companies that aim to commercialize and profit of those early attempts. The small start-ups – more or less profit-oriented – that have already formed around the idea of implantable technology are likely to spread the phenomenon further by making the tools more easily accessible, thereby potentially positioning it closer to a commercialized DIY activity like the quantified self. But grinding is also a symbolic force. Much like the DIY EpiPencil and Aull's hemochromatosis test, grinding is a form of demonstration: that it *is* possible to undertake this type of intervention not just yourself but in general. Grinders as such also have a trailblazing role, they might pave the way for (commercialized) endeavors by delivering a proof of concept and an enthusiastic base. It is this symbolic force that makes grinding also political: It is a movement that advertises a radical freedom of choice about what to do with one's own body and biology, a "morphological freedom" (More 4) of form and function.