

# Information as Truth

## Cybernetics and the Birth of the Informed Subject

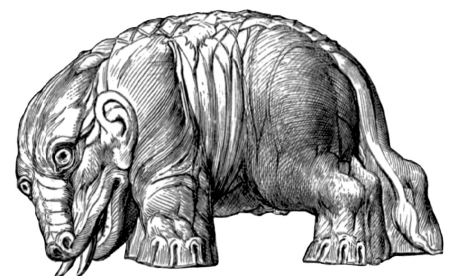
Janosik Herder

### Abstract

What is the specific subjectivity of the computer age? Donna Haraway and Katherine Hayles suggested that the spread of computers and the post World War II discourses of cybernetics and information theory enabled us to construe subjects as cyborgs or posthumans. This paper offers another perspective that regards subjectivity in relation to the central conceptual innovation cybernetics introduced—information. Cybernetics and information theory first of all enabled a new understanding of humans as informed subjects—subjects, for whom the feedback of information is a specific way to manifest truth. By help of Michel Foucault I will conceptualise subjectivity and its relation to information as a specific regime of truth. This regime presently gains enormous momentum as is evident by practices such as self-tracking but also the growing importance of information or data in general.

**Keywords:** information, cybernetics, truth, Foucault, Haraway, Hayles, cyborg, posthuman, self-tracking

**Janosik Herder** is research assistant in political theory at the University of Osnabrück. He is working on a genealogy of the concept of information and its political implications. He has published on the political role of algorithms and the works of Michel Foucault, Gilles Deleuze and Karl Marx. **E-Mail:** [jherder@uni-osnabrueck.de](mailto:jherder@uni-osnabrueck.de)



*It is readily possible to construct a machine which will manipulate premises in accordance with formal logic simply by the clever use of relay circuits. Put a set of premises into such a device and turn the crank and it will readily pass out conclusion after conclusion. We may some day click off arguments with the same assurance that we now enter sales on a cash register.*

— Vannevar Bush, 1945

*To live effectively is to live with adequate information.*

— Norbert Wiener, 1950

## Introduction

Michael is a long-time self-tracker who identifies with the California born ‘Quantified Self’ movement. He uses small computers and sensors to log his daily routine, his movements, heart rate, moods, weight, and habits. “He is particularly concerned”, Dawn Nafus and Jamie Sherman (2014, 1788) recall in their study on the movement,

with his morning routine: ‘If I don’t do it, I’m off for the rest of the day.’ It starts with weighing himself, then doing some pushups, followed by a meditation, and then a writing exercise using a program called 750 Words, in which he writes the first 750 words that come to mind. It acts as a meditative exercise that comes with an analytical bonus: algorithms scan the contents for mood, mindset, and current preoccupations.

Obviously, it is easy to see Michael’s behaviour as a cry for control, or to disregard it as some absurd practice of self-surveillance or neoliberal optimisation. However, Nafus and Sherman conclude, his approach is much more subtle: “He tracks things when he needs to cultivate a particular habit, or when he is trying to understand what is happening with his body.” (ibid.) For Michael and for scholars of self-tracking, the advent and success of this practice indicates a more general transformation of subjectivity in relation to information technology. How, then, can we understand the form of subjectivity articulated by this peculiar practice?

Donna Haraway and Katherine Hayles have put forward the most important and most influential proposals for understanding the transformation of subjectivity through information technology—and both remain pivotal in the debate on self-tracking (see i.e. Lupton 2016a). Haraway and Hayles’s theories allow us to understand how subjectivity was disrupted by the spread of computers and the post World War II discourses of cybernetics and information theory. [1] Both take this disruption to be about transgressed boundaries and the possibility to envision new subjectivities. Still, there is another, presently more crucial way to understand this disruption. One that takes into account the central conceptual innovation that cybernetics introduced—the concept of

[1] I will use the terms cybernetics and information theory more or less interchangeably because they are when seen from the history of the idea of information. However, it is important to acknowledge fundamental differences between information theory and cybernetics. Information theory proper proposed by Claude Shannon is mainly an engineering theory of communication (Nahin 2012). Cybernetics proper proposed by Norbert Wiener and others is a general system theory (Galison 1994; Hagner/Hörl 2008; Kline 2015; Rid 2016). For a comprehensive overview on the history of the concept of information as developed by information theory and cybernetics see Aspray 1985; Lash 2002; Day 2008.

information. Cybernetics and information theory have enabled us to envision the transgression of boundaries between humans, machines, and animals. But they also allowed a new understanding of humans as informational beings. This cybernetic reformulation has important consequences to this day. Tellingly, Nafus and Sherman (2014, 1792) conclude that self-tracking is ultimately about making sense of oneself by collecting and processing information. Self-trackers establish a relation to their true self by help of information—information, in other words, allows them to become subjects in the first place. This indicates a profound transformation of how subjects are able to relate to truth and it presupposes the emergence of what I will call an informational regime of truth in which the feedback of information becomes the measure of truth. Accordingly, the subjects of these practices are not cyborgs or posthumans but *informed subjects*.

To bring this argument forward, I will proceed in three steps: *First*, contrary to usual readings of Haraway and Hayles, I will show how both understand contemporary subjectivity to be essentially characterised by information. Both acknowledge the central role of information—as proposed by cybernetics and information theory—for understanding the present. However, both ultimately take information as a prerequisite of any contemporary form of theory or politics and appropriate it for their own ends. This rereading of Haraway and Hayles allows me, *second*, to analyse genealogically how information and subjectivity have been linked in the tradition of cybernetics. To engage with this question, I use Michel Foucault's concept of 'regimes of truth'. Foucault introduced this concept to think of different ways in which truth may be produced. For example, the institution of confession is not just an ecclesiastic regime of power but also a specific regime of truth that produces a certain (in this case, moral) truth about the subject. Similarly, we may use Foucault's concept to analyse the relation between subjectivity and information as a specific informational regime of truth that evolved with information theory and cybernetics after World War II. Indeed, the specific relation of information, subjectivity, and truth can be traced back to the earliest texts of cybernetics. *Third*, to elaborate on this idea and show how it presently gains momentum, I will discuss the phenomenon of self-tracking. Self-tracking exemplifies the main characteristics of informed subjectivity: it fundamentally relies on the assumption that information is a way to manifest truth about the self. Self-trackers are subjects that gain their status as subjects through the feedback of information—they establish a relation to truth by constituting themselves as information systems.

By returning to the very roots of the debates about cyborgs and posthumans we may be able to actualise Haraway and Hayles's assumption that cybernetics and information theory play a fundamental role in the history of the present. However, it is important to acknowledge that any attempt to appropriate the cybernetic and information theoretic narrative may today be in vain. We have—in a sense—become thoroughly cybernetic subjects enclosed in a world where the use of information technology is ubiquitous and inevitable, where, as Richard Brautigan dreamed in 1967, we are 'all watched over by machines of loving grace'. Our best hope is to critically return to the beginning of the

cybernetic narrative. And for that, we need to first understand where and why Haraway and Hayles decided not to pursue the question of subjectivity as a critique of cybernetics and the concept of information itself.

### Donna Haraway, Cyborgs and a Critter Called Information

Donna Haraway's famous cyborg is a hybrid subject not made up of one substance. A cyborg is a mixed being that fundamentally relies on prostheses to be able to act, speak and think.<sup>[2]</sup> Obviously, someone who is relying on a cardiac pacemaker can be understood as some kind of cyborg, since she needs a machine to survive and ceases to be an autonomous human subject. We could also think of a typewriter or a computer as a prosthesis that enables us to speak or think in a certain way. The figure of the cyborg provides a perspective on the ways in which subjects essentially rely on things outside of themselves to be subjects. Cyborgs are at once expressions of technological progress and timeless, they provide an understanding of the subject of the present and an ontological understanding of the human condition in general. William Mitchell (2003, 39), following Haraway, characterises himself as a cyborg in this way:

So I am not a Vitruvian man, enclosed within a single perfect circle, looking out at the world from my personal perspective coordinates and, simultaneously, providing the measures of all things. [...] I construct and I am constructed, in a mutually recursive process that continually engages my fluid, permeable boundaries and my endlessly ramifying networks. I am a spatially extended cyborg.

Mitchell's stance perfectly illustrates the ontological understanding implied by the figure of the cyborg. Following Mitchell, humans are not and never were clearly bound entities in time and space but rely on things outside of themselves to be subjects in the first place. In this regard, humans are essentially cyborgs. However, when Haraway in her famous *Manifesto for Cyborgs* declares the "cyborg is our ontology" (Haraway 1991, 150) she explicitly makes a twofold argument.

The first argument is strategic. One reason her manifesto was greeted with so much attention and enthusiasm can be found in the strategic potential she ascribes to the cyborg. Before Haraway's intervention, the growing power and ubiquity of technology was in most cases simply read as a form of domination by critical theorists and feminists. Herbert Marcuse in his *One Dimensional Man* clearly saw technology as a process of domination (Marcuse 2013 [1964], foreshadowed in Marcuse 1941), as did ecological and green feminists who found refuge with the idea of paganism and harmonious relations with nature. Haraway disagrees and suggests we may likewise see the cyborg as a figure of liberation. If cyborgs have indeed become our ontology, we can—at the very least—utilise their hybridity to question the concept of the male, liberal subject. For Haraway, cyborgs articulate the potential to enact new social relations.

The second—and more important—argument of her *Manifesto* is historical. What enables Haraway's strategical argument is a specific account of the

[2] Especially in her later works, Haraway loses interest in the question of the melding of humans and machines and focuses primarily on the relation between humans and animals, or what she calls 'companion species' (Haraway 2003, 2007, 2016).

history of the present. If cyborgs are our best chance to produce new social relations, they actually have to become the 'last resort' of politics. Accordingly, Haraway describes the cyborg as "the two joined centres structuring any possibility of historical transformation" (1991, 150). In this regard Haraway somewhat accepts the analysis of critical theory of technology as dominance and simply opts for a strategic appropriation. She both accepts the idea of domination associated with the cyborg and its liberating potential:

From one perspective, a cyborg world is about the final imposition of a grid of control on the planet, about the final abstraction embodied in a Star Wars apocalypse waged in the name of defence. [...] From another perspective, a cyborg world might be about lived social and bodily realities in which people are not afraid of their joint kinship with animals and machines, not afraid of partial identities and contradictory standpoints. (Haraway 1991, 154)

Her strategic point therefore relies on the historical assumption of a technologically dominated world inhabited by cyborgs.<sup>[3]</sup> Even though the idea of humans as hybrid subjects may be understood as timeless—and, certainly, is understood so by Mitchell and many others—Haraway herself does not frame the cyborg ahistorically. Especially in her works on the epistemic shifts in the discipline of biology, she presents a story on how the cyborg came about.

Haraway analysed and criticised how sociobiology, as well as other life sciences, incorporated cybernetics and information theory in their studies. Between 1955 and 1970 the famous sociobiologists Stuart Altmann and Edward Wilson established cybernetic discourses in their field and by this changed the way we think about the social life of animals. "Biologies of animal behavior", Haraway asserts, "were deeply transformed in this complex process; it was all a question of the reproduction of communication" (Haraway 1981, 246). Altmann and Wilson basically theorised life as "essentially a military/game problem, in which the organism became a complex cybernetic device characterized by its communications functions" (249). In this regard, the newly established paradigm was "highly political—it produced", Haraway goes on to argue, "a discourse about and technology for the exercise of power as domination by producing particular kinds of objects of knowledge; i.e., command-control systems ordered by the probabilistic rules of efficient language and work, information and energy" (246). Haraway ultimately reads cybernetics as a new technology of power which treats machines, humans, and all living organisms as command-control systems ordered by the communication of information. In this cybernetic view humans, machines, and animals are basically the same—they are systems radically open to the exchange of information.

The concept of the cyborg accepts the cybernetic view of the human and utilises it for specific ends. Haraway's cyborg does not fight the cybernetisation of the world but tries to appropriate its positive aspects. In so doing Haraway concedes that humans actually are constituted by the control and communication of information. In order to utilise the cybernetisation she has to accept that humans are thoroughly informational beings.

"Cyborgs have to do with this interesting critter called information", Haraway

<sup>[3]</sup> A few years before the *Manifesto* Haraway opted for a more 'naturalist' solution in her paper *Signs of Dominance* where she argued it may be now "historically possible to craft a nature not structured by principles of dominance and practices of domination, to know something other than the natural order of command-control systems" (Haraway 1983, 197). Interestingly, she here understands nature to exist of command-control systems but sees the possibility to craft another nature that does not rely on these cybernetic fundamentals.

therefore concludes in an interview with Nicholas Gane, “and you really can’t treat that ahistorically—as if ‘information’ refers to something existing all the time, everywhere. That’s a mistake because you don’t get at the ferocity and specificity of now” (Haraway/Gane 2006, 146). Information is a historically contingent concept but that does not mean we can easily escape its grasp. “This is not”, she insists,

a relativist position. This is about those objects we non-optionally are. Our systems are probabilistic information entities. It is not that this is the only thing we or anyone else is. It is not an exhaustive description but it is a non-optional constitution of objects, of knowledge in operation. (139)

The cyborg is the historical product of the informationalisation of the world performed by cybernetics, information theory, and computerisation. Irritatingly, even though critical towards cybernetisation, Haraway ultimately accepts this idea of information as non-optional and develops her figure of the cyborg from this historical vantage point without trying to undermine the validity of the cybernetic and information theoretic assumptions. Still, what constitutes the cyborg is not hybridity but this interesting ‘critter’ called information.

### **Katherine Hayles, Posthumans and Bodies of Information**

Katherine Hayles analyses this ‘critter’ called information in her version of the posthuman. For her, the ‘human’ was the specific subjectivity of the industrial age, of steam, manufacturing, and mass production; the ‘posthuman’, by contrast, is the specific subjectivity of the computer age, of silicon chips, micro-electronics, and robotic factories. Hence, “the posthuman appears when computation rather than possessive individualism is taken as the ground of being” (Hayles 1999, 34). The posthuman is produced by interaction with machines and is open to encounters with machines. It is defined by its relation to technology—a relation not of domination but of interaction and mutuality (Hayles 2005, 243).<sup>[4]</sup> Posthumanism urges us to accept this new subjectivity and search for its critical potentials. Hayles—as Haraway—and likely for the same reasons, embraces the potential of posthumanism in decentering the disembodied, liberal, male subject (see Kroker 2012).<sup>[5]</sup>

It is important to acknowledge that Hayles’s version of posthumanism is primarily a critique to naïve or overly enthusiastic versions of the posthuman. Her main concern with this ‘other’ version of posthumanism is the “illusion of erasure” (Hayles 1999, 28) of the body performed by ideological notions of information. While we—following Hayles—should embrace being posthuman in a certain sense, we should likewise be careful not to reproduce these ideological notions. “If my nightmare”, she warns us,

is a culture inhabited by posthumans who regard their bodies as fashion accessories rather than the ground of being, my dream is a version of the posthuman that embraces the possibilities of information technologies without being seduced by fantasies of unlimited power and disembodied immortality (5).

<sup>[4]</sup> On the discussion about posthumanism see Badmington 2004; Braidotti 2013; Herbrechter 2013; Wolfe 2010.

<sup>[5]</sup> Hayles criticises Haraway for neglecting the technological question of the cyborg and the posthuman in her later works (Hayles 2006). With the focus on companion species, Hayles argues, Haraway loses sight of the more crucial question of the computational era.

The main problem when engaging with the idea of posthumanism is that we may be tempted to think of human subjectivity as essentially informational. Hayles explicitly states that her main concern with most approaches to posthumanism is that they accept an immaterial version of subjectivity. She is not interested in questioning cybernetics or information theory in itself (12). She wants to write the story of how information lost its body—of how we came to accept the idea that information is “a kind of bodyless fluid that could flow between different substrates without loss of meaning or form” (XI). For her, this ideology of information is problematic because it devalues the body and allows for a disembodied view of the posthuman.

Hayles is especially put off by the ideas of an artificial intelligence researcher and transhumanist called Hans Moravec. In his influential 1988 book *Mind children* Moravec suggested it may one day be possible to upload subjectivity into a computer or robot in order to gain immortality. “A kind of portable computer (perhaps worn like magic glasses)”, he writes,

is programmed with the universals of human mentality, your genetic makeup, and whatever details of your life are conveniently available. It carries a program that makes it an excellent mimic. You carry this computer with you through the prime of your life; it diligently listens and watches; perhaps monitors your brain and learns to anticipate your every move and response. Soon it can fool your friends on the phone with its convincing imitation of you. When you die, this program is installed in a mechanical body that then smoothly and seamlessly takes over your life and responsibilities. (Moravec 1988, 110f.)

For Moravec, subjectivity is simply an informational pattern computers may one day be able to reproduce. Like any information, subjectivity may be transferred to a different medium without loss (from brain to memory, from body to machine). From a feminist perspective this disembodied view of information is nothing short of an updated version of the liberal, male subject, feminist theory disposed of. Hayles here claims, as did Friedrich Kittler or Marshall McLuhan, that we cannot think of information apart from the medium that is used to communicate it. While she does criticise the idea of subjectivity as bodyless information, she also accepts that we cannot escape computerisation and the disruption caused by cybernetics and information theory. She believes “that our best hope to intervene constructively in this development is to put an interpretive spin on it” (Hayles 1999, 49).

Hayles concludes that information is a problem we have to criticise when understood as a bodyless fluid abstracted from the bodily reality. But at the same time she does not question information theory and the concept of information itself, she does not critique the cybernetic assumptions about humans being merely very complex forms of information systems. Instead, she develops an embodied version of the posthuman and ultimately a better version of cybernetics. Yet, if we have indeed become posthuman the task at hand may not be to formulate a better version of cybernetics. Rather, the task is to begin to understand how these posthumans—we apparently are—are constituted and what role cybernetics and information theory play in this

process apart from ideological notions of bodyless information.

In a paper from 1987—one year before Moravec laid out his dream of informational subjectivity—Hayles asserted that the “first, and perhaps the most crucial, move in the information revolution was to separate text from context” (Hayles 1987, 25). In order to be quantifiable, the idea of information had to neglect the meaning of a message. Information measures the amount of information of a message not its ‘level’ of meaning or its social relevance. Subsequently, Hayles interprets this separation as one of text from context, or as she later puts it, immaterial information from embodied reality. For her, information theory and cybernetics allowed separating text from context, information from meaning, patterns from embodied reality. However, it is not primarily the separation itself we should be concerned with. What is interesting about Moravec is not that he reframes subjectivity as bodyless information and separates subjectivity from embodiment. More importantly, information for him ultimately allows the articulation of a true version of subjectivity unrestrained by bodily needs. By separating text from context cybernetics first of all introduced a new relation to truth.

### **Towards an Informational Regime of Truth**

What Haraway and Hayles both assert but not further analyse is, indeed, a very profound insight: information is a historically contingent concept whose introduction into scientific debate after World War II caused a fundamental disruption. The transformation cybernetics brought about were so radical that—for them—it seemed pointless to try to question this transformation itself. Instead, both tried to strategically appropriate the informational discourse for other ends—this is precisely the function of the theories of cyborgs and posthumans. Regrettably, in so doing they essentially accept and reproduce the fundamental assumptions of cybernetics and information theory about the world being fundamentally structured by the communication of information. As I indicated in the beginning, we may be able to avoid this reification by analysing cybernetic subjectivity from the perspective of ‘regimes’ or ‘games’ of truth. What does that mean?

In his later work Michel Foucault drops the terms of power-knowledge-relations (Foucault 1995, 1998) in favour for the concept of ‘regimes’ or ‘games’ of truth (Foucault 1987, 1988). In his lecture *On the Government of the Living* Foucault reminds us that in Descartes’s famous ‘I think, therefore I am’ “between the ‘I think’ and the ‘I am’, you have a ‘therefore’ that is theoretically unanswerable” (Foucault 2014, 98). If ‘I think’ is the articulation of a certain truth, and ‘I am’ is the subject’s pledge to be bound to this truth, then ‘therefore’ stands for the moment of submission to the truth. Hence, Foucault translates the Cartesian ‘I think therefore I am’ as: “It is true, therefore I submit” (96). In this reading of Descartes’ proposition it is not truth itself that is interesting, but the act of submission allowing truth to manifest. Foucault argues, it is not because of some external power that I am bound to a certain truth (i.e. Descartes literally forcing me to adhere to his *ego cogito, ergo sum*). Likewise, I am not bound to a certain truth by



truth itself (i.e. I do not submit just because it is true, even though Descartes claimed exactly that). Following Foucault, I am bound to the truth at the moment that I am constituting myself or have been invited to constitute myself as a *specific* subject. The ‘therefore’ between the ‘truth’ and the ‘I submit’ introduces a fundamental political problematic into the question of knowledge. For Foucault, truth is always the truth of a specific subject. This subject is by its subjectivation—by its becoming a subject—bound to this truth. Something may only meaningfully be considered as true to the extent that there is a subject who is for some reason or other bound to it. For Foucault, truth and the production of subjectivity are two sides of the same coin, and the concept of regimes of truth translates this insight for historical analysis.

Foucault gives the illuminating example of a logician who submits to a certain truth. In logics, and in science in general, the submission to truth seems to stem from truth itself (because it is true). The logician and the scientist seemingly submit to the truth of science because it is true. Yet, Foucault argues, it is not because of the truth of a certain proposition that the logician submits to it. He submits to it because “he is doing logic, that is to say, because he constitutes himself, or has been invited to constitute himself as operator in a certain number of practices or as a partner in a certain type of game” (98). The logician doesn’t submit to the truth of logics because it is true (although he might believe that it is), but because and insofar as he constitutes himself as the subject of logics. So when the logician is saying ‘this is true, therefore I submit’ he is enacting the truth of logics by becoming the subject of logics.

The logician can only be a logician insofar as he submits to the truth of a set of knowledges and therefore constitutes himself as a subject in a specific game. The truth of logics has to be manifested by a subject according to a specific set of rules, which are not part of the truth of logics itself, but of a regime of truth that binds subjects to a specific truth. A regime of truth, then, is “the set of processes and institutions by which, under certain conditions and with certain effects, individuals are bound and obliged to make well-defined truth acts” (94). Foucault urges us to analyse how and why subjects are able to speak the truth in a specific historical situation. The underlying question is: What had to happen that this particular truth could be articulated by this particular subject? In that effect: What had to happen that information became a way for subjects to manifest truth?

### **Behaviour and Purpose: A Brief Genealogy**

In 1948 Norbert Wiener famously wrote, that “information is information, not matter or energy” (Wiener 1961, 132). Information, he—and cybernetics in general—claimed, is a distinct reality, and to understand this reality is to undertake the “general study of communication and the related study of control in both machines and in living beings” (Wiener 1950, 2). Analysing how systems communicate and process information for cybernetics meant to analyse how the world actually works—information is the central concept that made cybernetics possible. In the same year Claude Shannon, the founding father of information science, declared that information had nothing to do with

meaning by famously claiming that the “semantic aspects of communication are irrelevant to the engineering problem” (Shannon 1948, 379).[6] For information theory and cybernetics, information was henceforth understood to be an objective and quantifiable measure and its study was deemed crucial for the understanding of the world.

What cybernetics and information theory introduced was not just an objectivist and abstract idea of information which Hayles rightly criticises as ideological. What cybernetics from its first articulations as a science presented was a new—and for many scandalous—understanding of subjectivity. One of the core assumptions of cybernetics is that when seen as systems, humans, animals, and machines are basically the same: all of them communicate and process information. For cybernetics, humans are very complex systems of communication indeed, but systems nevertheless. While this was a very shocking assumption, it was not the only and maybe not the most important reformulation of subjectivity cybernetics undertook. Another reformulation is already apparent in the 1943 paper *Behavior, Purpose, and Teleology* by Arturo Rosenblueth, Norbert Wiener and Julian Bigelow. This paper retrospectively received the status as *the* foundational paper of cybernetics (Mead et al. 1976, 33; Bowker 1993, 109). It presents a ‘cybernetical’ solution to the age-old problem of purpose by defining it as a form of behaviour that relies on the feedback of information.[7]

Rosenblueth et al. introduce the concept of purpose in order to classify behaviour. They define behaviour very broadly as any “change of an entity with respect to its surroundings” (Rosenblueth et al. 1943, 18). First, they distinguish active from passive behaviour. Active behaviour is, secondly, distinguished into purposeless and purposeful behaviour. “The term purposeful”, they argue, “is meant to denote that the act or behavior may be interpreted as directed to the attainment of a goal. [...] Purposeless behaviour then is that which is not interpreted as directed to a goal.” (18) For Rosenblueth et al., purposeful behaviour has a very important characteristic that distinguishes it from other forms of behaviour: it relies on negative feedback. “All purposeful behavior may be considered to require negative feedback. If a goal is to be attained, some signals from the goal are necessary at some time to direct the behavior.” (19) This suggests that purposeful behaviour relies on signals from the goal or the environment to control the behaviour and direct it at the goal. A clock can thus be understood to be purposeless, since its behaviour is not directed towards the attainment of a goal and it does not rely on feedback from its surrounding for its behaviour. While a clock may have a purpose for someone, Rosenblueth et al. argue, it is not an intrinsically purposeful mechanism. By contrast, a thermostat can be understood to behave purposeful. It’s behaviour (the regulation of the temperature in a room) is directed towards a goal (a selected temperature) and relies on feedback from its surrounding (the actual temperature of the room) for its behaviour. A cat chasing a mouse may also be understood as purposeful behaviour on part of the cat, since the cat relies on feedback from its goal (the mouse) in order to reach its goal—to catch the mouse (20). Purpose here is generally reframed as behaviour that relies on feedback from its goal to attain that goal. Without the feedback of information,

[6] Contrary to this, in an influential commentary on Shannon’s paper Warren Weaver asserted it will only be a matter of time before the problem of meaning is solved mathematically (Weaver 1949). The philosophy of information is trying to handle this complicated relation of information and meaning ever since (see i.e. MacKay 1969; Dretske 1981; Floridi 2013).

[7] Both, feedback and information, were concepts without any substantial significance before cybernetics. On the history of the concept of feedback that is omitted in my paper see especially Bröckling 2017, 197ff.

behaviour cannot be purposeful.

When Rosenblueth et al. made this proposition in 1943 many people considered it outlandish, some found it fascinating—and gathered to conduct what later were called the ‘Macy Conferences on Cybernetics’ (Pias 2016)—but most scholars didn’t notice. It was only after the surprising success of Norbert Wiener’s 1948 book *Cybernetics* that the journal who originally published the paper of Rosenblueth et al. printed a harsh reaction by a philosopher named Richard Taylor, a response by Wiener and Rosenblueth, and eventually a final reply by Taylor. This debate provides a highly instructive account of what was actually at stake in this reframing of purpose. And it allows us to reconstruct what this reframing meant for the relation of subjectivity and information.

Taylor’s reaction first of all shows a latent astonishment about the apparent significance and popularity of what he considers a mechanistic and mostly absurd appropriation of the classical philosophical concept of purpose. Therefore, he insists “that the term ‘purpose’ as thus used, bears no similarity whatever to the meaning which is ordinarily attached to it” (Taylor 1950a, 310). Taylor argues that Rosenblueth et al. actually reduce purpose to observable behaviour and therefore allow not just humans, but animals and machines, to be purposeful. While he admits in his final reply to Rosenblueth and Wiener’s response that observable behaviour is probably “the best evidence we can have” (Taylor 1950b, 328) about the purpose of an agent, he asserts that only humans should count as purposeful beings. In order to behave purposeful, he says, we need to assume that the object in question does not just display purposeful behaviour but also possesses the ability to desire and believe. Rosenblueth and Wiener ferociously concluded their response by insisting that their “main reason for selecting the terms in question was to emphasize that, as objects of scientific enquiry, humans do not differ from machines” (Rosenblueth/Wiener 1950, 326). This is precisely what Taylor finds disturbing. While he is eventually not at odds with the research programme laid out by Rosenblueth et al., he strongly argues against the core assumption of cybernetics, namely, that as systems which communicate information animals, machines, and humans are basically the same.

This debate obviously foreshadows a whole strand of humanistic criticism towards cybernetics that sees humans reduced to machines. Seen from the cybernetic point of view, the exclusivity of human subjectivity is lost and what counts as subjectivity becomes an open question. This is precisely where Haraway, Hayles, and other theories enter the picture and appropriate the cybernetic narrative for their own ends. But if we shift our focus from the rather distracting proclamations about the similarity of humans, animals, and machines, we see another way in which this early paper of cybernetics reframes the relation between the subject and information. Indeed, what is at stake here is not just a mechanistic reframing of purpose and an insult to human subjectivity similar to those formulated by Darwin and Freud (Bowker 1993, 111). This reframing also implies a whole new ‘economy’ of truth centred around the idea of information. Taylor already suspected this in his critique as he was baffled what actually led Wiener and Rosenblueth to their conclusions. “Apparently”, he wondered, “the authors utilize here an

unnamed criterion of purposiveness.” (Taylor 1950a, 314) They indeed did. Because what eventually allowed them to undertake this reformulation of purpose was information, a wholly different measure of truth.

### Cybernetics and the Informed Subject

“All purposeful behavior”, Rosenblueth et al. argued, “may be considered to require negative feed-back.” (Rosenblueth et al. 1943, 19) In other words, action can only have a purpose if information is at some point ‘fed back’ into the action itself in order to steer it towards the goal. Consequently, we should judge action based on whether it relies on information or not. Another way to put this is to say that purposeful behaviour should be understood as *informed behaviour*. However, regarding subjectivity the question of purposeful behaviour may also be understood more generally as the question of true behaviour or true action. In terms of subjectivity we are generally interested in behaviour that is in some way purposeful or intentional and not accidental. Information in this regard becomes the measure of true behaviour, since whether behaviour is truly purposeful, is decided by it being informed or not. Rosenblueth, Wiener, and Bigelow’s point is not just that the communication of information is the central element for understanding the world. Information is a new way to decide the truth of behaviour.

The radicality of this idea becomes clear when we return to Taylor’s critique on Rosenblueth, Wiener, and Bigelow. His perspective shows a fundamentally different way to decide the truth of purposeful behaviour. In his last reply to the debate, Taylor lays out his own conception of behaviour. As said before, Taylor argues that we cannot assume any entity to act purposeful without granting it desire and belief. Desire and belief are features of human subjectivity that cannot be dissolved in information and separated from the human body. Taylor admits that with desire and belief he may invoke “dubious or occult entities” (1950b, 331) but posits that “everyone knows perfectly well, in one clear sense, what it is to desire something” (332) and that there is thus “nothing at all dubious or occult about them” (332). Taylor utilises what we could call a humanistic regime of truth were the truth of purposeful behaviour is deeply connected to human reason hidden somewhere in the human body. Since we cannot assume a clock to desire and we cannot reasonably assume a cat to believe, purposeful behaviour remains a fundamentally human matter. The truth of action here is ultimately decided by the presence of the human body and our acknowledgement that its presence likewise implies the presence of such ‘occult and dubious’ entities as desire and belief. The truth of action for Taylor resides hidden away in human reason, as a matter for philosophers and psychoanalysts to discover.

When asked about the significance of the paper of Rosenblueth et al., Gregory Bateson enthusiastically recalls how he and his former wife Margaret Mead immediately thought that it “was a solution to the problem of purpose” reminding us that from “Aristotle on, the final cause has always been a mystery” (Brand et al. 1976, 33). Instead of invoking some occult and dubious entity of desire or belief to explain purposeful behaviour, Rosenblueth et al. simply

declare all behaviour that relies on negative feedback as purposeful. A purpose can only be pursued when an entity relies on feedback from its environment and the goal it wants to achieve. Purpose is not a mystery hidden away in human consciousness. It is a form of behaviour that relies on information. Importantly, this implies that information and not reason, or the presence of human bodies, becomes the measure of truth. For Taylor the question of purposeful behaviour was ultimately decided by the presence of desire and belief in human bodies. This is exactly what Rosenblueth, Wiener, and Bigelow put into question. The truth of behaviour is “recognizable from the nature of the act, not from the study of or from any speculation on the structure and nature of the acting object” (Rosenblueth/Wiener 1950, 323). With cybernetics, the problem of truth generally becomes a problem of information.

This does not sound as outlandish today as it did for Charles Taylor and others in 1950. As the example of self-tracking in the next part will show, today we would basically agree that our actions and decisions are based on information, and we would assume that how we act and decide depends on the information we gather and process. To assume that true action or true behaviour depends on information seems almost arbitrary today. This indicates a very fundamental transformation. Cybernetics did not merely question the boundaries between humans, machines, and animals. It also reformulated truth into a problem of information. This informational reformulation envisions a specific procedure for the production of truth through feedback of information as we have seen in the case of purpose. Foucault described a regime of truth as “types of relations that link together manifestations of truth with their procedures and the subjects who are their operators, witnesses or possibly objects” (Foucault 2014, 100). The informational regime of truth reframes truth as the product of procedures of feedback of information between entities and their environment. This regime envisions subjects as operators as well as objects that are restrained by relations of feedback of information. The truth-value of actions—as seen in the example of purpose—but also of propositions in general depend on procedures of feedback of information, not on the existence or presence of human consciousness, belief, or desire. In Foucault’s words the procedure of feedback of information acts as a ‘therefore’ in the sentence ‘this is true, therefore I submit’. The procedure envisioned by cybernetics as negative feedback of signals stands between the manifestation of truth (‘this is true’) and the subjects pledge to be bound to this truth (‘I submit’). This procedure is not part of the truth itself, but it is the condition that enables subjects to manifest truth as information. What the informational regime of truth does is to restrain the manifestation of truth to subjects who essentially consider themselves information systems. In order to ‘see’ the truth in a piece of information or data, subjects have to become informed subjects, subjects that relate to truth by feedback of information.

We could therefore conclude that cybernetics introduced not just a general theory of systems, but from the very beginning put forward a theory of subjectivity. Ronald Kline has asked why there are so few cyborgs in the history of cybernetics. In his reconstruction Kline shows that while today we tend to believe that cybernetics was always about cyborgs and posthumans,

in actual fact early and also later cybernetics was not overly interested in the merging of humans and machines (Kline 2009, 351). Cyborgs became the iconic subjectivity of cybernetics only by help of Haraway and Hayles's popularisations. While this is an important point and certainly true, this does not imply that cybernetics did not put forward a concept of subjectivity. Rather, this proves that the characteristic form of cybernetic subjectivity is not that of cyborgs or posthumans, but of *informed subjects*. What characterises this form of subjectivity is not its openness to meld with machines and animals, and not its potential to transcend the humanistic version of subjectivity. The informed subject is the subject for which the feedback of information has become the procedure to manifest truth.

### From Quantified Selves to Informed Subjects

To elaborate on this idea, it is instructive to look at the recent phenomenon of self-tracking. As we have seen in the beginning, self-tracking is usually understood as the collection and use of information on the own body and habits with the help of small wearable computers and sensors. These computers for example record your number of steps taken, monitor your heart rate, log your location, log if you're standing or sitting and help you to monitor your moods or your weight. What this practice produces is some kind of informational double of the self. This double is used to improve or change the behaviour of the actual self, which is why self-tracking is generally understood and sometimes criticised as a tool of optimisation, as Minna Ruckenstein (2014, 69) pointed out:

With the aid of digital technology, particularly the tracking and monitoring of the self, optimization becomes not only possible, but also desirable. It is not enough to have a more transparent view of oneself, one needs to respond to that knowledge and raise one's goals, thereby framing the 'natural' body as incomplete, as failing the demands and potentials of the information age. With new data streams, the body may be increasingly controlled by reason; it can be transformed and improved in order to attain happiness and excellence.

This is an important point, especially when considered as a practice of neoliberal conduct of the self or a subtle way to discipline labour (Moore/Robinson 2016). However, there is something more peculiar about the practice of self-tracking.

When people set out to improve their selves by the help of self-tracking, they assume this practice gives them an insight into themselves that could not be gained through deliberate reflection. Self-tracking is assumed to allow an insight into what Phoebe Moore calls the "autonomic self" that was before "seen to be largely out-of-bounds for the layman and woman's knowledge and understanding" (Moore 2018, 2). In this regard, self-tracking is sometimes even considered a practice of emancipation that allows access to the true self and therefore helps to counter attempts of 'formal' authorities like the state and 'informal' authorities like the family to impose false identities to the self

(O'Hara et al. 2008, 165). The informational double is taken as a glimpse at the true self, and this glimpse is utilised to optimise the actual self or to defend it against attempts to impose false identities on the self. In this sense, self-tracking is a practice not of optimisation or self-surveillance but of truth.

This is a crucial point. One way to assess this is obviously to look at the history of quantification and try to explain why people put so much trust in numerical representations of the world—Joseph Porter called this the ‘calculative’ or ‘quantitative’ mentality (Porter 1995, 118; also Mau 2017). As communities grow bigger and more anonymous, it becomes more practicable to rely on impersonal, quantified accounts of the world instead of people and their personal evaluation. It is, in other words, easier to trust an universalised representation in the form of numbers than to trust someone you do not know and may never hope to meet. While this holds true, it is—as Porter (1995, ix) himself pointed out—a rather weak argument when it comes to truth and does not explain why people actually think of these numbers as *true* representations of the world. Yet, self-tracking shows that people indeed assume numbers and graphs about their steps taken, or moods logged to be manifestations of their true self. It may help to see that it is not the numbers and quantified representations of the world themselves that manifest truth, but the whole procedure cybernetics introduced as negative feedback of information. The quantified representations produced by computers through self-tracking are considered to be true, because in the procedure information is collected and fed back into the system. As Rosenblueth, Wiener, and Bigelow argued, feedback of information is a way to decide whether behaviour is purposeful, and thus, whether it manifests truth.

Let us, then, return to Michael, the self-tracker with whose account we started out with. In their study, Nafus and Sherman were especially interested in how he understood the role of self-tracking in his life. Michael, they write (2014, 1789),

uses a Buddhist framework of mindfulness and awareness to describe the role that data plays in his life. Tracking introduces purposefulness and intention into his everyday actions ('so I don't go on autopilot' he says). For him, data is a technology of noticing, not that different from the Buddhist meditation practices he draws on, which are not just about calming the mind but about taking note of what is going on inside the body.

While this sounds somewhat like new age mythology, there is a rational core to Michael's approach when considered from the idea of an informational regime of truth: what the constant feedback of information actually establishes in his daily life is a relation to truth. He assumes that self-tracking allows his actions to become purposeful actions. The idea of feedback as a relation of truth is evident in self-tracking, “in which people knowingly and purposively collect information about themselves, which they then review and consider applying to the conduct of their lives” (Lupton 2016b, 2). The idea of optimisation is grounded in the belief that the information that is fed back by the devices actually shows the true self. And it is by applying the information back into

their daily actions—to guide their behaviour—that it becomes true or proper behaviour. Self-tracking has effectively turned Michael into an informed subject.

## Conclusion

In the early 2000s the American military agency DARPA funded a program called *LifeLog*. This program essentially foreshadowed the practice of self-tracking as it envisioned the total capture of information about someone's life (in DARPA's version primarily for military purposes). Myriads of sensors were pictured to track all raw and metadata available: location, heart rate, breathing, video, images, sound, written words, conversations, credit card information, e-mail messages, phone calls, and so on. The program which was officially discontinued in 2004 had the goal to comprehensively gather "both the flow of the user's physical experiences in the world and the stream of his or her interactions with other entities in the world" (DARPA 2003). The idea of *LifeLog* was to gather all information available and to allow computers to make sense of them in ways that humans could not. The ultimate aim was to find a way to accomplish the process of automatically "telling the story" of the user's experience" (DARPA 2003). However, this automatic story should not be confused with the story the user tells himself. It is another story, one that is true because it is manifested in information. The *LifeLog* is astonishingly similar to Moravec's ideas about gaining immortality through information without the transhumanist vigour. In both cases, the underlying idea is the total capture of information for the production of a true version or story of yourself. Still, in all cases the question remains: Why should anyone engage in self-tracking or lifelogging if not for the underlying assumption that information allows a relation to truth?

*LifeLog* and self-tracking in general are thought to address a difficult problem: "how individuals might capture and analyze their own experiences, preferences and goals" (DARPA 2004). Therefore, self-tracking is usually understood as a kind of advanced diary helping people remember what they experienced or thought. While this is somewhat correct, it is generally overlooked that self-tracking presupposes a wholly different regime of truth. When we write in a diary and after some time read our entries to remember or evaluate what we thought or did last month we consider the locus of truth to be, as Taylor argued, our conscious and unconscious desires and beliefs. We are then practically engaging in a sort of self-psychoanalysis. When we engage in self-tracking we do not seek to understand our desires or beliefs, we want to gain access to the truth about ourselves manifested immediately in the form of information in relations of feedback. Truth is, then, not established by the conscience looking at itself. It is established by the introduction of feedback of information into the equation. The informational regime produces an immediate, deictic relation to truth.

It is important to insist on the central role of information in the production of truth and to frame the characteristic subjectivity of information theory and cybernetics as informed subjectivity. This is important not merely because it may be a more adequate description of cybernetic subjectivity and the



specific regime of truth cybernetics introduced. More importantly, to frame the problem in this way allows a different form of critique. If we stick with the notions of cyborgs and posthumans, the example of self-tracking may be recognised as either being about the melding of machines and humans or about the use of information technology to transcend the humanistic subject. But self-tracking is not about merging, and it is not primarily about transcending or optimisation. It articulates a fundamental shift in how we think about truth and how we rely on notions of information and feedback in the constitution of truth in general. The problem is not the widespread use of computers, and the collection and processing of information. The problem is the underlying idea that all of this somehow allows us to establish a relation to our true selves or gives us a glimpse at the true world.

The practice of self-tracking may allow specific forms of emancipation from ‘imposed’ identities, and it may allow everyday behaviour that seemed arbitrary and meaningless to become purposeful. But the price for this is the comprehensive integration of the subject into the cybernetic world of information systems. The entities Taylor called ‘occult and dubious’ also indicated that the humanistic subjectivity was something unpredictable and, ultimately, indeterminable. This is precisely the quality the informed subject loses as its very thoughts and actions become a transparent matter of the feedback of information, and computation takes the place of imagination. The informed subject is a calculable subject—a subject whose thoughts are predictable, and whose actions are always already integrated into the proper relations of feedback. Freed from indeterminable desires and beliefs, the informed subject leads a life of joyous integration governed by relations of feedback of information.

Why are, then, we tempted to say ‘this is true, therefore I submit’ when we consider information or data? To think about it this way urges us to be critical about the ways in which we rely on information, data, and relations of feedback as seemingly neutral ways to manifest truth. After all, cybernetics had a clear and simple message that has successfully penetrated scientific and everyday discourse: We are basically information machines. What enabled this assumption has not disappeared when cybernetics lost its hegemonic appeal in the 1970s. We still rely on information—the central conceptual innovation of cybernetics. And this brings with it a specific subjectivity and a specific procedure for the manifestation of truth. We need to start asking whether we really want to be informed subjects, ultimately a kind of advanced thermostat, controlled by the feedback of information, enmeshed in a world of communicating systems—or if we’d rather be something else. What Haraway and Hayles indeed showed is that Taylor’s humanistic version is no alternative. But this should not tempt us to be satisfied with the answer cybernetics provided.

## References

- Aspray, W. F. (1985) The Scientific Conceptualization of Information: A Survey. In: *Annals of the History of Computing* 7(2): 117–140.
- Badmington, N. (2004) *Alien Chic Posthumanism and the Other Within*. London: Routledge.
- Bowker, G. (1993) How to Be Universal: Some Cybernetic Strategies, 1943-70. In: *Social Studies of Science* 23(1): 107–127.
- Braidotti, R. (2013) *The Posthuman*. Cambridge; Malden: John Wiley & Sons.
- Bröckling, Ulrich. 2017. *Gute Hirten führen sanft. Über Menschenregierungskünste*. Berlin: Suhrkamp.
- DARPA (2003) *BAA # 03-30 LifeLog Proposer Information Pamphlet*. [https://web.archive.org/web/20030603173339/http://www.darpa.mil/ipto/Solicitations/PIP\\_03-30.html](https://web.archive.org/web/20030603173339/http://www.darpa.mil/ipto/Solicitations/PIP_03-30.html) (14/09/2018).
- DARPA (2004) *LifeLog Program*. <https://web.archive.org/web/20041210022133/https://www.darpa.mil/ipto/Programs/lifelog/index.htm> (14/09/2018).
- Day, R. E. (2008) *The Modern Invention of Information: Discourse, History, and Power*. Carbondale: Southern Illinois University Press.
- Dretske, F. I. (1981) *Knowledge & the Flow of Information*. Cambridge: MIT Press.
- Floridi, L. (2013) *The Philosophy of Information*. New York; Oxford: Oxford University Press.
- Foucault, M. (1987) The Ethic of Care for the Self as a Practice of Freedom: An Interview with Michel Foucault on January 20, 1984. In: *Philosophy & Social Criticism* 12(2/3): 112–131.
- Foucault, M. (1988) (Auto)biography. Michel Foucault. 1926-1984. In: *History of the Present* 4(Spring): 13–15.
- Foucault, M. (1995) *Discipline & Punish: The Birth of the Prison*. New York: Vintage.
- Foucault, M. (1998) *The Will to Knowledge. The History of Sexuality Vol. 1*. London: Penguin Books.
- Foucault, M. (2014) *On the Government of the Living: Lectures at the Collège De France, 1979–1980*. Basingstoke: Palgrave Macmillan.
- Galison, P. (1994) The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision. In: *Critical Inquiry* 21(1): 228–266.
- Hagner, M; Hörl, E. (2008) (eds.) *Die Transformation des Humanen. Beiträge zur Kulturgeschichte der Kybernetik*. Frankfurt a. M.: Suhrkamp.
- Haraway, D. J. (1981) The High Cost of Information in Post-World War II Evolutionary Biology: Ergonomics, Semiotics, and the Sociobiology of Communication Systems. In: *The Philosophical Forum* 13(2/3): 244–278.
- Haraway, D. J. (1983) Signs of Dominance: From a Physiology to a Cybernetics of Primate Society. In: *Studies in History of Biology* 6: 129–219.
- Haraway, D. J. (1991) A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century. In: Haraway, D. J. *Simians, Cyborgs, and Women: The Reinvention of Nature*. New York: Routledge: 128–149.
- Haraway, D. J. (2003) *The Companion Species Manifesto: Dogs, People and*

- Significant Otherness*. Chicago: The University of Chicago Press.
- Haraway, D. J. (2007) *When Species Meet*. Minneapolis: University of Minnesota Press.
- Haraway, D. J. (2016) *Staying with the Trouble: Making Kin in the Chthulucene. Experimental Futures*. Durham: Combined.
- Haraway, D. J.; Gane, N. (2006) When We Have Never Been Human, What Is to Be Done? Interview with Donna Haraway. In: *Theory, Culture & Society* 23(7–8): 135–158.
- Hayles, N. K. (1987) Text Out of Context: Situating Postmodernism Within an Information Society. In: *Discourse* 9: 24–36.
- Hayles, N. K. (1999) *How We Became Posthuman. Virtual Bodies in Cybernetics, Literature, and Informatics*. Chicago: University of Chicago Press.
- Hayles, N. K. (2005) *My Mother Was a Computer. Digital Subjects and Literary Texts*. Chicago: University of Chicago Press.
- Hayles, N. K. (2006) Unfinished Work: From Cyborg to Cognisphere. In: *Theory, Culture & Society* 23(7/8): 159–66.
- Herbrechter, S. (2013) *Posthumanism*. New York: Bloomsbury.
- Kline, R. (2009) Where are the Cyborgs in Cybernetics? In: *Social Studies of Science* 39(3): 331–362.
- Kline, R. (2015) *The Cybernetics Moment: Or Why We Call Our Age the Information Age*. Baltimore: Johns Hopkins University Press.
- Kroker, A. (2012) *Body Drift: Butler, Hayles, Haraway*. Minneapolis: University of Minnesota Press.
- Lash, S. (2002) *Critique of Information*. London; Thousand Oaks: Sage.
- Lupton, D. (2016a) Digital Companion Species and Eating Data: Implications for Theorising Digital Data-Human Assemblages. In: *Big Data & Society* January–June: 1–5.
- Lupton, D. (2016b) *The Quantified Self*. Cambridge; Malden: Polity.
- MacKay, D M. (1969) *Information, Mechanism and Meaning*. Cambridge: M.I.T. Press.
- Marcuse, H. (1941) Some Social Implications of Modern Technology. In: *Studies in Philosophy and Social Science* 9(3): 414–39.
- Marcuse, H. (2013 [1964]) *One-Dimensional Man. Studies in the Ideology of Advanced Industrial Society*. New York: Routledge.
- Mau, S. (2017) *Das metrische Wir. Über die Quantifizierung des Sozialen*. Berlin: Suhrkamp.
- Mead, M; Bateson, G.; Brand, S. (1976) For God's Sake, Margaret. In: *The CoEvolution Quarterly* Summer: 32–44.
- Mitchell, W. J. (2003) *Me++: The Cyborg Self and the Networked City*. Cambridge: MIT Press.
- Moore, P. (2018) *The Quantified Self in Precarity: Work, Technology and What Counts*. London: Routledge.
- Moore, P.; Robinson, A. (2016) The Quantified Self: What Counts in the Neoliberal Workplace. In: *New Media & Society* 18(11): 2774–2792.
- Moravec, H. (1988) *Mind Children: The Future of Robot and Human Intelligence*. Cambridge: Harvard University Press.
- Nafus, D.; Sherman, J. (2014) Big Data, Big Questions. This One Does Not Go Up

- To 11: The Quantified Self Movement as an Alternative Big Data Practice. In: *International Journal of Communication* 8(June): 1784–1794.
- Nahin, P. J. (2012) *The Logician and the Engineer. How George Boole and Claude Shannon Created the Information Age*. Berlin; Boston: Princeton University Press.
- O'Hara, K.; Tuffield, M; Shadbolt, N. (2008) Lifelogging: Privacy and Empowerment with Memories for Life. In: *Identity in the Information Society* 1(1): 155–172.
- Pias, C. (2016) (ed.) *Cybernetics. The Macy Conferences 1946-1953. The Complete Transactions*. Zürich; Berlin: diaphanes.
- Porter, T. (1995) *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*. Princeton: Princeton University Press.
- Rid, T. (2016) *Rise of the Machines: A Cybernetic History*. New York: Norton.
- Rosenblueth, A.; Wiener, N (1950) Purposeful and Non-Purposeful Behavior. In: *Philosophy of Science* 17(4): 318–326.
- Rosenblueth, A.; Wiener, N.; Bigelow, J. (1943) Behavior, Purpose and Teleology. In: *Philosophy of Science* 10(1): 18–24.
- Ruckenstein, M. (2014) Visualized and Interacted Life: Personal Analytics and Engagements with Data Doubles. In: *Societies* 4(1): 68–84.
- Shannon, C. E. (1948) The Mathematical Theory of Communication. In: *The Bell System Technical Journal* 27(3): 379–423.
- Taylor, R. (1950a) Comments on a Mechanistic Conception of Purposefulness. In: *Philosophy of Science* 17(4): 310–317.
- Taylor, R. (1950b) Purposeful and Non-Purposeful Behavior: A Rejoinder. In: *Philosophy of Science* 17(4): 327–332.
- Weaver, W. (1949) Recent Contributions to the Mathematical Theory of Communication. In: Shannon, C. E.; Weaver, W. *The Mathematical Theory of Communication*. Urbana: University of Illinois Press: 1–29.
- Wiener, N. (1950) Cybernetics. In: *Bulletin of the American Academy of Arts and Sciences* 3(7): 2–4.
- Wiener, N. (1961 [1948]) *Cybernetics or, Control and Communication in the Animal and the Machine*. Second Edition. Cambridge: The M.I.T. Press.
- Wolfe, C. (2010) *What Is Posthumanism?* Minneapolis: University of Minnesota Press.