Chapter 11
Autonomy and Technology: From Instrumentalism to Technocomplexity

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Abstract In this chapter, we briefly present different visions of the relationships between technology and autonomy. We accomplish this by a historical and (partly) dialectical exploration of three positions. We start with the modern thesis by which autonomous humans instrumentalize tools and techniques for their own benefit and self-determination. Next, we address the antithesis: the notion that technological systems have become autonomous, subordinating people to their own self-maintenance. Finally, we explore a synthetic position, which underlines that the only space for autonomy in a technologically mediated world is a technopolitical autonomy that takes the individual beyond itself, back to the ontotechnical constitution of its being, and forward into a personal and collective, ethical and political, participation in its becoming.

Keywords Instrumentalism · Autonomy of Technology · Technopolitical Autonomy · Technocomplexity

11.1 Thesis. Technoinstrumentalism: Politics and Morality Subordinate Technique

Although the condition, practice and experience of autonomy may be traced back to early human societies, its western conceptualization derives from the ancient greek notion of αὐτονομία, composed of "*autos*" (self) and "*nomos*" (norm, rule). Etymologically, its meaning points to the capacity of creating, having or living by

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"one's own norm or law". Contrary to much contemporary understanding, in its original sense autonomy had a predominantly collective and political character because the self (*autos*) it primarily referred to was the city (*polis)*, which valued its self-determination against external powers. Meanwhile, technique (*tekne)* was a form of know-how, art, craft, or skill, perceived as a questionable complement to nature (*physis)* (Mitcham 1994, Epilogue). According to the Platonic version of the myth of Prometheus, fire and techniques were given to humanity to complement a human body lacking key survival capacities. But techniques had to be complemented, in turn, with justice (*dike*) and other virtues to ensure collective flourishing. More broadly, in Ancient Greece, techniques and technical work were symbolically and materially subordinated to philosophical and political life.

The concept of autonomy revived in the sixteenth century still with a political meaning. But during the seventeenth, the concept of sovereignty came to occupy its place on the political field, and autonomy shifted towards a moral and personal understanding, associated with debates concerning freedom of conscience (Rosich 2020). This process culminated in the eighteenth century in the work of Immanuel Kant. For Kant, human freedom and morality are grounded in the subject's ability to discover a categorical imperative and align its will with it, not as a vassal adhering to an extrinsic rule (heteronomy), but as a rational, universal legislator capable of identifying, sanctioning, and following an endogenous, universal norm (Kant 1998).

These transformations correlated with social, cultural and technical changes. The late medieval and early modern rise in relevance of mechanical arts had convinced Francis Bacon that science and arts were key instruments for salvation, commanded by God to be deployed to control nature, rather than to complement it occasionally as suggested by the ancient greeks. The scientific revolution (associated to a centuries long accumulation of new artifacts such as mechanic clocks, the printing press, microscopes, or telescopes) saw the world itself as a machine regulated by universal laws, a clockwork built by a clockmaker God that could be measured and controlled by a science that correctly read, and increasingly tinkered with, the mathematical book of nature.

This vision culminated in the Enlightenment and utilitarianism, and bequeathed a position that is part of our common sense nowadays: technological instrumentalism (or technoinstrumentalism). From this perspective, techniques and artifacts (progressively tied to science, which would ultimately bring about modern technology[1]) are instruments, axiologically neutral and controlled means to achieve predefined ends. In the early days of the industrial revolution, the modern narrative went beyond Bacon and suggested that the "God hypothesis" was no more necessary (as stated by Laplace), humanity had reached its majority of age (according to Kant), and humans were tool-making animals (as claimed by Benjamin Franklin) ready to save themselves. Humans were becoming autonomous moral subjects able to control and transform a mechanic, axiologically neutral world by means of increasingly powerful and axiologically neutral knowledge, artifacts, and techniques.

[1] Etimologically, the term "technology" emerged from a combination of *tekne* and *logos,* understood as systematic discourse or rationality.

Etymology is revealing: *instrumentum* comes from *in*, "inside", *struere*, "to gather together", and *mentum*, a "means" for something. What grants instruments their ontological status is human intentionality in designing and producing them (Baker 2004). The designer is thereby central. But the focus of modern instrumentalism is even more on the side of the user and its relation to technology. Technological instrumentalism enshrines de vision of "the master" and "the tool": a powerful and amoral human holding a basic type of artifact (Winner 1978). An *instrumentum* is then understood as a means that can be set inside a course of action to contribute to control and ensure the achievement of its ends (i.e.: the transformation of goals into results) without altering its orientation. That orientation depends primarily on factors such as foresight, interpretation, and evaluation. So, instruments are supposed to affect the subject's capacity to perceive and act (usually, to increase it) but not warp its thought, its will or its identity. Humans must become more autonomous thanks to technology. As a corollary, when morality (and politics) are considered, good and evil, power and responsibility, lie exclusively with the autonomous subject, its decisions and uses. These are some of the key tenets of technological instrumentalism, a "common sense view" in contemporary societies.

11.2 Antithesis. Technoautonomism: Technology Subordinates Morality and Politics

An antithetic conception of technology, technological autonomism (or technoautonomism) emerged at the end of the 18th century, rose during the 19th, and peaked between the 50s and 70s of the 20th. It can be traced from the foundational myth of Frankenstein (a modern and careless Prometheus) to Chaplin's Modern Days or the unstoppable war systems of Dr. Strangelove. A milestone within this trajectory is the work of Karl Marx, who, at the peak of the industrial revolution, reconceived the relations between technology and autonomy, be it moral or political. Marx considered techniques and artifacts as forces of production (along factors such as human labour or raw materials) that operate as key drivers in the production and reproduction of society. In correspondence with those forces emerge specific relations of production, such as property relations, which constitute the "economic base" of society. In turn, a social superstructure, including the political and the moral realms, is constituted and acts back upon such a foundation. "The hand-mill gives you a society with the feudal lord; the steam-mill a society with the industrial capitalist" (Marx 1976, p. 166), he sentenced. For Marx, political and moral autonomy are socioeconomically grounded in material conditions defined by labour and technology, as well as the struggles around them. In capitalism, technologies are a means for and a chrystallization of the accumulation of capital. Under the control of the capitalist class, technologies are incorporated (as fixed capital, dead labour) into a system of exploitation that alienates workers, who in the factory become "a living appendix" of a "lifeless mechanism" which they themselves have created (Marx 1906, pp. 461–462). Capital

and the capitalist class become autonomous (although surely not independent nor separate), labour and workers become heteronomous, while alienating technologies codify such situation, since they are subordinated to the former to subordinate the latter.

A century later, Jacques Ellul went beyond Marx in prioritising technology as a key sociohistorical factor and conceiving it as autonomous and value laden,[2] definitely turning the instrumentalist vision upside down. A long tradition had addressed the momentum, as well as the unanticipated, unintended or undesired consequences of technological systems, which defy instrumentalist optimism concerning both technology and human capacities for foresight, choice, or control (Winner 1978). But Ellul (1964) went beyond that in suggesting we live in a "technological society" where all rationalities, including the economic, are subordinated to a technical rationality defined by a drive for "absolute efficiency". Such technical rationality turns everything into a means and is unable to ponder ends. It subverts Kant's moral rationality, which sanctioned the role of human beings as autonomous, universal legislators. The Enlightenment's dream of instrumental reason (in Horkheimer and Adorno's terms) generated a modern monster, *la Technique* (no more the ancient *tekne*), a mass of methods, techniques, artifacts, forms of organization (e.g. bureaucracies, corporations), megasystems (e.g. chemistry, electricity, automotion, nuclear energy…) and their conditions (the means of the means) which, from 18th century onwards, have slowly become both material and normative conditions for modern society.

For Ellul, modern humans have willingly developed, and come to love and rely on, technological innovations and their benefits. However, the increasing number, scale, opacity, interdependency, interconnection and interpotentiation of those technologies has not only entrenched and made the total ensemble difficult to change, but has increasingly made it self-generating, self-determining and self-augmenting; ultimately, the key force defining the evolution of society. Only selected social groups (technicians, scientists, etc.) know and understand parts of such an ensemble, but not even them can do much to redefine it. For Ellul, technology has become anthropomorphic (e.g. self-determining) because humans have become technomorphic, externally enframed by the whole ensemble and internally reconfigured by its drive for rational efficiency and optimization. In what Winner (1978) calls a "reverse adaptation", those forms and ends of human life that fit within the ensemble, succeed, and those that do not, wither away. With Ellul, the unbridled development of the arts and sciences, which Bacon saw as a way to overcome the original sin, becomes itself the original sin of modernity.

[2] Feenberg (1999) distinguished four key theories of technology: technological determinism (e.g. "traditional Marxism"), that conceives technology as autonomous (non-humanly controlled) and neutral (a means differentiated from ends); technological substantivism (e.g. Ellul), that conceives technology as autonomous and value-laden (a way of life that includes ends); instrumentalism, that conceives technology as humanly controlled and neutral; and, finally, critical theory of technology, which conceives technology as humanly controlled and value laden. This last position, which Feenberg defends, is connectable to our proposals in the synthesis section of this chapter. Meanwhile, technodeterminism and technosubstantivism are forms of what, in the current section, we are calling "technoautonomism".

Ellul stressed the autonomy of the technological ensemble at the macro-level, but others have attended to the micro-level of technical objects. Simondon (2017) provided arguments that allow to characterize technical objects as autonomous, as they develop through a process of concretization (functional and structural material integration), generating "evolutionary" lineages and essences that humans discover rather than create. In more Darwinian views, technical objects have been seen as units of evolution and humans as environments that select among them (Basalla 1988). Ironically, when technical objects become a systemic condition of society, there emerges the so-called "technological imperative", which demands not only to use them (as its most common understanding suggests) but also to adapt their environment (society and nature) to them to ensure their operation (Winner 1978). Against the Kantian categorical imperative, this new imperative seems to enshrine the growing autonomy of the technological and the heteronomy of the human. More recently, evolutionist leitmotivs can be found among authors such as Kurzweil (2005), who has crafted a history of the universe from the perspective of technical objects (specially, general artificial intelligence), culminating in a Technological Singularity where the human first recombines and then dissolves into an AI complex that grows and recrafts the whole cosmos. Less hyperbolic narratives also consider lower forms of AI and other technical objects (e.g. self-driving cars) as autonomous, mixing reality and myth in visions of humans either guided or substituted by machines (Bradshaw et al. 2013), in ways that sometimes recall debates on automation of the previous two centuries.

Finally, other analyses have attended to technological influence in psychological terms. Discussions about behavior-shaping technological environments have surfaced in contemporary behavioural economics and digital design, as in Eyal's (2014) guidelines for creating engagement or Thaler and Sunstein's (2008) concept of nudging as a design of the user's choice environment oriented to bring about a predictable change in behaviour. In this line, Zuboff (2019) denounced the rise of a surveillance capitalism where big digital corporations surveil and *surwill* (as labelled in Barandiaran et al. 2024; Calleja-López et al. 2018), that is, try to predict and shape users' behaviours to make a profit from it, thereby threatening moral and political autonomy. Ultimately, the "societies of control" heralded by Deleuze are defined by technologies oriented to shape the minds and habits of *dividuals* (the result of the datafication and decomposition of the modern individual) and their swarms (de la Torre et al. 2025).

All these philosophical views and historical processes have stressed the ascendancy and rule of technology (at various levels and in various forms, driven autonomously or by factors such as capital) over moral and political autonomy.

11.3 Synthesis. Technocomplexity: Reconstructing the Relations Between Technology, Morality, and Politics

Since the mid-twentieth century, different brands of cybernetics and their technologies, from servomechanisms to artificial life and intelligence, have focused on the integration of humanity and technology into increasingly complex and digitalized systems. Soon, the postmodern myth of the cyborg was born. Simultaneously, developments in paleoanthropology and philosophy went beyond Franklin's idea of the human as toolmaker and explored the relations of the human species and technology in terms of co-evolution and co-constitution: silex with cortex and hand (Leroi-Gourhan 1993), tools with language and sociopolitical norms (Birch 2021). Similarly, the extended mind thesis (Clark and Chalmers 1998) has gone beyond individualism and bio-centrism to highlight the role of technology in the constitution of the human mind, through dynamical relations that go from the sensorimotor (Pérez-Verdugo and Barandiaran 2023) to the institutional domain (Maiese 2026, this volume). Technologies are no more conceived as neutral instruments nor autonomous realities but as mediators in human-technology-world relations. These relations take a variety of forms –e.g. embodiment, hermeneutic, alterity, background (Ihde 1995), cyborg, composite (Verbeek 2008)– depending on which elements of the triad occupy the foreground or the background, resulting in different configurations of human interpretation, intentionality, action, and responsibility. Latour (2002, 2005) has suggested exploring the net-works of actants that, as quasi-subjects and quasi-objects, enter in a variety of associations to generate any form of self (*autos*), other (*allos*), and normativity (*nomos*). Going towards the spatial macroscale, Katheryne Hayles (2017) has examined global cognitive ecologies that entangle human and non-human actors in new collective forms of intelligence, decision, and action. Earlier, and still with modern undertones, Hans Jonas's (1985) "imperative of responsibility" to maintain genuine human life on Earth had widened the temporal and ecological horizons of analyses of technology. Together, these views contribute to a multiscalar ontological rethinking of autonomy (specially, of the *autos*) in the context of human-technology-world relations and human-and-non-human complexes and ecosystems; a third historical position that we may label "technocomplexity".

Bringing some of these insights into the field of morality, the ethics of design has mapped the variegated shaping of user behaviour –through coercion, decision, seduction or persuasion, depending on the strength and overtness of the influence– (Tromp et al. 2011). In the same line, it has questioned linear understandings of the influence of design intentions upon artefact utilisation by stressing the relevance of emergent and potentially unforeseen contexts of use (Albrechtslund 2007). Finally, as a complement, it has attended and proposed changes to the structural conditions of responsibility in design practice (Swierstra and Jelsma 2006).

But of more interest to us are political takes on technocomplexity. Langdon Winner convincingly argued that "artifacts have politics" and thereby connect to "ways of life". He showed that technologies are "politeia", "institutions in the making" that

bring about a "second constitution" of society beyond the political-legal one (Winner 1986, pp. 54–55). For this reason, he stressed the potential of experiments in participatory design, and reclaimed new political virtues for this purpose (Winner 1992). Shared critical reflection by designers and users has been demanded (Sengers et al. 2005) as a way to unearth, analyse, choose and operate upon hidden or unconscious factors (e.g. cultural values or biases) shaping technology and its relation to human life. Meanwhile, recent calls for community-centred and intersectional approaches to technological design (attentive to discriminations based on ethnicity, gender, class, ability or other factors, and inclusive of affected groups and their interests) look to ensure more socially just technological artifacts and systems (Costanza-Chock 2020). Complementarily, the reflections of Donna Haraway (2016) and others (Driessen 2014; Cabello et al. 2026, this volume) suggest that such interventions should be careful, response-able and inclusive of non-human living beings, opening to a more diverse *autos*. Along these newly included actors, a diversity of values and virtues may be incorporated into design and use, a widening of *nomos* opposed to the absolutism of technical neutrality, efficiency, and proficiency. This may also challenge capitalism as a regime of universal heteronomy where, as Marx diagnosed, any principle, practice, or value is tendentially subordinated to exchange value.

Against Bacon's technoinstrumentalist dream and Ellul's technoautonomist nightmare, this third position suggests that technology should not dominate or serve to dominate humans and non-humans (old modern society and nature). Instead, new democratic technopolitical forms may appropriately involve those humans and non-humans (and their interests, values…) in the detection and framing of problems, the formulation of potential responses and the choice between those responses (which may or may not call for technologies as the way to advance), moving to the moments of technological design, development, and deployment, as well as the monitoring and evaluation of impacts, iteratively. This implies to recognize and productively incorporate the various scales of *autos* and *tekne* mentioned above, from the nano to the megascale, in both spatial terms (from *dividuals* to human-and-non-human orders, from the local to the global) and temporal terms (past, present and future, from the fleeting instant to deep time). This position critically builds upon earlier ones also by exploring the shapes, possibilities, and limits of technical knowledge (foresight and transparency but also uncertainty and opacity), control (flexibility and participation but also technological momentum and breakdown), intentionality (planning and assessment but also unintendedness and reverse adaptation), and value (fairness and justice but also biases and power contexts).

Building upon ontological, moral and political technocomplexity, this third position points towards a descriptive and prescriptive, empirical and normative, transformation of the modern *logos* around *tekne*. As an example, this may imply reducing technological complexity by opting for various forms of small, appropriate, low or slow tech in specific situations, and opting for big, high, fast and still appropriate technologies in others. In both cases, such technological options should incorporate autonomy (in the expanded sense –moral, political, ecological…– that we are outlining) as an ongoing precondition and as an ongoing result, as a central

element in the complexes of principles and practices defining technological becomings. In digital societies built on top of multilayered stacks (of hardware, software, data, AI systems, etc.), to achieve this may require different cycles and forms of technopolitical democratization (Calleja-López 2021).

To sum up, the crucial form of autonomy in our technologically hypermediated world may be a recursive *technopolitical autonomy* that reflexively incorporates technocomplexity, taking the individual beyond itself, back to the ontotechnical and ecological constitution of its being, and forward into a personal and collective, ethical and political (careful, intersectional and mutispecific) participation in sociotechnical becomings. This is all to be considered at various scales, from concrete artifacts and people to wide megasystems and collectivities, with an orientation towards free, diverse and common forms of flourishing in the short, mid, and long term (Barandiaran et al. 2024; Chapter 5; Calleja-López et al. 2022, Sect. 5). New myths and makings will be necessary for such a struggle.

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