HUMAN-MACHINE COMMUNICATION

Human-Machine Communication
Volume 9, 2024
https://doi.org/10.30658/hmc.9.1

From Automation to Autonomy: Human Machine Relations in the Age of Artificial Intelligence

Caja Thimm[1], Gabriele Gramelsberger[2], Maximilian Mayer[3], and Frank Piller[4]

1 Media Studies and Intermediality at the University of Bonn, Germany
2 RWTH Aachen University, Germany
3 Center for Advanced Security, Strategic and Integration Studies (CASSIS), University of Bonn, Germany
3 TIME Research Area, RWTH Aachen University, Germany.

Abstract

The shift from automation to autonomy marks a new chapter in human-machine relations, especially in the context of the expanding and diversifying applications of Artificial Intelligence (AI). As machines gain capabilities that resemble autonomous agency, the boundary between human and machine autonomy blurs, challenging traditional concepts of agency, control, and independence. This special issue examines the multidisciplinary perspectives on autonomy in the digital age, addressing the complexities of attributing autonomy to machines and AI systems. Philosophical, sociological, and technical approaches converge to explore how emerging forms of machine autonomy impacts human agency, freedom, and decision-making, with applications spanning from autonomous vehicles to digital assistants and military drones. Central to this discourse is the growing tension between viewing autonomy as a positive attribute and the concerns about diminishing human authority in the face of increasingly independent technologies. By framing autonomy as a

Funding Acknowledgments: Caja Thimm and Maximiliaan Mayer gratefully acknowledges funding by the transdisciplinary research area on Individuals, Institutions and Societies (TRA 4) of the University of Bonn.

Frank Piller gratefully acknowledges funding by the German Research Foundation (DFG, Deutsche Forschungsgemeinschaft) under Germany's ExcellenceStrategy—EXC-2023 Internet of Production—390621612.

CONTACT Caja Thimm • thimm@uni-bonn.de • Media Studies and Intermediality • University of Bonn • Regina-Pacis-Weg 3, 53113 Bonn, Germany

ISSN 2638-602X (print)/ISSN 2638-6038 (online)
www.hmcjournal.com

Copyright 2024 Authors. Published under a Creative Commons Attribution 4.0 International (CC BY-NC-ND 4.0) license.

gradual, relational, and attributional concept, the essays of this special issue aim to foster an integrated understanding of autonomy as both an individual and collective construct, reflecting the highly complex and quickly evolving nature of current societal, ethical, and technological challenges. Through contributions from diverse fields, the issue offers theoretical insights and empirical findings to better understand how AI systems reshape human-machine interactions and redefine autonomy within modern sociotechnical landscapes.

Introduction

The growing tendency to attribute autonomy not only to humans but also to machines and algorithms signifies a novel paradigm in both popular and academic perspectives on technology and its relationship with humanity, as evidenced by a growing body of research (e.g., Chiodo, 2023; Formosa, 2021; Gramelsberger, 2020; Prunkl, 2022; Rubel et al., 2021). The term autonomy has rapidly evolved into a metaphor for the detachment of technology from the realm of human control, used ubiquitously and, at times, even excessively. Particularly noteworthy is its usage in the ongoing transformation of the communicative relationships between humans and machines, a change that has become increasingly pronounced in recent years. The term *machine* in this context encompasses not only tangible physical objects, but also the diverse new software applications enabled by Artificial Intelligence (AI). This perception shift is largely driven by computer science and cognitive science, which, from a technicist perspective, label so-called intelligent, self-learning algorithms or purportedly self-governing robots as *autonomous*. While machines are generally characterized by some automatic properties, a key feature of these advanced machines is their unprecedented ability to act increasingly autonomously and cognizant through (digital, and increasingly AI-based) processes of self-control and self-learning (Chen et al., 2022).

When placing the term autonomy within the context of the current debate on the technologization of everyday life, it is often associated with positive qualities such as independence and self-direction. At the same time, it also evokes fears of overly powerful technologies and the corresponding diminishment of human authority and control. As the emerging tension between the power of humans and those of machines has increasingly been evaluated and characterized by an increase or loss of *autonomy* for humans, the old fears of the competitive machine have resurrected (Brynjolfsson, 2023), some even see the *bad machine* endangering human culture and morals (Köbis et al., 2021). Many argue, for instance, that self-determined technologies will become a crucial touchstone for mankind, in particular, in automated warfare (Ernst, 2019; Scharre, 2018).

This special issue is animated by the observation that in spite of the proliferation of semi-autonomous and autonomous systems, we are confronted with a lack of comprehensive approaches that integrate insights about shifting human-machine relations from the humanities and social sciences, with those of technical disciplines. The contributions to this special issue represent a first attempt to open up the discussion across disciplines, by including a curated selection of papers that present diverse, heterogeneous, and sometimes conflicting perspectives on the issues and intersections of human and machine autonomy.

Multidisciplinary Perspectives and Understandings of Autonomy

A central articulation of the idea of autonomy, originally rooted in Enlightenment and modern philosophical thought as referring to human free will and self-determined agency (Schneewind, 1998), is currently undergoing a significant resurgence. The notion of autonomy has migrated from disciplinary into interdisciplinary and multidisciplinary readings and interpretations. Beside the humanities and the social sciences, the term autonomy is widely used in economic, policy and legal contexts, computer science, and engineering. Particularly, ethical questions on the role of future machines, human mean over machines or, respectively, machine control over humans, are driving public and policy debates (De Sio & Van Den Hoven, 2018). Finally, marketing and advertising from large tech companies and startups alike use the term autonomy as a buzzword to promote AI-based products.

Of central interest in this debate is the emergence of so-called *autonomous systems*. Autonomous systems are observed in various domains, ranging from work to warfare, from health to transportation, and from individual actions to state-level operations, leading to a new and dynamic field of study on *machine autonomy* (Simmler & Frischknecht, 2021). This includes examining aspects such as machine autonomy in design and ergonomics (De Visser et al., 2018), the role of autonomous bots in journalism (Wu et al., 2018), robots designed for human well-being and caregiving (Calvo et al., 2020), or the implications of machine autonomy within the Internet of Things (Janiesch et al., 2019; Piller et al., 2022), the ethics of AI-enabled military drones (Brown, 2023), AI-enabled management approaches (Drukarch & Fosch-Villaronga, 2022) and the interplay of labor autonomy and automation in the AI industry (Steinhoff, 2021).

The conceptualizations of autonomy rooted in European philosophical traditions—from its use on Greek city-states to the philosophers of the enlightenment period—are increasingly challenged when applied to an expanding range of entities to which autonomy is attributed within diverse contexts. Looking at the rational autonomy of the individual (Kant 1785/2016), Kant's moral philosophy can be regarded as most influential. Inspired by Rousseau, Kant developed a concept of autonomy that put human freedom at the center stage. According to Kant, every object in space and time is subject to natural laws while only persons possess the capacity of acting in accordance with the idea of law (Kant, 1785, p. 412). This is based on the condition of reason and rationality: every person, and in general every rational being, exists as an end in itself, because it can understand and act due to reasoning (Kant, 1785, p. 428). Based on this line of thought, a widely shared understanding regards *autonomy as personal freedom* (Colburn, 2023; see also Formosa, 2013). This concept of autonomy not only continues to dominate discourses on democratic structures in the Western democracies, but also describes fundamental dispositions of humans in relation to their well-being. From that perspective autonomy can be defined as an idea that refers to the "capacity to be one's own person, to live one's life according to reasons and motives that are taken as one's own and not the product of manipulative or distorting external forces, to be in this way independent" (Christman, 2020, p. 1). Clearly, autonomy as such is a construct for the individual, but its actual manifestation also depends on the historical, social, and cultural circumstances in which people live and how they define their personal view of autonomy. How exactly the parameters for defining autonomy can be agreed on, however,

is highly controversial. Dworkin (1988, p. 6) pointed out that "about the only features held constant from one author to another are that autonomy is a feature of persons and that it is a desirable quality to have."

However, in today's understanding the attribution of autonomy to (technical) systems has formed entire new fields of research because autonomy is obviously no longer reduced to *features of a person* anymore. The previously accepted understanding that autonomy is only applicable to humans has been invalidated. This expansion of the concept and shifting reference object opens up new areas of research, while also presenting challenging theoretical issues, as attributing autonomy to objects, especially machines, significantly diverges from attributing autonomy to humans (Suchman & Weber, 2016). Machines, for one, lack the rationality and self-awareness that Kant attributes to human moral agents. Consequently, machine autonomy is, at least as seen by some, a distinct phenomenon from human autonomy. Others, however, attribute autonomy to machines in a comparable way and anticipate the "rise of the autonomous machines" (Liu & Gaudiot, 2022) or some form of equivalency such as "ought-to-be norms" (Laitinen & Sahlgren, 2021, p. 6).

Autonomy as a concept is also contested in other contexts and disciplines. Although originally mostly discussed in (moral) philosophy and ethics, autonomy has also long been a key concept of political theory (Foldvary, 2011). Within the realm of modern political theory, a central debate revolves around the paradoxical process of self-legislation (see Fischer, 2017). One of the questions pursued in this line of thought concerns societal organization: If individuals are granted freedom as autonomous beings, how can they maintain their freedom while being subjected to laws, even if these laws are self-imposed? This debate highlights an understanding of autonomy, wherein the relationship between freedom and law are intertwined, combining free will and binding regulatory obligations (Menke, 2010, p. 675). Consequently, this discussion frames issues such as the limits of state coercion, particularly when arguing against paternalistic laws and policies. The interplay of (self-) regulation and freedom presents itself as a dynamic dialectic of normativity and agency and has been framed through the concept of the "paradoxes of autonomy" (Khurana, 2013). The paradox of autonomy remains unresolved, which renders autonomy an ambiguous concept. At the same time, the preservation of citizens' autonomy is often seen as best protected by democratic procedures, as democracies are built upon the fundamental understanding of the autonomous individual and the freely expressed will of the people. When Lawless and Sofge (2017) asked "Autonomy and Artificial Intelligence: A Threat or Savior?" (likewise, Thimm & Bächle, 2018), it becomes clear that autonomy carries both a positive connotation of independence and self-directedness, as well as the fear of (overly) powerful technologies and the associated loss of human (or state) control (human vs. machine control).

In light of the expanding scope of autonomy attributions, multidisciplinary discussions articulate autonomy in the digital era in relation to technological trajectories of society. Highlighted by the comprehensive reviews by Chiodo (2023) and Ezenkwu and Starkey (2019), these contributions envision a future in which the traditional Kantian conception of autonomy appears to be diminishing in its applicability. Concurrently, discussions surrounding post-Kantian notions of autonomy refer to issues related to the attribution of autonomy to objects such as Voice Assistants (VAs), robots, weaponry, and vehicles. Yet, due to inconsistent ascriptions, the term *autonomy has evolved into a metaphor* for the intricate interplay between the human and technological realms, often devoid of precise

definition or adequate contextualization. So, the long tradition of studying human-machine relations in the social sciences and humanities (e.g., Suchman, 1987) would profoundly benefit from a shared interdisciplinary approach including ethics. As Laitinen and Sahlgren (2021, p. 1) point out, "it is relatively clear that AI technology can make a difference to the conditions of human autonomy and it would be surprising if the difference it makes could not be negative or positive."

Since at least the second half of the 20th century, the discourse on autonomy has been deeply intertwined with ethical debates and critical-emancipatory reflections (Gabriel, 2020). These debates encompass such diverse ethically contentious issues as the right to self-determined dying and the trustworthiness of autonomous systems (e.g., the reliability of an airplane autopilot). The associated debates about privacy and autonomy, furthermore, include the development of socially sustainable technologies, digital sovereignty of societies, universities, and social groups as well as the protection of informational self-determination of nation-states (see e.g., Bahr, 2024; Mayer & Lu, 2023), the risks of information-based individualization and discrimination (such as racial profiling), and issues related to intellectual property rights.

The current conflation of various interpretations and connotations of the term autonomy should not result in its reduction to a few specific application areas. Instead, we argue that this concept represents a framework for anticipating future societal developments centered around the evolving relationship between technology and humanity. In this context, the emerging field of "media and information ethics," which addresses both technical and societal phenomena, appears particularly well-suited to engage with this critical issue (Floridi, 2013). The debate on *digitality* also addresses fundamental philosophical debates, including the question of autonomy in the context of digital platform technologies and interconnected systems (Gramelsberger, 2023) and the implications for state sovereignty and societal autonomy in a world increasingly dominated by global technology stacks" (Bratton, 2016; Huang & Mayer, 2023).

One of the most captivating aspects of AI arises from its potential for humans in relation to their living experiences, communicating practices with and future expectations about machines. For instance, the idea of the *autonomous vehicle* is not only a semantic marker but also symbolizes future technologies in public perception (Kassens-Noor et al., 2021). For many, the concept of autonomous behavior in vehicles marked the initiation of a process wherein an expanding array of technologies gains the capability to surpass the faculties and competencies of human agents. This perception is reinforced by the practical observation that everyday human activities, traditionally characterized by social interactions among humans, are progressively entwined with seemingly intelligent technical objects and processes of post-human decision-making. Humans are assuming the role of *co-players* alongside technologies such as ChatGPT, Voice Assistants (e.g., Alexa), and various types of service robots. In essence, we are witnessing a notable and escalating shift in patterns of interpersonal interaction with technology, necessitating profound reflections and theoretical reconsiderations of the essential dynamics within human-technology relationships as well as empirical research for a more context-based understanding of agential roles of AI/machines (Prunkl, 2024). On a practical level, these challenges are being addressed through, for example, the adoption of new individual practices, adaptations of

institutional frameworks, and new regulatory policies for algorithms as well as for social robots at the national and supranational level (Gössl, 2023; Thimm & Thimm-Braun, 2024).

This discussion underscores how the concept of autonomy effectively captures essential aspects of the evolving hybridization and co-production dynamics between humans and technology (Chiodo, 2021; Gramelsberger, 2023; Thimm & Bächle, 2018). However, as an analytical term, autonomy requires greater conceptual clarity to fully realize its potential in future interdisciplinary research.

Toward a Multidimensional Understanding of Autonomy

The questions arising in the context of technologization and the changing relationship between humans and technology, or humans and machines (also evident from other perspectives, especially in robotics), should be understood as inter- and transdisciplinary puzzles. Philosophers, computer scientists, sociologists, and media scholars among others ask questions such as those formulated by Gransche et al. (2014, p. 9):

- What does autonomy mean in relation to humans and, for example, robots?
- What does it mean for a society to be increasingly intertwined with ever more *autonomous* technological systems?
- Does autonomous technology make humans more autonomous or the opposite?
- How could autonomous technology compensate for a loss of autonomy in, for instance, older or sicker individuals, and if so, under what conditions?

As mentioned initially, the broad application of the concept of autonomy has led to the development of highly diverse perspectives. The disciplinary differences are particularly pronounced. For instance, degrees of autonomy are specified, which are based on the self-activity of the technical system. On the one hand, the advancement of autonomous machines is considered an efficiency gain in certain societal subfields, such as the economy or warfare. On the other hand, the effects of this development on individual personal autonomy are viewed more pessimistically. The perception that powerful sectors of society possess autonomous machines can also lead to a general fear of the restriction of personal autonomy. Due to the entanglement and hybridization of humans, technology, and society, the criteria of the social can no longer be claimed exclusively as human under specific circumstances. Particularly in the 20th century, the status of technology has emerged as a critical field where the breaking points of social self-determination of humans in their environments are problematized. Autonomy is the defining problem concept in the contemporary debate on the social changes triggered by the advancement of Artificial Intelligence. It is notable that the discussion about so-called autonomous (media-)technical systems occurs at a time when media-theoretical and techno-sociological approaches largely reject or at least critically scrutinize the idea of autonomous or deterministic technologies (Dafoe, 2015; Smith & Marx, 1994; Wyatt, 2008). The problematic nature of adapting the term autonomy from its philosophical-historical context becomes apparent when considering its use in the technical repertoire of computer science or mechanical engineering, often narrowed down to straightforward questions.

In order to understand more precisely what autonomy could mean for the relationship between technology and humans, some dimensions should be differentiated. To assess and integrate different disciplinary viewpoints and methodologies and enable productive interdisciplinary conversations, our research starts from three shared theoretical premises that underpin the concept of autonomy:

(1) autonomy as gradual
(2) autonomy as relational
(3) autonomy as attribution

A core understanding of autonomy is that of *gradual autonomy*. As Rössler (2000, p. 146) points out, "autonomy always has to be conceptualized as being gradual, a matter of degree." Although autonomy is often seen as absolute, it is, in fact, a phenomenon with a gradual nature (Nagel, 2013). As Nagel aptly summarizes: "Autonomy should not be viewed as an all-or-none phenomenon" (2013, p. 60). Based on our key understanding as *gradual*, a baseline distinction reflecting on autonomy from a multidisciplinary approach is that between *automation* and *autonomy.* The observation that AI-related systems are becoming increasingly independent of human control, intervention, and action is often associated with a loss of human autonomy, or also referred to as a *zero-sum game* (Formosa, 2021; also Floridi & Cowls, 2022), referring to a new balance between the two: "The autonomy of AIs and social robots and the autonomy of humans are often seen as a zero-sum game: more autonomy for social robots by offloading decisions to them equals less autonomy for humans" (Formosa, 2021, p. 605). This requires a dual perspective of autonomy gains and autonomy losses that focuses primarily on humans as agents, but also sheds light on new roles and the agency of technology.

It is not surprising therefore that the properties of the concept of *autonomy* do not seem to be compatible with the technological understanding of *autonomous systems*, which is based on the functional premises of automation (Hepp et al., 2023). However, rapidly improving computational methods based on AI, such as the large language models underlying advanced chatbots, now offer the possibility of generating knowledge which is gradually emancipated from human control and influence. When it is no longer the programmers alone who inscribe desired action scripts into algorithms, but when the algorithms themselves are able to develop independent action and knowledge structures, the autonomous objects will become a new, nonhuman voice in the debate about future societies.

By adopting the view of *relational autonomy* we are taking up a line of research which regards autonomy as to be more inclusive of social and interpersonal dynamics, thus aligning an understanding of autonomy to broader issues of justice, collective recognition, and co-constitution of social or cultural practices (Baumann, 2008; Oshana, 2020). This interpretation of (human) autonomy also adopts feminist critique on traditional conceptions of autonomy in social relations (Campbell, 2022; Christman, 2020; Friedman, 2000). This approach emphasizes that as autonomous individuals we are dependent on recognition from others on an emotional level (respect, love, appreciation). According to this view, there is no autonomous subject or agent per se; rather, autonomy is to be seen as the effect of relationships that enable autonomous processes. "We are dependent on these social structures, but also on language or our bodies, in order to 'be' autonomous" (Rössler, 2021, p. 3, online). As a consequence, environmental structures have to be regarded as key conditions

of autonomy. This ties in with the paradoxical character of individual freedom restricted by rules, as explained by Khurana (2013). Certain freedom(s) have to be restricted, for example, by rules laid down in laws or societal norms, in order to ensure autonomy for the many.

Although relational conceptions of autonomy offer "a provocative alternative to traditional models of the autonomous individual" (Christman, 2020, online), they have been predominantly conceptualized for persons and their social relations with others. As the key focus here is the relation between a technological entity (*autonomous system*) and humans under the perspective of human and/or machine autonomy, an extended understanding of *relational autonomy* should include machines as objects as well as collaborative or even social partners (Schmidt & Loidolt, 2023).

As a third premise, we conceptualize autonomy as the outcome of attribution processes that can vary based on factors such as situational, functional, political, or personal contexts. Consequently, autonomy cannot be meaningfully assessed without considering these discursive influences. Rather, autonomy is employed for different purposes in different social and normative contexts, and in these different contexts it may be appropriate to set different thresholds for satisfying the conditions for autonomy (i.e., in the tech industry, (inter)national politics, care relations, or public discourse) (Wahlström, 2017). Attribution also influences individual attitudes toward autonomous systems. Studies examining how people perceive autonomy when interacting with AI-based applications have shown differences in perception and instances of reactance when participants felt their personal autonomy was threatened (Sankaran et al., 2021).

From Automation to Autonomy: Levels of Description

While the multidisciplinary approaches to autonomy discussed above may seem to pre-sent primarily theoretical challenges, it is important to remember that many practical and applied perspectives are also directly involved and require analytical attention. In fields like engineering and information science, the emphasis shifts away from human-centered considerations to focus instead on increasing levels of automation, which can be measured and experimentally observed (Schmitz et al. 2009; Sheridan & Parasuraman, 2005). In these disciplines, algorithmically *modeling autonomy* has become a productive practice of meaning-making that not only challenges the traditionally anthropocentric premises of the human condition, but also expresses a (historically constant) sociocultural desire to develop technology that reflects the human condition in behavioral practices or physical appearance. Broadly defined as the use of logical programming commands and mechanized equipment to replace the decision-making and manual command-response activities of human beings (Schmitz et al. 2009), this practice conceptualizes automation as a replacement measure for humans. Taking into account the models used in engineering or robot studies, the notion of control is at the heart of differentiating automation from autonomy (Chiodo, 2021; Rubel et al., 2021). Parasuraman et al. (2000) offer a detailed account of the types of control which define the degrees of *automation of the machines themselves* and the technical features, which lead to an assessment of a machine as autonomous, whereas De Visser et al. (2018) point to the role of trust and underline the role of attribution processes. Both in engineering or legal theory, a machine's level of autonomy is measured by its degree of dependence on

humans, meaning: the greater the machine's ability to observe, orient, decide, and act on its own in a dynamic environment, the greater its autonomy. Various concepts on how to differentiate automation from autonomy have been put forward in applied models (e.g., Marra & McNeil, 2012; O'Neil et al., 2020; Parasuraman et. al., 2000) and suggested differentiating dimensions to define the degree to which a machine is merely automated or truly autonomous. They give a detailed account of the types of control which define the degrees of *automation of the machines themselves* and the technical features, which lead to an assessment of a machine as autonomous.

One of the most influential models describing human-machine relations is the *human-in-the-loop model* (HITL). The HITL-model has received wide discussion in both technology (overview in Mosqueira-Rey et al., 2022), media and communication research (Calero Valdez & Ziefle, 2018; Dogruel & Dickel, 2022), legal studies (Enarsson et al., 2022; Marra & McNeil, 2012), medicine (Rainey & Erden, 2020), and social robot studies and human-robot interaction (Beer et al., 2015; Liu & Gaudiot, 2022). *In-the-loop* generally refers to control that is executed directly when an action is initiated, *on-the-loop* refers to systems whose actions can be prevented or aborted, and *out-of-the-loop* refers to systems that no longer require human control, but are (still) monitored by human agents. However, the notion of *in, on, and out-of-the-loop* is often misunderstood, as characterizing machine autonomy ex negativo by classifying the possibilities of human intervention in contrast to automation.

The further iterations of the model then reflect human, social-collective, systemic, and technological implications of a shared agency as well as a shared space of (hybrid) action (Suchman & Weber, 2016). The relationship between humans and autonomous systems became a key focus in the social sciences and humanities. An important elaboration on the HITL model was the extension to go beyond the micro-level injunction of keeping the human in the loop in order to include society as a controlling factor. Rahwan (2017, p. 1) proposed keeping *society in the loop* by implementing negotiation mechanisms between stakeholders with different value systems and expand the model from "HITL [human in the loop] to SITL [society in the loop]." Herrmann and Pfeiffer (2022, p. 1523) have called for "socio-technical extensions," by integrating organizations into the model. The authors argue that the integration of human and machine intelligence is achievable only if human organizations—not just individual humans—remain in control.

Special Issue Contributions—Overview

The evolving concept of autonomy encompasses both theoretical challenges and practical implications across multiple disciplines. From philosophical theories to legal considerations, and from engineering models to anthropomorphism, the discussion of autonomy reflects the complex interplay between human and technological realms. When ChatGPT and other LLMs entered the market and raised public awareness for AI, the notion of autonomy got even more momentum (Händler, 2022). These approaches result in a conjoint understanding of autonomy that needs to be analyzed, tested, and discussed in respect of contextual conditions. As introduced above, cognitive faculties, ethical challenges, interpersonal customs, political frameworks, and normative narratives of contemporary societies are reshaped within the parameters of a technological framework (Grunwald, 2022) and within evolving sociotechnical imaginaries (Jasanoff & Kim, 2015; Sartori & Bocca, 2023).

This special issue explores numerous theoretical puzzles and societal challenges emerging from the symbiotic relationship between humans and technology. It examines how the growth of autonomous systems is reshaping this relationship, deepening the socio-technical amalgamation, and fostering new forms of autonomy at the heart of modern society. The contributions capture diverse perspectives and highlight a range of conceptual and methodological approaches, showcasing the depth and complexity of examining autonomy within human-machine communication.

Opening the special issue with an interview featuring Lucy Suchman sets a distinct tone, as she differentiates her perspectives on autonomy as a fundamental aspect of humanity and explicitly distances herself from the concept of *machine autonomy*.

Bert Heinrichs and Roman Wagner ("Four Notions of Autonomy. Pitfalls of Conceptual Pluralism in Contemporary Debates") explore selected philosophical interpretations of autonomy, such as works by Frankfurt or Beauchamp, and contrast them with those advocating for the acceptance of conceptual diversity. They question the philosophical hegemony over the autonomy discourse and argue for its continued relevance particularly in multidisciplinary discussions. A different approach is offered by Anne Hoss ("Rethinking Autonomy in the Digital Age: Between Human Exceptionalism, Hybridity, and Conviviality"), who focuses on Ivan Illich's conception of autonomy in respect of *conviviality*. Hoss argues that Illich offers a distinctly relational perspective on the status of individuals in socio-technical environments by emphasizing the ideal of collaborative, amicable coexistence in a socio-ecologically balanced environment, which might even include newly imagined relationships between humans and machines.

Following one of the central defining categories for autonomy drawn up in the introduction, Hendrik Kempt, Camilla Colombo, and Saskia K. Nagel ("Human-Machine Relations and Relational Autonomy") discuss and analyze relational autonomy concepts. They describe the conditions and constraints under which humans can be considered autonomous within their social environments and the respective circumstances. The paper addresses the question, whether interactive and autonomous technology can become embedded in our relational contexts in a way that it is genuinely contributing to human autonomy, reflecting thereby on the desirability of such a development.

A very different perspective is taken by Andrew Prahl, Shanice Koh Jie Qing, and Justina Tan Ann Qi ("Wired to Offend: The 'Cancellation' of Artificial Intelligence"). They look at autonomy from a public discourse point of view and base their argument on the idea of the so-called *cancel culture* discourse. As an example of such cancellation discourse, they highlight an AI-based *Seinfeld* parody on Twitch. The authors argue that the intersection of cancellation culture and AI poses a challenge for future AI, especially as new AI systems increasingly exhibit human-like, perhaps even *autonomous,* behavior.

The paper by Corinna Peil and Ricarda Drueke ("Autonomy and Agency in Farming: Exploring Human, Machine, and Animal Dynamics") draws attention to an important sector of applied AI, agriculture, and animal farming. The interplay between agricultural labor, modern technologies, and the life of farm animals is reflected through the lens of automated systems. The authors see such technologies on the one hand as a great opportunity and support for daily work such as in the farming sector where tasks are often dull, dangerous, and dirty. But on the other hand, they point to the complexity of the integration of working practices, daily routines, and technologies, which by itself reshapes farming profoundly.

Another work-related context is addressed in Blake Atwood's contribution ("Between Autonomy and Automatization: Mapping Practices Among Syrian Delivery Drivers in Beirut"). The author looks at the individual expression of personal autonomy conflicting with the power of an algorithm. This conflict stems from the inherent tension between the personal expertise of local drivers on road conditions and the automatized recommendation system. The paper explores in detail how the drivers develop their own mental maps of the city of Beirut, alongside the app's navigational system, to assert their autonomy over the automated system. This paper offers a precise and detailed reflection on the role of human expertise in contrast to the assumed power of algorithms.

A comparable conflict is addressed in the paper by Zehui Yu, Lukas Otto, Dennis Assenmacher, and Claudia Wagner ("A Systematic Review of the Effects of AI-Assisted Moderation on Individuals and Groups"). The authors highlight the positive potential of autonomous systems and argue that automated systems could help to improve debate quality and decrease polarization on online platforms. In other words, automated moderation systems with different degrees of autonomy might provide a solution in an unclear, fragmented, large-scale online communication environment and, additionally, help adhere to legal requirements for removing harmful content from digital platforms.

One of the core types of machinery in the context of human-machine communication are robots. But so far, little is known about the way those (humans) who build them relate their products. The contribution by Yifan Xu and Elliott Hauser ("Accomplishing Robotic Autonomy: The Complexities of Sociotechnical Care and Agency in the Laboratory") takes a look into the production circle of robots and observes the (mixed) emotions toward their perceived autonomy. Applying the framework of *sociotechnical care* the authors uncover a very personal development process concerning the autonomy of *their* robots. Of particular interest is the exploration of the emotional and technical attachment that roboticists develop toward their creations, highlighting how even mundane activities such as repair and testing can assume personal and anthropomorphic dimensions.

The question, in which contexts and how humans can collaborate with machines, is at the core of the last two contributions. The paper by Jyrki Oraskari, Lukas Kirner, Marit Zöcklein, and Sigrid Brell-Cokcan ("Toward Human-Machine Collaboration in Autonomous Material Handling on Construction Sites") examines human-robot interaction (HRI) in the context of autonomous ground vehicles (AGVs) for transportation purposes on construction sites. The authors delineated four distinct scenarios for the integration of AGVs, namely *temporal separation*, *spatial separation*, *timeslot reservation*, and *no separation*. The paper illustrates each scenario's operational dynamics through a systematic analysis, evaluates the degree of autonomy achievable, and elucidates the communication patterns essential for effective human-robot collaboration.

The final paper by Iremnur Tokac Celikyay, Caja Thimm, and Sigrid Brell-Cokcan ("From Automation to Autonomy: Reconsidering Human-Robot Interaction in the Context of Design and Fabrication") adds an industrial view to the *Human-Autonomy Teamwork* (HAT) approach. The authors consider an interplay of human, robot, and material and describe three types of co-creation (human-robot, human-material, robot-material). Essentially the paper looks at the shift in digital fabrication from a linear to an iterative co-creation process through the interaction between humans and fabrication machines, such as industrial robots. The paper demonstrates how fostering human-robot teamwork in

the context of design and architecture can add important insights into the concrete communication needs and demands on both sides, humans and (robot) technology.

Author Biographies

Caja Thimm (PhD) holds a chair in Media Studies and Intermediality at the University of Bonn, Germany. She has done extensive research on social communication on the web, e-learning, and e-democracy and taught as a visiting scholar at UC Santa Barbara (USA), University of Cardiff (UK), and as a professeur invité at the Université de Bourgogne Dijon (France). She also served as a member of various political committees. She was head of the research program "Deliberation Online" (2010–2016) and is now coordinator and principal investigator of the collaborative research program on "Digital Society" (2017–2022).

https://orcid.org/0009-0004-3167-7038

Gabriele Gramelsberger (PhD) is Professor for Theory of Science and Technology at RWTH Aachen University. Her research topic is the digitalization of science, in particular the introduction of new research methods such as computer simulation and machine learning. In 2018 she founded the Computational Science Studies Lab at RWTH Aachen University. She is a member of the North Rhine-Westphalian Academy of Sciences and Arts and Director of the Käte Hamburger Kolleg "Cultures of Research"—an International Center of Advanced Studies for History, Philosophy, and Sociology of Science and Technology. She received the K. Jon Barwise Prize 2023 by the American Philosophical Association. Recent books: *Operative Epistemologie* (Meiner 2020), *Natures of Data* (Diaphanes 2020), *Philosophie des Digitalen zur Einführung* (Junius 2023).

Maximilian Mayer (PhD) is Junior-Professor of International Relations and Global Politics of Technology at the University of Bonn. His research interests include the global politics of science and technology; China's foreign and energy policy; global energy and climate politics; theories of International Relations. He is coeditor of *The Global Politics of Science and Technology* (2014, two volumes), *Art and Sovereignty in Global Politics* (2016), editor of *Rethinking the Silk-Road: Chinas Belt and Road Initiative and Emerging Eurasian Relations* (2018), coeditor of the *Routledge Handbook on Global China* (2024) and is currently leading the research group on "Infrastructures of China's Modernity and Their Global Constitutive Effects", funded by the Ministry of Culture and Science of the State of North Rhine-Westphalia.

https://orcid.org/0000-0002-1857-1413

Frank Piller (PhD) is a professor of management at RWTH Aachen University, where he also serves as co-director of the Institute for Technology and Innovation Management and as the academic director of the Executive Master of Business Administration (EMBA) program. His research interests include open innovation, managing disruptive change in established organizations, and the interaction of human and machine intelligence in creative settings. He is a principal investigator in the Excellence Cluster "Internet of Production" and the ERC Synergy project "SAFEr Grid." He obtained a doctoral degree from the

University of Würzburg and previously held positions at TUM, HKUST, and the MIT Sloan School of Management.

https://orcid.org/0000-0003-2532-4020

References

Bahr, A. (2024). Bridges without foundation? Why the use of AI tools in academia needs to build on ethics first. *FILOZOFIA, 79*(5), 486–500. https://doi.org/10.31577/filozofia.2024.79.5.2

Baumann, H. (2008). Reconsidering relational autonomy: Personal autonomy for socially embedded and temporally extended selves. *Analyse und Kritik, 30*(29), 445–468. https://doi.org/10.5167/uzh-27845

Beer, J. M., Fisk, A. D., & Rogers, W. A. (2014). Toward a framework for levels of robot autonomy in human-robot interaction. *Journal of Human-Robot Interaction, 3*(2), 74–99. https://doi.org/10.5898/jhri.3.2.beer

Bratton, B. H. (2016). *The stack: On software and sovereignty.* MIT Press. https://doi.org/10.7551/mitpress/9780262029575.001.0001

Brown, A. (2023). Ethics, autonomy, and killer drones: Can machines do right? *Comparative Strategy, 42*(6), 731–746. https://doi.org/10.1080/01495933.2023.2263333

Brynjolfsson, E. (2023). The turing trap: The promise & peril of human-like artificial intelligence. In *Augmented education in the global age* (pp. 103–116). Routledge.

Calero Valdez, A., & Ziefle, M. (2018). Human factors in the age of algorithms: Understanding the human-in-the-loop using agent-based modeling. In G. Meiselwitz (Ed.), *Social computing and social media: Technologies and analytics* (Vol. 10914, pp. 389–398). Springer. https://doi.org/10.1007/978-3-319-91485-5_27

Calvo, R. A., Peters, D., Vold, K., & Ryan, R. M. (2020). Supporting human autonomy in AI systems: A framework for ethical enquiry. In C. Burr & L. Floridi (Eds.), *Ethics of digital well-being* (pp. 31–54). Springer. https://doi.org/10.1007/978-3-030-50585-1_2

Campbell, S. A. (2002). Relational autonomy: Feminist perspectives on autonomy, agency, and the social self (review). *Hypatia: A Journal of Feminist Philosophy, 17*(2), 165–168. https://doi.org/10.1353/hyp.2002.0028

Caporael, L. R. (1986). Anthropomorphism and mechanomorphism: Two faces of the human machine. *Computers in Human Behavior, 2*(3), 215–234. https://doi.org/10.1016/0747-5632(86)90004-X

Chen, J., Sun, J., & Wang, G. (2022). From unmanned systems to autonomous intelligent systems. *Engineering, 12*, 16–19. https://doi.org/10.1016/j.eng.2021.10.007

Chiodo, S. (2021). Human autonomy, technological automation (and reverse). *AI & Society, 37*(1), 39–48. https://doi.org/10.1007/s00146-021-01149-5

Chiodo, S. (2023). *Technology and the overturning of human autonomy*. Springer. https://doi.org/10.1007/978-3-031-26159-6

Christman, J. (2020, June 29). Autonomy in moral and political philosophy. In *The Stanford Encyclopedia of Philosophy*. Retrieved October 5, 2023, from https://plato.stanford.edu/entries/autonomy-moral/

Colburn, B. (2023). *The Routledge handbook of autonomy*. Routledge. https://doi.org/10.4324/9780429290411

Dafoe, A. (2015). On technological determinism: A typology, scope conditions, and a mechanism. *Science, Technology, & Human Values, 40*(6), 1047–1076. http://www.jstor.org/stable/43671266

De Sio, F. S., & Van Den Hoven, J. (2018). Meaningful human control over autonomous systems: A philosophical account. *Frontiers in Robotics and AI, 5*. https://doi.org/10.3389/frobt.2018.00015

De Visser, E. J., Pak, R., & Shaw, T. H. (2018). From 'automation' to 'autonomy': The importance of trust repair in human–machine interaction. *Ergonomics, 61*(10), 1409–1427. https://doi.org/10.1080/00140139.2018.1457725

Dogruel, L., & Dickel, S. (2022). Die Kommunikativierung der Maschinen. *Publizistik, 67*(4), 475–486. https://doi.org/10.1007/s11616-022-00755-7

Drukarch, H., & Fosch-Villaronga, E. (2022). The role and legal implications of autonomy in AI-driven boardrooms. In B. Custers & E. Fosch-Villaronga (Eds.), *Law and artificial intelligence* (pp. 345–364). T.M.C. Asser Press. https://doi.org/10.1007/978-94-6265-523-2_18

Dworkin, G. (1988). *The theory and practice of autonomy*. Cambridge University Press. https://doi.org/10.1017/CBO9780511625206

Enarsson, T., Enqvist, L., & Naarttijärvi, M. (2022). Approaching the human in the loop: Legal perspectives on hybrid human/algorithmic decision-making in three contexts. *Information & Communications Technology Law, 31*(1), 123–153. https://doi.org/10.1080/13600834.2021.1958860

Ernst, C. (2019). Beyond meaningful human control? Interfaces und die Imagination menschlicher Kontrolle in der zeitgenössischen Diskussion um autonome Waffensysteme (AWS). In C. Thimm & T. C. Bächle (Eds.), *Die Maschine: Freund oder Feind? Mensch und Technologie im digitalen Zeitalter* (pp. 261–299). VS Verlag für Sozialwissenschaften. https://doi.org/10.1007/978-3-658-22954-2_12

Ezenkwu, C. P., & Starkey, A. (2019). Machine autonomy: Definition, approaches, challenges and research gaps. In K. Arai, R. Bhatia, & S. Kapoor (Eds.), *Intelligent computing* (pp. 335–358). Springer International Publishing. https://doi.org/10.1007/978-3-030-22871-2_24

Fischer, K. (2017). Das Paradox der Autonomie und seine Entfaltungen. Eine Urgeschichte politischer Liberalität. In C. Bumke & A. Röthel (Eds.), *Autonomie im Recht: Gegenwartsdebatten über einen rechtlichen Grundbegriff* (pp. 411–434). Mohr Siebeck.

Floridi, L. (2013). *The ethics of information*. Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199641321.001.0001

Floridi, L., & Cowls, J. (2022). A unified framework of five principles for AI in society. In S. Carta (Ed.), *Machine learning and the city: Applications in architecture and urban design* (pp. 535–545). Springer. https://doi.org/10.1162/99608f92.8cd550d1

Floridi, L., & Cowls, J., Beltrametti, M., Chatila, R., Chazerand, P., Dignum, V., Luetge, C., Madelin, R., Pagallo, U., Rossi, F., Schafer, B., Valcke, P., & Vayena, E. (2018). AI4People—An ethical framework for a good AI society: Opportunities, risks, principles, and recommendations. *Minds & Machines, 28*(4), 689–707. https://doi.org/10.1007/s11023-018-9482-5

Foldvary, F. E. (2011). Political autonomy. In D. K. Chatterjee (Ed.), *Encyclopedia of Global Justice*. Springer. https://doi.org/10.1007/978-1-4020-9160-5_350

Formosa, P. (2013). Kant's conception of personal autonomy. *Journal of Social Philosophy, 44*(3), 193–212. https://doi.org/10.1111/josp.12028

Formosa, P. (2021). Robot autonomy vs. human autonomy: Social robots, artificial intelligence (AI), and the nature of autonomy. *Minds and Machines, 31*(4), 595–616. https://doi.org/10.1007/s11023-021-09579-2

Friedman, M. (2000). Autonomy, social disruption, and women. In C. Mackenzie & N. Stoljar (Eds.), *Relational autonomy: Feminist perspectives on autonomy, agency, and the social self* (pp. 35–51). Oxford University Press. https://doi.org/10.1093/oso/9780195123333.003.0002

Gabriel, I. (2020). Artificial intelligence, values, and alignment. *Minds & Machines, 30*, 411–437. https://doi.org/10.1007/s11023-020-09539-2

Gössl, S. (2023). Diskriminierungsfreie KI (10). *Digital | Recht*. https://doi.org/10.25353/UBTR-XXXX-476A-12BF

Gramelsberger, G. (2020). Algorithm awareness: Towards a philosophy of artifactuality. In B. Bösel & S. Wiemer (Eds.), *Affective media and policy* (pp. 41–49). http://doi.org/10.25969/mediarep/14999

Gramelsberger, G. (2023). *Philosophie des Digitalen zur Einführung*. Junius.

Gransche, B., Shala, E., & Hubig, C. (2014). Wandel von Autonomie und Kontrolle durch neue Mensch-Technik-Interaktionen. Frauenhofer Verlag.

Grunwald, A. (2022). Soziale Roboter—vermenschlichte Technik und technische Menschenbilder. In S. Gerlek, S. Kissler, T. Mämecke, & D. Möbus (Eds.), *Von Menschen und Maschinen: Mensch-Maschine-Interaktionen in digitalen Kulturen* (1st Edition, pp. 62–73). Hagen University Press. http://doi.org/10.57813/20220623-150622-0

Händler, T. (2023). A taxonomy for autonomous LLM-powered multi-agent architectures. In *Proceedings of the 15th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management* (IC3K 2023, Vol 3, KMIS) (pp. 85-98). SCITEPRESS—Science and Technology Publications, Lda. http://doi.org/10.5220/0012239100003598

Hepp, A., Loosen, W., Dreyer, S., Jarke, J., Kannengießer, S., Katzenbach, C., Malaka, R., Pfadenhauer, M., Puschmann, C., & Schulz, W. (2023). ChatGPT, LaMDA, and the hype around communicative AI: The automation of communication as a field of research in media and communication studies. *Human-Machine Communication, 6*, 41–63. https://doi.org/10.30658/hmc.6.4

Herrmann, T., & Pfeiffer, S. (2022). Keeping the organization in the loop: A socio-technical extension of human-centered artificial intelligence. *AI & Society*. https://doi.org/10.1007/s00146-022-01391-5

Huang, Y., & Mayer, M. (2023). Power in the age of datafication: Exploring China's global data power. *Journal of Chinese Political Science 28*(1): 25–49. https://doi.org/10.1007/s11366-022-09816-0

Janiesch, C., Fischer, M., Winkelmann, A., & Nentwich, V. (2019). Specifying autonomy in the Internet of Things: The autonomy model and notation. *Information Systems and E-Business Management, 17*(1), 159–194. https://doi.org/10.1007/s10257-018-0379-x

Jasanoff, S., & Kim, S.-H. (Eds.). (2015). *Dreamscapes of modernity: Sociotechnical imaginaries and the fabrication of power*. University of Chicago Press. http://doi.org/10.7208/chicago/9780226276663.001.0001

Kant, I. (1785/2016). *Grundlegung zur Metaphysik der Sitten*. Felix Meiner Verlag. https://doi.org/10.28937/978-3-7873-2878-9

Kassens-Noor, E., Wilson, M., Cai, M., Durst, N., & Decaminada, T. (2021). Autonomous vs. self-driving vehicles: The power of language to shape public perceptions. *Journal of Urban Technology, 28*(3–4), 5–24. https://doi.org/10.1080/10630732.2020.1847983

Khurana, T. (2013). Paradoxes of autonomy. *Symposium, 17*(1), 50–74. https://doi.org/10.5840/symposium20131714

Köbis, N., Bonnefon, J. F., & Rahwan, I. (2021). Bad machines corrupt good morals. *Nature Human Behavior, 5*, 679–685. https://doi.org/10.1038/s41562-021-01128-2

Laitinen, A., & Sahlgren, O. (2021). AI systems and respect for human autonomy. *Frontiers in Artificial Intelligence, 4*. https://doi.org/10.3389/frai.2021.705164

Lawless, W. F., & Sofge, D. A. (2017). Evaluations: Autonomy and artificial intelligence: A threat or savior? In *Springer eBooks* (pp. 295–316). https://doi.org/10.1007/978-3-319-59719-5_13

Liu, S., & Gaudiot, J.-L. (2022). Rise of the autonomous machines. *Computer, 55*(1), 64–73. https://doi.org/10.1109/MC.2021.3093428

Marra, W., & McNeil, S. (2012). Understanding 'the loop': Autonomy, system decision-making, and the next generation of war machines. *SSRN Electronic Journal, 36*(2). https://doi.org/10.2139/ssrn.2043131

Mayer, M., & Lu, Y. (2023). Illusionen der Autonomie? Europas Position in den globalen digitalen Abhängigkeitsstrukturen. *SIRIUS—Zeitschrift für Strategische Analysen, 7*(4), 390–410. https://doi.org/10.1515/sirius-2023-4005

Menke, C. (2010). Autonomie und Befreiung. *Deutsche Zeitschrift für Philosophie, 58*(5), 675–695. https://doi.org/10.1524/dzph.2010.58.5.675

Mosqueira-Rey, E., Hernández Pereira, E., Alonso-Ríos, D., & Bobes-Bascarán, J. (2022). A classification and review of tools for developing and interacting with machine learning systems. In *Proceedings of the 37th ACM/SIGAPP Symposium on Applied Computing (SAC '22)* (pp. 1092–1101). Association for Computing Machinery. https://doi.org/10.1145/3477314.3507310

Nagel, S. K. (2013). Autonomy: A genuinely gradual phenomenon. *AJOB Neuroscience, 4*(4), 60–61. https://doi.org/10.1080/21507740.2013.827278

O'Neill, T. A., McNeese, N. J., Barron, A. E., & Schelble, B. G. (2020). Human–autonomy teaming: A review and analysis of the empirical literature. *Human Factors, 64*(5), 904–938. https://doi.org/10.1177/0018720820960865

Oshana, M. (2020). Relational autonomy. In *International Encyclopedia of Ethics*. https://doi.org/10.1002/9781444367072.wbiee921

Parasuraman, R., Sheridan, T. B., & Wickens, C. D. (2000). A model for types and levels of human interaction with automation. *IEEE Transactions on Systems, Man, and Cybernetics, 30*(3), 286–297. https://doi.org/10.1109/3468.844354

Piller, F. T., Nitsch, V., & Van Der Aalst, W. (2022). Hybrid intelligence in next-generation manufacturing: An outlook on new forms of collaboration between human and algorithmic decision-makers in the factory of the future. In F. T. Piller, V. Nitsch, D. Lüttgens, A. Mertens, S. Pütz, & M. Van Dyck (Eds.), *Forecasting in next generation manufacturing. Digital shadows, human-machine collaboration, and data-driven business models* (pp. 139–158). Springer. https://doi.org/10.1007/978-3-031-07734-0_10

Prunkl, C. (2022). Human autonomy in the age of artificial intelligence. *Nature Machine Intelligence*. http://doi.org/10.1038/s42256-022-00449-9

Prunkl, C. (2024). Human autonomy at risk? An analysis of the challenges from AI. *Minds and Machines, 34*(26). https://doi.org/10.1007/s11023-024-09665-1

Rahwan, I. (2017). Society-in-the-loop: Programming the algorithmic social contract. *Ethics and Information Technology, 20*(1), 5–14. https://doi.org/10.1007/s10676-017-9430-8

Rainey, S., & Erden, Y. J. (2020). Correcting the brain? The convergence of neuroscience, neurotechnology, psychiatry, and artificial intelligence. *Science and Engineering Ethics, 26*(5), 2439–2454. https://doi.org/10.1007/s11948-020-00240-2

Rössler, B. (2000). Problems with autonomy. *Hypatia*, *17*(4), 143–162. https://doi.org/10.1111/j.1527-2001.2002.tb01077.x

Rössler, B. (2021). *Autonomy: An essay on the life well-lived*. John Wiley & Sons.

Rubel, A., Castro, C., & Pham, A. (2021). *Algorithms and autonomy*. Cambridge University Press. https://doi.org/10.1017/9781108895057

Sankaran, S., Neff, G., & Lin, A. (2021). Exploring peoples' perception of autonomy and reactance in everyday AI interactions. *Frontiers in Psychology, 12,* Article 713074. https://doi.org/10.3389/fpsyg.2021.713074

Sartori, L., & Bocca, G. (2023). Minding the gap(s): Public perceptions of AI and socio-technical imaginaries. *AI & Society, 38*(2), 443–458. https://doi.org/10.1007/s00146-022-01422-1

Scharre, P. (2018). *Army of none: Autonomous weapons and the future of war*. W. W. Norton & Company.

Schmidt, P., & Loidolt, S. (2023). Interacting with machines: Can an artificially intelligent agent be a partner? *Philosophy & Technology, 36*(3). https://doi.org/10.1007/s13347-023-00656-1

Schmitz, S., Schluetter, M., & Epple, U. (2009, October). Automation of automation—Definition, components and challenges. In *2009 IEEE Conference on Emerging Technologies & Factory Automation (ETFA)* (pp. 1–8). IEEE. https://doi.org/10.1109/ETFA.2009.5347197

Schneewind, J. B. (1988). *The invention of autonomy: A history of modern moral philosophy*. Cambridge University Press. http://doi.org/10.21555/top.v18i1.366

Sheridan, T., & Parasuraman, R. (2005). Human-automation interaction. *Reviews of Human Factors and Ergonomics, 1*(1), 89–127. https://doi.org/10.1518/155723405783703082

Simmler, M., & Frischknecht, R. (2021). A taxonomy of human–machine collaboration: Capturing automation and technical autonomy. *AI & Society, 36*(1), 239–250. https://doi.org/10.1007/s00146-020-01004-z

Smith, M. R., & Marx, L. (Eds.). (1994). *Does technology drive history? The dilemma of technological determinism*. MIT Press.

Steinhoff, J. (2021). *Automation and autonomy: Labour, capital and machines in the artificial intelligence industry*. Palgrave Macmillan. https://doi.org/10.1007/978-3-030-71689-9

Suchman, L. A. (1987). *Plans and situated actions: The problem of human-machine communication*. Cambridge University Press.

Suchman, L. A., & Weber, J. (2016). Human-machine autonomies. In N. Bhuta, S. Beck, H. Geis, & Y. Liu (Eds.), *Autonomous weapons systems: Law, ethics, policy* (pp. 75–102). Cambridge University Press. https://doi.org/10.1017/cbo9781316597873.004

Thimm, C., & Bächle, T. C. (2018). Autonomie der Technologie und autonome Systeme als ethische Herausforderung. In M. Rath, F. Krotz, & M. Karmasin (Eds.), *Ethik in mediatisierten Welten* (pp. 73–87). Springer VS. https://doi.org/10.1007/978-3-658-21083-0_5

Thimm, C., & Thimm-Braun, L. (2024). Policies, regulation and legal perspectives on social robots. In F. Leopoldina & E. Autumn (Eds.), *De Gruyter handbook of social robots. De Gruyter handbook of robots in society and culture* (pp. 161–176). De Gruyter.

Wahlström, M. (2017). How to study public imagination of autonomous systems: The case of the Helsinki automated metro. *AI & Society, 32*(4), 599–612. https://doi.org/10.1007/s00146-017-0689-4

Wu, S., Tandoc, E. C., & Salmon, C. T. (2018). Journalism reconfigured. *Journalism Studies, 20*(10), 1440–1457. https://doi.org/10.1080/1461670x.2018.1521299

Wyatt, S. (2008). Technological determinism is dead; long live technological determinism. In E. J. Hackett, O. Amsterdamska, M. E. Lynch, & J. Wajcman (Eds.), *The handbook of science and technology studies* (pp. 165–180). MIT Press.