JOURNAL OF DIGITAL SOCIAL RESEARCH

WWW.JDSR.IO ISSN: 2003-1998

VOL. 2, NO. 3, 2020, 1–15

A SOCIAL SCIENCE PERSPECTIVE ON ARTIFICIAL INTELLIGENCE: BUILDING BLOCKS FOR A RESEARCH AGENDA

Simon Lindgren and Jonny Holmström*

ABSTRACT

In this article, we discuss and outline a research agenda for social science research on artificial intelligence. We present four overlapping building blocks that we see as keys for developing a perspective on AI able to unpack the rich complexities of sociotechnical settings. First, the interaction between humans and machines must be studied in its broader societal context. Second, technological and human actors must be seen as social actors on equal terms. Third, we must consider the broader discursive settings in which AI is socially constructed as a phenomenon with related hopes and fears. Fourth, we argue that constant and critical reflection is needed over how AI, algorithms and datafication affect social science research objects and methods. This article serves as the introduction to this JDSR special issue about social science perspectives on AI.

Keywords: social science; artificial intelligence; sociotechnical perspectives; social constructionism

* Umeå University, Sweden.

1 TOWARDS A TRULY SOCIAL SCIENCE OF AI

People have been grappling with the social consequences of technology for centuries. Take, for example, Langdon Winner's (1980) example of how New York City's overpasses were built, in the early-to-mid 20th century, in ways that discouraged the presence of buses on the parkways. This was analysed, later on, as a result of master builder Robert Moses' racial prejudice and social-class bias. While the design of the overpasses allowed car-owning whites of the upper and middle classes to use them for recreation and commuting, low-income groups and racial minorities – who largely relied on public transport – were effectively denied access (Woolgar, & Cooper, 1999). Such examples clearly illustrate that technologies are political. They embody power and social relations. Historian of technology Melvin Kranzberg (1986, p. 545–546) has argued that:

> Technology is neither good nor bad; nor is it neutral. […] Technology's interaction with the social ecology is such that technical developments frequently have environmental, social, and human consequences that go far beyond the immediate purposes of the technical devices and practices themselves, and the same technology can have quite different results when introduced into different contexts or under different circumstances.

As technology is political, and because it is preceded, succeeded, and surrounded by the social, the comprehensive study of any technologies, including artificial intelligence (AI), demands a social science perspective.

In a recent paper on the emerging scholarly field of *machine behaviour*, Rahwan et al. (2019) point out the fact that AI is still predominantly studied by the same scientists who are engaged in creating the AI agents themselves. This leads to a strong focus on research that in various ways is designed to ensure that AI fulfils intended functions. AI is seen as having to be adequate, efficient, responsible, and so on. And even though it could be argued that social scientists, and also humanities scholars, are taking part in AI research to a growing degree (Araujo et al., 2020; Dung et al., 2020; Gupta & Tu, 2020; Miller et al., 2017), the research agenda is still largely set through posing questions based in the AI technologies per se, rather than in their social and cultural contexts.

In many cases, an interdisciplinary approach to the study of AI is advisable. Social scientists can clearly learn a lot about technological aspects of AI from those that work with developing AI systems, agents, and algorithms, and such understanding is key to carrying out well-informed research on the societal dimensions of these (Reutter, 2018; Richardson, 2015). Conversely, computer scientists and AI developers can get valuable knowledge through carrying out user-studies and evaluations of implemented systems by collaborating with social scientists (Guzman,

2017; Irving & Askell, 2019), as this can counteract "AI's social sciences deficit" (Sloane & Moss, 2019).

Even if code is social, and the social is code, the purely technological sciences must in some instances detach themselves from social and cultural considerations to work simply on the technological side of AI – on the silicon and digits. And just as well, the social sciences must sometimes disconnect from technological considerations to focus on purely socio-cultural dimensions of AI. In spite of the many advantages of interdisciplinary research, there is often a translation problem between social and technological research, also potentially involving a mismatch between different overarching objectives for the research as such. As some social science research has shown, "AI doesn't make everybody's life easier or safer" (Sloane & Moss, 2019, p. 330). It can also exacerbate inequality, lead to discrimination, and inflict harm based on race, gender and class (Eubanks, 2017; Noble, 2018; O'Neil, 2016).

While research on how AI systems may reproduce, or sometimes even worsen, prevailing patterns of oppression, can function as direct input into work with enhancing AI technologies themselves, this must not always be the case. Another, even more important, role for social science research is to do what it does best, that is systematically analyse society, scrutinize historical continuities and discontinuities, and to produce knowledge about the political, economic and social structures and conditions under which we live. This includes focusing on issues of power and oppression, on social differences, on identities, on language and ideologies, and on hindrances or possibilities for action for given individuals and collectives. Such knowledge has a value in itself, and as indirect input into a broad range of other scholarly fields.

In light of this, we argue in favour of proliferating, alongside relevant efforts to evaluate the social consequences of particular AI technologies, a truly social science of AI as a political and socio-historical phenomenon. This entails drawing on well-established literatures in the social sciences which relates to (1) *Humans and machines in context*, (2) *AI agents as social actors*, (3) *AI as social construction*, and (4) *AI, datafication and research methods.*

1.1 Humans and machines in context

Practices and concepts for understanding the role of code and software in human-computer interaction (HCI) have been developed in literature from computer and information sciences since the coming of personal computing in the 1980s (Dix 2004; Preece 1994). HCI scholars like Suchman (1987; 2009) and Nardi (1995) have emphasized the importance of taking contextual and socio-cultural dimensions into account and have argued for a view where humans and machines constantly construct and reconstruct the social world

through dynamic interactions. These perspectives have been influential in areas where the aim has been to improve the usability of computers, and designing systems that make human-computer interaction flow as smoothly as possible

Retaining the key idea in HCI, that communication between humans and machines is a socio-cultural rather than a technological process (cf. Carey, 2009), we suggest that social science research on AI must move far past issues of mere usability, fairness, and responsibility, towards a research framework that allows for posing more far-reaching and deeper-cutting questions. A promising path would be to position social research on AI closer to the area of human-machine communication (HMC) as outlined by scholars such as Guzman and Lewis (2019; Guzman 2018). This pushes in the direction of conceiving of AI agents not as mere AI technologies, but as communicative agents that engage in ongoing and adaptive acts of communication in people's everyday social spaces. This view challenges many concepts that tend to be taken for granted in social science research, such as the question of what constitutes an actor (cf. Latour, 2005). But as is ever more evident from the emerging and proliferated presence of AI in public and civic life, interaction and communication can no longer be seen as a human-only process. Instead, we must accommodate the study of the interplay between people, and between people and AI, within one and the same theoretical framework. How can we best account for social structures that also include social machines?

While one strategy is to simply understand AI agents as technologically "automated social actors" (Abokhodair et al., 2015), AI is created by humans and thus encoded with human intentions (Siponen, 2004). This means that they embody social values, which makes them human-dependent rather than completely autonomous (Keller & Klinger, 2019). Furthermore, the behaviour of AI systems can be affected by input from the humans with whom they interact. Generally, as argued by Carey (1990, p. 247), technologies always function as "concrete embodiments of human purposes, social relations, and forms of organization". As AI is always somehow imbued with social intentionality, is must also be seen as a site of power (Chun, 2011; Holmström & Robey, 2020). The path for social theory past this increasingly altered border between human and machine goes through assuming a hybrid, or 'cyborg', perspective.

1.2 AI agents as social actors

A truly social science of AI needs to approach the human/AI relationship as complex and multidimensional (Gehl & Bakardjieva, 2017). This means expecting a symbiotic interconnection between technological and human elements (Neff & Nagy, 2016). Drawing on the perspective of Carey (2009),

AI must be seen as being simultaneously constituted and expressed in an ongoing relationship with a surrounding social world (Carey, 1990, p. 247). We believe that in order to be able to demystify AI as an analytical category (cf. Barocas et al., 2013), we must study its agents alongside other agents in their social and communicative context.

This perspective also aligns with the constructionist view on technology and society which is widely advocated in the field of Science and Technology Studies (STS). In this field, sociologists such as Latour, Callon, and Law have contributed to formulating so-called Actor-Network theory (ANT), that allows for networks of social action where the agency of human and non-human agents is seen as equal (Bijker & Law, 1992; Callon, 1986; Latour & Callon, 1991). This is an analytical approach that wants to move beyond the anthropological, human-centred, bias of traditional sociology and instead focus on the entangled and symbiotic nature of relationships between humans and technologically social actors such as for example software, algorithms, and intelligent agents (Faraj et al. 2018; Woolley, 2018).

Social relations can emerge between all different kinds of entities — which is what happens when the actions of one entity (e.g. a bot or a human) has an effect on the actions of another (e.g. a human or a bot). Because of this, a social science approach to AI has much to gain by drawing on theories such as ANT insofar that it provides conceptual tools for exploring the complex role of intelligent agents in online and offline socio-technical systems. The key concept within ANT, which fits the most succinctly here comes from Latour's discussions of how technological artifacts can both replace human actions and shape further human actions. His notion of "delegation" refers to processes where human agents, such as for example engineers, design technological systems to which they *delegate* tasks to be carried out on human behalf. Latour points out how us humans "have been able to delegate to nonhumans not only force as we have known it for centuries but also values, duties, and ethics" (Latour, 1992, p. 232). We can conceive of AI as technologies to which human subjects delegate agency and abilities. In turn, these "non-humans intervene actively to push action in unexpected directions" (Callon & Law, 1997, p. 178).

1.3 AI as social construction

In approaching AI as an object of social scientific study, it is useful to draw on understandings that have been developed within the theoretical tradition referred to as the *social shaping of technology* (Pinch & Bijker, 1984; Williams & Edge, 1996). Aligning with ideas developed in this area, we see the social scientific study of AI as by necessity having a strong discursive component, focusing on how social talk and action around it is structured.

The design and implementation of technologies is always socially and historically dependent, and technologies are used and developed in processes that are based on a variety of social considerations (MacKenzie & Wajcman, 1985).

The socio-technical phenomenon of 'AI' comes into being through a co-construction process where various *interpretive frames* are negotiated and established. According to scholars in this field, technologies are surrounded by "socially shared structures of meaning" (Latzko-Toth, 2014, p. 50), that reflect and orient how various groups of actors relate to a given technological artifact and how they make sense of it. Bijker (1987) argues that such modes of speaking and acting in relation to technological artifacts constitutes an interpretive "frame", that provides a "grammar" for how meaning is attributed to the artifact in question. Such frames include "assumptions, knowledge, and expectations, expressed symbolically through language, visual images, metaphors, and stories" (Orlikowski & Gash, 1994, p. 178). These will have powerful effects, as the knowledge, assumptions, and expectations that people have about the meaning, purpose, and importance of technology will influence their societal uses and hence their impact. Another way of putting this is that the interpretive frames will affect how the technology in question becomes *socialized* — how it becomes a social object and how it acquires social significance (Jouet, 2000; Scott & Orlikowski, 2014), as the result of a process where its relevance, meaning and compatibility with societal norms and values are negotiated and debated (Latzko-Toth, 2014; Mallein & Toussaint, 1994).

1.4 AI, datafication and research methods

More broadly speaking, we conceive of AI agents and technologies as being part of — and an expression of — the social and communicative hybridity that is characteristic of 21st century society (Chadwick, 2013; Lindgren, 2014). Carrying out truly social science on AI, therefore, must also take into account and investigate the role and impact of networks, software, and algorithms on the social, cultural, and political. AI, its developers, and subjects/users, analysed in context can be considered to be "hybrid techno-social formations" (Woolley, 2018, p. 134). A central aspect of these formations is their *datafication*, a process that not only affects society at large and comprehensively, and which supplies some present-day AI with crucial raw material, but that also has an impact on our choice of research methods and analytical strategies when studying AI as social scientists. Datafication is the process which has led to the situation where we now live in "a culture that is shaped and populated with numbers, where trust and interest in anything that cannot be quantified diminishes" (Beer, 2016, p. 149). Furthermore, in the age of big data, there is an obsession with

causation. As boyd and Crawford (2012, p. 665) argue, the mirage and mythology of big data demand that a number of critical questions are raised with regard to "what all this data means, who gets access to what data, how data analysis is employed, and to what ends". There is a risk that the lure of big data will sideline other forms of analysis, and that other alternative methods with which to analyse the beliefs, choices, expressions, and strategies of people are pushed aside by the sheer volume of numbers.

We believe that a truly social science of AI, must rely on a custom and open-minded combinations of methodological and theoretical approaches (cf. Lindgren, 2020). This means sometimes embracing both the massive flows of data, as well as computational analytical approaches, and sometimes stepping out of the data flows, observing them through the lens of tried and tested social and cultural theories about technology and social change, or other critical perspectives. This also entails approaching the digital object of study through forms of hermeneutic, ethnographic, and seemingly 'analogue' methods. These convictions position our suggested perspective in a sympathetic position in relation to the area of *software studies* (Kitchin & Dodge, 2011; Manovich, 2013), that is focused on studying various social expressions of computer code as politically imbued and analysing how algorithmic agency is entangled with social practice (Gillespie, 2014, p. 168). As Lindgren (2020, p. 12) writes:

> Being data-driven is not a bad thing, but there must always be a balance between data and theory – between information and its interpretation. This is where sociology and social theory come into the picture, as they offer a wide range of conceptual frameworks, theories, that can aid in the analysis and understanding of the large amounts and many forms of social data that are proliferated in today's world.

AI, in its full sense, is only partly a technological phenomenon. It is also a cultural and socio-political phenomenon, imbued with certain assumptions, hopes, beliefs, and ideologies. The consequences of AI span a range of areas, including challenges as well as opportunities relating to power, oppression, health, work, economy, sustainability, learning, inclusion, diversity, and justice. Prominently, AI and automated agents also play into processes of democracy, governance, and social trust. This development, where the emergence and proliferation of AI agents based on algorithms are key, most definitely demands to be scrutinised from a social science perspective. We need more knowledge about what the pervasive use of these human-software hybrids, and the black-boxed and sometimes discriminatory algorithms behind them, mean for future societies. Critical social science research must run alongside and monitor the development by which AI agents will unavoidably become increasingly interwoven in

our society, in areas ranging from online dating and credit scoring, through parenting and education, to social welfare control, policing and warfare.

2 ARTIFICIAL INTELLIGENCE: BUILDING BLOCKS IN THE SOCIAL SCIENCE APPROACH

Researchers have begun to address the real-life quandaries that AI introduces (e.g. Boden, 2016; Bostrom, 2016). But while we are thrilled to see how some AI researchers are increasingly addressing the legal, political, economic and societal aspects of AI, we are surprised over the ways in which many technology-focused AI researchers tend to ignore decades of social science technology research. We are equally worried over how social scientists have been slow starters in researching AI. This has meant that scholars that lack the appropriate expertise have begun to take on social questions on their own, without any solid foundation in social science. At the same time, scholars from the social sciences, physical sciences, and humanities seem to be losing touch with the rapid advances in AI (Frank et al., 2019). We believe that the contributions to this special issue of JDSR are illustrative examples of how AI can be approached in ways that include a strong social science element.

As a first building block, we wrote above about the importance of looking at *humans and machines in context*. The social scientific study of AI is interested in how humans and machines interact to construct their social world. Machines are technological, humans are social, but in context they are socio-cultural phenomena. This perspective must go both ways, recognising the agency, as well as the structurally defined ('programmed', as it were) character of humans as well as machines. In this special issue such a contextual perspective comes to the fore in Govia's (2020) contribution. This study targets assumptions of technological determinism and shifts focus to everyday interaction with AI systems and processes. Fruitfully drawing on an STS perspective, Govia contributes to a situated understanding of AI. Similarly, in another contribution, Seidel et al. (2020) write about how AI use in video game creation can be analysed. They apply a contextualised perspective where the autonomous design tools are seen as participating agents in the design process, and also draw on control theory to analyse the relationship between context, humans, and technology.

Our second building block was about approaching and conceptualising *AI agents as social actors*. In doing so we also pointed to the usefulness of applying an STS perspective, such as Govia's, according to which the agency of human and non-human (e.g. technological) actants are seen as equal. Like Govia's rendition of anthropology, this view wants to move away from human-centred social science towards more entangled

ways of seeing humans and technologically social actors (software, algorithms, intelligent agents). In Svensson and Poveda Guillen's (2020) contribution to this issue, the authors align with a view of data and algorithms as dynamic actants, rather than as objective and firmly-set entities. They develop a compelling critique of data-essentialism and contend that seeing both the data/algorithms and their human subjects as dynamic and historically shaped, can counteract the rise of a new form of positivism. Connecting also to our previous point about the importance of context, the authors write that:

> [A]cknowledging the importance of data, conceiving of data as contextual and situated traces we leave behind in an increasingly computer saturated world is substantially different from reducing our existence and bodies to data (Svenson & Poveda Guillen, 2020, p. 78).

Both of the above points, focusing on the embedded and interactive character of AI as phenomenon, in turn relates to our third building block about *AI as a social construction*. In our discussion of this point, we especially emphasised that AI has a strong discursive component, meaning that it is, like so many other terms, part of a political language. It gets shaped, defined, and acquires its social significance through how it is framed and understood, and through which hopes or fears are symbolically tied to it. Svensson and Poveda Guillen's paper in this special issue is also of strong relevance to this, as it critiques how data tends to be seen as objective, and suggests alternative views. Digging deeper into this territory, Lagerkvist's (2020) contribution draws on the existential philosophy of Karl Jaspers to discuss how AI is not merely a medium, but also a message. Addressing similar discursive issues as those mentioned above, Lagerkvist problematises how the self-presentation of AI mythologically constructs its futures as inevitable. This is not 'simply' about talk and discourse, as the current moment, Lagerkvist argues, constitutes a "digital limit situation" with high political and ethical stakes. The stakes are also existential, as the ways in which AI futures are imagined symbolically close down other potential futures. Lagerkvist writes:

> Presenting themselves as the only set of solutions to problems that face us on the fringes of our late modern societal order of disintegration – while operating through forecasting, prediction and precision – [AI imaginaries] thus effectively close the very horizon of the future at the same time (Lagerkvist, 2020, p. 35).

It is through such theoretical insights, and through empirical research that draws upon them, that social and cultural perspectives on AI can make

important contributions. Sometimes social scientists can help evaluate whether this or that AI system is more or less user-friendly, more or less democratic, or more or less accurate, or more or less ethical. This is equal to doing social science research within the paradigm of what Lagerkvist calls the prevailing 'AI imaginaries', and often drawing on what Svensson and Poveda Guillen label as 'data-essentialism'. The truly social science of AI, especially a critical one, lies beyond such confines and enables posing questions not only from inside the technological paradigm, but from the outside.

Doing such work entails a range of methodological challenges, the depth and scope of which exceeds what we can address within this special issue alone. However, Pop Stefanija and Pierson's (2020) contribution, to this special issue addresses some of the challenges with researching algorithms from the outside in the face of their inherent opacity and black-boxedness. The issues that they discuss relate to our fourth building block presented earlier, namely that of dealing with *AI and datafication in relation to research methods*. Stefanija and Pierson discuss a number of limitations with API-based research, and how constant changes in platforms' politics of visibility constitutes data access gaps. The authors' work is an enlightening example of how the present data landscape demands continuous adaptation and smart combinations of both new and existing methods. Pop Stefanija and Pierson advocate an approach, using non-traditional research tools, in an endeavour to letting and making 'the platforms speak'.

3 ARTIFICIAL INTELLIGENCE AND THE SOCIAL SCIENCES: TOWARDS A RESEARCH AGENDA

AI is a rapidly emerging phenomenon of societal significance. As such, the ethical and social implications of AI have become topics of compelling interest to academia, industry, and the public. We however find that the dominant framings of AI are still limited since they tend to approach AI in a narrow and deterministic way, essentially understanding AI as a shaper of society. The examples of social science perspectives on AI in this special issue together demonstrate a richer and more multifaceted view, in which AI is indeed seen to shape society, but not necessarily in the ways envisioned by its creators, and where society's shaping of AI is also highlighted.

A social science research agenda on AI should be informed by such a mutual shaping approach guiding our inquiry into the dynamic processes of AI design and use, suggesting that society and AI are not mutually exclusive but, instead, influence and shape each other. As a whole, the papers in this special issue demonstrate, in different ways, what is to be

gained from a applying a mutual shaping approach, and to focus on analysing how social and cultural factors influence the ways in which technologies are designed, used, and evaluated, as well as how technologies affect the construction of society.

AI is still a poorly understood societal phenomenon today, since social scientists have been slow out of the gates. By building on the rich resources we find in social science theory and method, we can articulate a truly social science approach to AI. Again, as building blocks in such a social science approach, we suggest considering: (1) Humans and machines in context, (2) AI agents as social actors, (3) AI as social construction, and (4) AI's relationship to datafication and research methods. By drawing on these building blocks, social science scholars can fruitfully explore the complexities involved in human-machine configurations to contribute to the emerging scholarly AI discourse.

REFERENCES

Abokhodair, N., Yoo, D. and McDonald, D. W. (2015) 'Dissecting a social botnet: Growth, content and influence in Twitter', in *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing*. ACM, pp. 839–851.

Araujo, T. *et al.* (2020) 'In AI we trust? Perceptions about automated decision-making by artificial intelligence', *AI & SOCIETY*, 35(3), pp. 611–623. doi: 10.1007/s00146-019-00931-w.

Barocas, S., Hood, S. and Ziewitz, M. (2013) *Governing Algorithms: A Provocation Piece*. SSRN scholarly paper ID 2245322. Rochester, NY: Social Science Research Network. Available at: https://papers.ssrn.com/abstract=2245322 (Accessed: 8 October 2019).

Beer, D. (2016) *Metric power*. London: Palgrave Macmillan.

Bennett, W. L. and Segerberg, A. (2012) 'The Logic of Connective Action: Digital Media and the Personalization of Contentious Politics', *Information, Communication & Society*, 15(5), pp. 739–768.

Bijker, W. E., Hughes, T. P. and Pinch, T. (eds) (1987) *The social construction of technological systems: New directions in the sociology and history of technology*. Anniversary ed. Cambridge, Mass: MIT Press.

Bijker, W. E. and Law, J. (eds) (1992) *Shaping Technology/Building society: Studies in sociotechnical change*. Cambridge, Mass: MIT Press (Inside technology).

Boden, M. A. (2016) *AI: Its nature and future*. Oxford: Oxford University Press.

Bostrom, N. (2016) *Superintelligence: Paths, dangers, strategies*. Oxford: Oxford University Press.

boyd, danah and Crawford, K. (2012) 'Critical Questions for Big Data', *Information, Communication & Society*, 15(5), pp. 662–679. doi: 10.1080/1369118X.2012.678878.

Callon, M. (1986) 'Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay', in Law, J. (ed.) *Power, Action and Belief: A New Sociology of Knowledge*. London: Routledge & Kegan Paul, pp. 196–233. Available at: http://journals.sagepub.com/doi/10.1111/j.1467-954X.1984.tb00113.x (Accessed: 27 May 2019).

Callon, M. and Law, J. (1997) 'After the Individual in Society: Lessons on Collectivity from Science, Technology and Society', *Canadian Journal of Sociology / Cahiers canadiens de sociologie*, 22(2), pp. 165–182. doi: 10.2307/3341747.

Carey, J. W. (1990) 'Technology as a totem for culture: And a defense of the oral tradition', *American Journalism*, 7(4), pp. 242–251.

Carey, J. W. (2009) *Communication as culture: Essays on media and society*. New York: Routledge.

Castells, M. (1996) *The Rise of the Network Society*. Malden, MA: Blackwell.

Chadwick, A. (2013) *The hybrid media system: Politics and power*. Oxford: Oxford University Press (Oxford studies in digital politics).

Dix, A. J. (2004) *Human-computer interaction*. London: Prentice Hall.

Dung, L. *et al.* (2020) 'Integrating social sciences research with artificial intelligence (AI): A case study from the Great Barrier Reef', *CAUTHE 2020: 20: 20 Vision: New Perspectives on the Diversity of Hospitality, Tourism and Events*, p. 130.

Eubanks, V. (2017) *Automating inequality: How high-tech tools profile, police, and punish the poor*. New York: St Martin's Press.

Faraj, S., Pachidi, S. and Sayegh, K. (2018) 'Working and organizing in the age of the learning algorithm', *Information and Organization*, 28(1), pp. 62–70. doi: 10.1016/j.infoandorg.2018.02.005.

Frank, M. R. *et al.* (2019) 'The evolution of citation graphs in artificial intelligence research', *Nature Machine Intelligence*, 1(2), pp. 79–85.

Gehl, R. W. and Bakardjieva, M. (eds) (2017) *Socialbots and their friends: Digital media and the automation of sociality*. New York: Routledge.

Gillespie, T. (2014) 'The Relevance of Algorithms', in Gillespie, T., Boczkowski, P. J., and Foot, K. A. (eds) *Media technologies: Essays on communication, materiality, and society*. Cambridge, Mass.: The MIT Press, pp. 167–193.

Govia, L. (2020) 'Coproduction, Ethics and Artificial Intelligence: A Perspective from Cultural Anthropology', *Journal of Digital Social Research*, 2(3), pp. 42–64.

Gupta, S. and Tu, P. H. (2020) *What is artificial intelligence?: a conversation between an ai engineer and a humanities researcher*. Hackensack, NJ: World Scientific.

Guzman, A. L. (2017) 'Making AI safe for humans: A conversation with Siri', in Gehl, R. W. and Bakardjieva, M. (eds) *Socialbots and their friends: Digital media and the automation of sociality*. New York: Routledge, pp. 69–85.

Guzman, A. L. (2018) *Human-Machine Communication: Rethinking communication, technology, and ourselves*. New York: Peter Lang.

Guzman, A. L. and Lewis, S. C. (2019) 'Artificial intelligence and communication: A Human–Machine Communication research agenda', *New Media & Society*. doi: 10.1177/1461444819858691.

Holmström, J. and Robey, D. (2020) 'Materiality and Organizing: Actor-Network Theory Revisited', in Hernes, T. and Czarniawska, B. (eds) *Actor-Network Theory and Organizing*. Lund: Studentlitteratur, pp. 177–201.

Irving, G. and Askell, A. (2019) 'AI Safety Needs Social Scientists', *Distill*, 4(2), p. e14. doi: 10.23915/distill.00014.

Ito, M. (2008) 'Introduction', in Varnelis, K. (ed.) *Networked Publics*. Cambridge, MA: MIT Press, pp. 1–14.

Jouët, J. (2000) 'Retour critique sur la sociologie des usages', *Réseaux. Communication-Technologie-Société*, 18(100), pp. 487–521.

Keller, T. R. and Klinger, U. (2019) 'Social Bots in Election Campaigns: Theoretical, Empirical, and Methodological Implications', *Political Communication*, 36(1), pp. 171–189. doi: 10.1080/10584609.2018.1526238.

Kitchin, R. and Dodge, M. (2011) *Code: Software and everyday life*. Cambridge, Mass.: MIT Press. Available at: http://site.ebrary.com/id/10479192 (Accessed: 31 October 2019).

Lagerkvist, A. (2020) 'Digital Limit Situations: Anticipatory Media Beyond 'The New AI Era'', *Journal of Digital Social Research*, 2(3), pp. 16–41.

Latour, B. (1992) 'Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts', in Bijker, W. E. and Law, J. (eds) *Shaping Technology/Building society: Studies in sociotechnical change*. Cambridge, Mass: MIT Press (Inside technology), pp. 225–258.

Latour, B. (2005) *Reassembling the social: An introduction to actor-network-theory*. Oxford: Oxford University Press.

Latour, B. and Callon, M. (1981) 'Leviathan: How Actors Macro-Structure Reality and How Sociologists Help Them to Do So', in Knorr-Cetina, K. and Cicourel, A. V. (eds) *Advances in Social Theory and Methodology: Toward an Integration of Micro- and Macro-Sociologies*. London: Routledge, pp. 277–303.

Latzko-Toth, G. (2014) 'Users as Co-Designers of Software-Based Media: The Co-Construction of Internet Relay Chat', *Canadian Journal of Communication*, 39(4), pp. 577–595. doi: 10.22230/cjc.2014v39n4a2783.

Lindgren, S. (2014) *Hybrid Media Culture: Sensing place in a world of flows*. London: Routledge.

Lindgren, S. (2020) *Data Theory: Interpretive Sociology and Computational Methods*. Cambridge: Polity.

MacKenzie, D. A. and Wajcman, J. (eds) (1985) *The Social shaping of technology: How the refrigerator got its hum*. Milton Keynes: Open University Press.

Mallein, P. and Toussaint, Y. (1994) 'L'intégration sociale des technologies d'information et de communication: Une sociologie des usages', *Technologies de l'information et société*, 6(4), pp. 315–335.

Manovich, L. (2013) *Software takes command*. New York: Bloomsbury.

Miller, T., Howe, P. and Sonenberg, L. (2017) 'Explainable AI: Beware of Inmates Running the Asylum Or: How I Learnt to Stop Worrying and Love the Social and Behavioural Sciences', *arXiv:1712.00547 [cs]*. Available at: http://arxiv.org/abs/1712.00547 (Accessed: 4 September 2020).

Nardi, B. A. (1995) *Context and consciousness: Activity theory and human-computer interaction*. Cambridge, Mass.: MIT Press.

Neff, G. and Nagy, P. (2016) 'Talking to Bots: Symbiotic Agency and the Case of Tay', *International Journal of Communication*, 10, pp. 4915–4931.

Noble, S. U. (2018) *Algorithms of Oppression: How Search Engines Reinforce Racism*. New York: New York University Press.

O'Neil, C. (2016) *Weapons of math destruction: How big data increases inequality and threatens democracy*. First edition. New York: Crown.

Orlikowski, W. J. and Gash, D. C. (1994) 'Technological Frames: Making Sense of Information Technology in Organizations', *ACM Trans. Inf. Syst.*, 12(2), pp. 174–207. doi: 10.1145/196734.196745.

Owen, T. (2015) *Disruptive power: The crisis of the state in the digital age*. Oxford: Oxford University Press.

Pinch, T. J. and Bijker, W. E. (1984) 'The Social Construction of Facts and Artefacts: Or How the Sociology of Science and the Sociology of Technology might Benefit Each Other', *Social Studies of Science*, 14(3), pp. 399–441. doi: 10.1177/030631284014003004.

Pop Stefanija, A. & Pierson, J. (2020) 'Practical AI Transparency: Revealing Datafication and Algorithmic Identities', *Journal of Digital Social Research*, 2(3), pp. 84–125.

Preece, J. (1994) *Human-computer interaction*. Wokingham: Addison-Wesley.

Rahwan, I. *et al.* (2019) 'Machine behaviour', *Nature*, 568(7753), pp. 477–486. doi: 10.1038/s41586-019-1138-y.

Rainie, Harrison. and Wellman, Barry. (2012) *Networked: The New Social Operating System*. Cambridge, Mass.: MIT Press.

Reutter, L. M. (2018) 'Unpacking the Socio-Technological Assemblage of Smart Algorithms - A Case Study on the Production of Machine Learning Algorithms in the Norwegian Labor and Welfare Administration'. Available at: https://ntnuopen.ntnu.no/ntnu-xmlui/handle/11250/2573466 (Accessed: 4 September 2020).

Richardson, Kathleen. (2015) *An anthropology of robots and AI: annihilation anxiety and machines*. New York: Routledge.

Scott, S. V. and Orlikowski, W. J. (2014) 'Entanglements in Practice: Performing Anonymity Through Social Media', *MIS Quarterly*, 38(3), pp. 873–894.

Schatzki, T. R. (2012) 'A Primer on Practices', in Higgs, J. et al. (eds) *Practice-Based Education: Perspectives and strategies*. Rotterdam: SensePublishers, pp. 13–26.

Seidel, S. *et al.* (2020) 'Artificial Intelligence and Video Game Creation: A Framework for the New Logic of Autonomous Design', *Journal of Digital Social Research*, 2(3), pp. 126–157.

Siponen, M. (2004) 'A pragmatic evaluation of the theory of information ethics', *Ethics and Information Technology*, 6(4), pp. 279–290.

Sloane, M. and Moss, E. (2019) 'AI's social sciences deficit', *Nature Machine Intelligence*, 1(8), pp. 330–331. doi: 10.1038/s42256-019-0084-6.

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

Suchman, L. A. (2009) *Human-machine reconfigurations: Plans and situated actions*. Cambridge: Cambridge University Press.

Svensson, J. & Poveda Guillen, O. (2020) 'What is Data and What Can It Be Used For? Key Questions in the Age of Burgeoning Data-Essentialism', *Journal of Digital Social Research*, 2(3), pp. 65–83.

Williams, R. and Edge, D. (1996) 'The social shaping of technology', *Research policy*, 25(6), pp. 865–899.

Winner, L. (1980) 'Do Artifacts Have Politics?', *Daedalus*, 109(1), pp. 121–136.

Woolgar, S. and Cooper, G. (1999) 'Do artefacts have ambivalence? Moses' bridges, Winner's bridges and other urban legends', *Social Studies of Science*, 29(3), pp. 433–449.

Woolley, S. (2018) 'The Political Economy of Bots: Theory and Method in the Study of Social Automation', in Kiggins, Ryan. (ed.) *The Political Economy of Robots Prospects for Prosperity and Peace in the Automated 21st Century*. Cham: Springer, pp. 127–155.