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The mirror for (artificial) intelligence: Working in whose reflection?

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Abstract

'The mirror for (artificial) intelligence: In whose reflection?' sets out the parameters for caution in considering as-yet relatively un-debated issues in artificial intelligence (AI) research, which is the *concept itself* of 'intelligence'. After the AI 'winters' ending in the late 1990s, during which AI development met substantive obstacles, a new AI summer commences. What is still missing is a careful consideration of the historical significance of the weighting that has been placed on particular aspects of consciousness and surrounding seemingly human-like workplace behaviour which takes increasing significance given the interest in machinic autonomous intelligence. The discussion paper argues that a series of machinic and technological invention and related experiments show how machines facilitate not only the processes of normalization of what are considered intelligent behaviours, via both human and machinic intelligence, but also facilitate and enable the integration of autonomous machines into everyday work and life. Today, ideas of *autonomous* machinic intelligence, seen in the ways AI-augmented tools and applications in human resources, robotics, and gig work are incorporated into workplaces, facilitate workplace relations via machinic intelligent behaviours, that are explicitly assistive, prescriptive, descriptive, collaborative, predictive and affective. The question is, given these now autonomous forms of intelligence attributed to machines, who/what is looking in the mirror at whose/which reflection?

Key words: Cybernetics, Artificial Intelligence, Robotics, Autonomous Machines, Workplace Relations, Human-Machine interaction, History of Technology

JEL classification: O30; J81; L00; I15

Wessen Spiegelbild zeigt sich im Spiegel (Künstlicher) Intelligenz?

Zusammenfassung

Der Beitrag 'The mirror for (artificial) intelligence: In whose reflection?' behandelt einen in der bisherigen Debatte um Künstliche Intelligenz (KI) noch relativ unbeleuchteten Gegenstand: Das Konzept von Intelligenz selbst. Nach dem KI-Winter der 1990er Jahre ist in jüngerer Zeit ein neuer Frühling angebrochen. Es wird untersucht, wie sich die Beziehungen zwischen Mensch und Maschine sowie zwischen Maschinen untereinander durch die immer stärkere Nutzung von KI-Technologie verändern. Eine Folge von technologischen Innovationen und damit in Verbindung stehende Experimente zeigen wie sehr Maschinen nicht nur den Prozess der Normalisierung als intelligent betrachteter Verhaltensweisen fördern, sondern auch die Integration von autonomen Maschinen in das alltägliche (Arbeits-)Leben ermöglichen. Die Idee autonomer maschineller Intelligenz, erkennbar etwa in der Weise, wie KI-basierte Werkzeuge und Applikationen in den Bereichen Human Resources, Robotik und Gig Work in den Arbeitsplatz integriert sind, fördert demnach über das intelligente maschinelle Verhalten spezifisch assistive, preskriptive, deskriptive, kollaborative, prädiktive und affektive Beziehungen am Arbeitsplatz.

Schlüsselwörter: Kybernetik, Künstliche Intelligenz, Robotik, Autonome Maschinen, Beziehungen am Arbeitsplatz, Mensch-Maschine-Interaktion, Innovationsgeschichte

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Contents

Introduction

While the original days of artificial intelligence (AI) research accepted there would be some level of human intervention in experimentation, these days, researchers hope, and even expect, machines to behave autonomously. Workplace professionals and work designers have joined the current so-called AI 'arms race' by introducing a variety of AI-augmented tools and applications to work design experimentation, attributing specific types of intelligences to machines. The integration of new technologies into the workplace always has implications for liability and safety and health risks, but the newest uses of AI tools introduces specific questions around regulatory and ethical implications, which are addressed in this Special Issue.

The present discussion paper[1] deals with one aspect of these rapidly emerging issues that has not, as yet, been fully debated: What is meant by 'intelligence' in discussions of the intelligence we hope can become increasingly human-like, but still supposedly artificial? Who or what is mirroring who (or what) in our search for human-like intelligence in machines? In 1972, Joseph Weizenbaum observed that discoveries and inventions in specific historical moments allow humans' self-image to develop accordingly, where e.g. germ theory and studies on evolution challenged the hegemony of religious ideas, or the invention of the microscope paved the way for other social changes.[2] Likewise, the introduction of the computer has led to a paradigm shift. The computer is not the same as the other machines which humans have made. It has allowed us to seriously consider whether there can be a machine that thinks and behaves almost identically to ourselves.

After two 'AI winters' in research lasting 1974 – 1980s and 1987 – 1993 were seen to have flopped due to failed experiments in e.g. machine translation of written documentation, the quite generous government research funding during the Cold War was withdrawn. But now, in 2019, we seem to have entered a new summer of AI innovations, where machinic autonomous intelligence is held in high esteem and potentially even *prioritised over* human decision-making such as in the workplace. The intelligence attributed to machinic AI-augmented tasks and aptitudes includes AI-augmented chatbots, which are designed to assist workers by taking basic questions from online banking customers; and wearable technologies such as hololenses in factories used to replace in-person training, all of which apply and rely on a type of intelligence that I call 'assistive'. Human resource (HR) tools called 'people analytics' that apply machine learning tools to predict worker performance and behaviour are expected to demonstrate a 'predictive' intelligence. Algorithms to assign customers to workers via platforms to drivers, riders and clickworkers, use a 'prescriptive'

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1 Versions of this piece will appear in the Special Issue 'Automation, AI, and Labour Protection', edited by Prof Valerio de Stefano for the Comparative Labor Law and Policy Journal and some of the research is from one commissioned special report Moore wrote for the European Union Agency for Safety and Health entitled OSH and the Future of Work: Benefits & Risks of Artificial Intelligence tools in workplaces. Moore presented this paper and sections have been translated into Korean for the Institute for Political & Economic Alternatives (IPEA) and Hankyoreh Economic & Society Research Institute (HERI) proceedings from the event Beyond the Phobia and Optimism, Artificial Intelligence and Capitalism, Seoul, Korea, May 30-31 with Min Geum, Frank Engster and Timo Daum. Moore also presented this work at the Regulating for Decent Work conference, International Labour Organization, Switzerland 8 – 10 July 2019.

2 Joseph Weizenbaum, 'On the Impact of the Computer on Society: How does one insult a machine?' *Science* Vol 176, 1972, pp. 609–614.

intelligence based on workers' profiles, locations and performance scores. Facial and mood recognition by way of videoing subjects, and sentiment analysis via data mining technologies that aid with identifying customer service workers' emotions in e.g. call centres, are practices called 'affect recognition' or 'emotion coding', which relies on 'affective' intelligence. Cobots in the factory, which work alongside people in moving boxes across the console that are seen to hold 'collaborative' intelligence. Even as these practices also contribute to automation of entire jobs or some tasks, both routine and more complex, the thinking behind the introduction of AI into workplaces reflects an intelligence that is assumed to be that of humanity during the current period of Industry 4.0, where discussions about AI rely on a *productivity* mindset, with relevant surrounding features. Weizenbaum also noted in his classical piece 'On the Impact of the Computer on Society: How does one insult a machine?' that 'it is the autonomy of the computer we value', and also that 'time after time, science has led us to insights that, at least when seen superficially, diminish man'[3]. The insights of this great thinker who was himself a forefather for AI, are worth recalling, as we begin to increasingly expect our tools to start to make decisions for us. Given the specific intelligences we ascribe now to AI-augmented applications in the workplace, it is eminently reasonable to thrown caution on these processes and invite meaningful debate, which this paper hopes to both contribute to where it is occurring but also to clearly indicate caution in this arena.

To legitimately discuss AI and its contemporary relevance and impact on workplaces and working conditions, this piece starts by outlining a short history of discussions about *intelligence* that has been attributed to humans, by humans. Cybernetics researchers sought for the best way to teach machines to control themselves through communication. It was theorised that all of human interaction and attempts to influence one another is linked to our ability for communication. They thereby adapted Pavlov's stimulus experiments and focussed on complex mathematical models involving functional and structural properties of 'nerve nets', where neurophysiological and neuroanatomical findings would help researchers to identify how neurons behave and thus informed machinic building in humans' image. These researchers, in fact, looked far more explicitly at the interplay of machine/human intelligences than AI researchers. In fact, Stanford University's *One Hundred Year Study of Artificial Intelligence* authors claim that there is a 'lack of a precise, universally accepted definition of AI', which has actually 'helped the field to grow, blossom and advance at an ever-accelerating pace'.[4] What these authors overlook is that AI is not only about intelligence, but AI relies on intelligent *behaviour*: As cited below, the very person who is credited with inventing the very term AI, described AI to be the activity of 'making a machine behave in ways that would be called intelligent if a human were so behaving'.[5] There is a wealth of research in philosophy, sociology and psychology, primarily by white men, about 'what is intelligence', and the thinkers who influenced early AI researchers, even if not precisely referenced, lend purpose to 'intelligent' behaviour. So, the first two sections ask, who is reflecting who (or what), in the search for machinic intelligence?

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3 Weizenbaum p. 610.

4 Cited in Jacob Turner, *Robot Rules: Regulating Artificial Intelligence* (London, Palgrave Macmillan, 2019).

5 John McCarthy; Marvin L. Minsky; Nathaniel Rochester; Claude E. Shannon, 'A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence' (1955), *available at* http://jmc.stanford.edu/articles/dartmouth.html

The piece then discusses how now, intelligence is being attributed to machines in the context of the integration of AI into specific practices in human resource practices, robotics and algorithmic management in workplaces. Software designers and engineers are creating calculation machines for workplace decision making and design which are inextricably linked to the work design frameworks into which they are integrated, putting a cadre of digital experts in the driving seat for what might have once been the role of a management guru with little or no technical expertise. What kinds of intelligence are expected from AI-augmented machines in this context, and why does it matter? This section furthermore explores what this may mean for human workers, because technology integrators, who embrace new processes, imagine specific machinic intelligences to have the potential to fulfil specific goals which align with the types of human intelligences also needed to get work done in the contemporary era of agile I have outlined elsewhere.[6] While these intelligences appear innocuous at first glance, the seemingly inherent value and reliability of these new dimensions of workplace practices is assumed and of concern, if machinic is prioritised above human intelligence, a definitive dimension of the employment relationship will potentially be disrupted.

In conclusion, it is asked, what is this future of work, where machines are increasingly ascribed superior, but still 'artificial' intelligence, and how will workers and our larger political and economic surroundings, ultimately, be affected?

The Intelligence of *Humans*, by Humans

Even before the term AI was depicted, theories of cognition, consciousness and ideas were prevalent in thoughts about thinking. For lack of space it will be impossible to cover all ontological and epistemological debates surrounding work design and management theories leading up the present iterations of AI as it is influencing the workplace – which is the theme of this piece – of course. Scientific management is probably the best-known era for linking machines with human behaviour, where the machine is seen as a superior calculator. But some important moments in the early developments of thinking about human reason stand out, some of which were later contemplated by the school of cybernetics, and then AI.

In British empirical philosophy, the mind is seen to be made up of ideas. In the chapter 'Of Reason and Science' of *Leviathan*, Hobbes mused: 'When a man reasons, he does nothing else but conceive a sum total from addition of parcels… for reason is nothing but reckoning'.[7] So, humans' capacity for reason, which animals were *not* expected to have, was seen to be a process whereby humans simply carve the world into symbolic units and use sums to make decisions, informing intention. We can consider the consequences of our actions and make theories and aphorisms, reasoning and reckoning: 'Not only in number, but in all other things whereof one may be added unto or subtracted from one another'. So, this form of human intelligence is portrayed in terms of calculative processes. Another well-known British empiricist, John Locke, held that the ideas that make up the human mind exist in a wholly passive way, where, on the basis of sensory contact

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6 Phoebe V. Moore, *The quantified self in precarity: Work, technology and what counts* (Abingdon, UK: Routledge, 2018).

7 Thomas Hobbes, *Leviathan* (1651), *available at*: http://www.philosophy-index.com/hobbes/leviathan/5-of-reason.php

with the outside world, pull themselves into bundles of similarity, borders, or cause and effect, similar to the ways that neural networks later were expected to behave.

Philosophers, social theorists, and cognitive and behavioural psychologists worked on many theses relating to the human mind and what defines consciousness, but only one significant body of research which predates AI, explores the specific aspects of human thought with continuous relation to machines: That of cybernetics. Despite they were working sometimes in direct parallel with AI researchers in the mid-1950s and beyond, cybernetics researchers dedicated far more time and energy to considerations about consciousness, thought, communication, and cognitive science, than their AI colleagues. There was cross-fertilisation in their projects of course. So, this section identifies some key points of thought during this period, to identify how human and machinic intelligence were portrayed.

Norbert Wiener, one of the key forefathers of cybernetics work, cogently noted in 1948 in *Cybernetics, or, Control and Communication in the Animal and the Machine* that 'the thought of every age is its technique',[8] where there are continuous entanglements between human thought and machinic invention. First published in 1950, in the second version of the text *The Human Use of Human Beings: Cybernetics and Society* published in 1954, Wiener outlines 'Cybernetics in History'. Wiener was influenced by Descartes; the British empirical philosophers; and Pavlov and he highlights their considerations of the workings of the human mind, to ultimately compare the capacity of machines for mimicry. This mathematician was the first to use the term 'cybernetics', from the Greek word kubernētēs which means 'steersman' and the Greek word from which the word 'governor' later formed. The definition of cybernetics is tied to a theory of communication, where Wiener theorises that:

> ...society can only be understood through a study of the messages and the communication facilities which belong to it; and that in the future development of these messages and communication facilities, messages between man and machines, between machines and man, and between machines and machine, are destined to play an ever-increasing part.[9]

Cybernetics researchers' purpose of was to develop techniques and a language to give humans the tools to 'attack the problem of control and communication in general', but also to 'find the proper repertory of ideas and techniques to classify their particular manifestations under concepts'.[10] The idea, ultimately, was to figure out how to give perfect orders to machine and then to train machines themselves to give orders to other machines (today's 'internet of things'), on the basis of understanding how communication works as a control mechanism. So, this way of identifying intelligence is through communication itself, where we as humans are intelligent because we can *control* each other via communication (see: basic management theory and labour process theories of control + consent).

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8 Norbert Wiener, *Cybernetics, or, Control and Communication in the Animal and the Machine* (Cambridge, MA: Massachusetts Institute of Technology, 1948/1961).

9 Norbert Wiener, *The Human Use of Human Beings: Cybernetics and Society* (Boston, MA: Da Capo Press, 1954).

10 Wiener 1954, p. 16.

In *The Origins and History of Consciousness*, another key cyberneticist Erich Neumann explores mythological theories of foreknowledge and pre-dualist consciousness. An ancient Egyptian symbol is described with the following text: 'Draco interfecit se ipsum, maritat se ipsum, impraegnat se ipsum' which means 'it slays, weds, and impregnates itself. It is man and woman, begetting and conceiving, devouring and giving birth, active and passive, above and below, at once'. This symbolises a one-ness, a 'wholeness, unity, nondifferentiation, and the absence of opposites'.[11] Children are treated with great respect in many primitive societies because much or their behaviour reflects a prenatal phase, where the 'feeble ego' is still determined by an ancestral state.[12] The myth of foreknowledge reflects the human belief that all knowing is somehow linked to 'memory'.[13] Neumann's beautifully written prose outlines several primitive, mythological and religious dispossessions to identify the history of consciousness (and beliefs around unconsciousness) to show that 'the act of becoming conscious consists in the concentric grouping of symbols around the object, all circumscribing and describing the unknown from many sides'.[14] It is difficult to imagine how machines could mimic such fantastic delineations of the human experience, but Neumann's work is central to the emerging discussions around what separates humans from machines. In *Understanding Understanding: Essays on Cybernetics and Cognition*, Heinz von Foerster considers the feasibility of the existence of self-organising systems and focusses on memory, which is as important today for computational systems as processing power. The book begins with the thesis that, in fact, self-organising systems *cannot exist*. Nonetheless, this cyberneticist deliberates extensively on the thesis of the conditions and premise upon which a self-organising system *could* exist, proposing that:

1) By a self-organising system, I mean that part of a system that eats energy and order from its environment;
2) There is a reality of the environment in a sense suggested by the acceptance of the principle of relativity;
3) The environment has structure.[15]

Thus, there must be context for existence and consciousness, which differentiates 'semantics' from 'syntax' in human/machinic consciousness.

Cyberneticists looked carefully at the depiction of human intelligence and consciousness as tied to the tendency toward entropy. Wiener indicates that 'a machine' is 'a device which locally and temporarily seems to *resist* the general tendency for the increase of entropy (italics added by current author). By its ability to make decisions it can produce around it a local zone of organisation in a world whose general tendency is to run down'.[16] Machines, then, were seen to have a distinct advantage over humans. These ideas transferred into AI research, to which we now turn.

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11 Erich Neumann, *The Origins and History of Consciousness* (London and New York: Routledge, 1954), pp. 599.
12 Neumann p. 583.
13 Neumann p. 809.
14 Neumann p. 530.
15 Heinz von Foerster *Understanding Understanding: Essays on Cybernetics and Cognition*. (New York: Springer-Verlag, 2003), pp. 76–77.
16 Wiener, supra note p. 34.

The Intelligence of *Machines*, by Humans

The history of actually termed 'artificial intelligence' begins at an academic conference in 1956, which were really a series of workshops led by an Assistant Professor named John McCarthy, who worked with Marvin Minsky of Harvard, Nathan Rochester of IBM and Claude Shannon (who was also involved with the cybernetics community) of Bell Telephone Laboratories at these workshops to see whether they could make 'a machine behave in ways that would be called intelligent if humans were so behaving'. McCarthy used the term 'artificial intelligence' to differentiate it from 'cybernetics' and soon, despite, or perhaps because, of its overlaps in research questions, the field of AI took precedence to cybernetics altogether.

The subsequent so-called Symbolic Approach to AI involved attempting to mimic the logical processes of the brain, which was an era of investigation that was later called GOFAI. In this first period of AI research, physical symbol systems (PSS), also called formal systems, were envisaged by Allen Newell and Herbert A. Simon, two of the 'godfathers' of AI. These systems are those which 'have the necessary and sufficient means for general intelligent action'.[17] PSS relied on rationalist fundamentals and logical assumptions in the tradition of Descartes, Hobbes, Leibniz, Kant and Hume, where one must have abstracted a theory based on invariant features in specific situations to deal with a domain. The claim that the PSS have the means for general intelligent action is based on an understanding of how humans think, i.e. that we *only* carry out symbol manipulation. Indeed, if that is right, and that humans only carry out symbolic manipulation and that equates intelligence, then machines, can, of course, be intelligent.

The term AI itself flourished in popularity and in this early phase of AI research, researchers held that human-readable representations of problems, in the form of symbols, should inform how all AI research should be conducted. This form of AI involved expert systems which reflected production rules that are altered by human deduction in the context of emergent errors, the processes relying on an 'if this, then that' type of formula, basically, a flow chart. Machine's intelligence required 'making the appropriate inferences' from their seemingly internal representations, where a PSS was seen to posit this, as quoted, 'necessary and sufficient means for general intelligent action'. There was a lot of criticism of PSS and of GOFAI in general, but nevertheless, is the basis of AI in the earliest considerations. Critics held that there are problems with expecting machines to supposedly represent the world exactly as humans do or argued that humans don't 'represent' the world at all, but in fact, 'are' the world. This reasoning sits alongside a more recent idea that machines should be fully autonomous.

So-called symbolic, and connectionist AI researchers did not agree on what are the more important features of intelligence, but Haugeland, who coined the term 'good old fashioned artificial intelligence' (GOFAI), describes intelligent beings as demonstrating the following characteristics: Firstly, our ability to deal with things intelligently, where intelligence is present due to our capacity to think about them reasonably (including subconscious thinking); and secondly, the capacity to think about things reasonably, which amounts to a faculty for internal/automatic symbol manipulation. It also becomes clear that memory and ability to process thoughts and ideas and turn those ideas into analysis; the capability to make choices

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[17] Allen Newell and H. A. Simon, Computer Science as Empirical Inquiry: Symbols and Search, *Communications of the ACM*, 19 (3): 113–126 (1976).

rather than simple decisions; and the ability for empathy and sentience, are necessary for intelligence to be manifest which is particularly important as machines are ascribed more forms of intelligence such as those argued in the second section, namely, collaborative capacities, prediction-making ability and prescriptive positioning. Marcus Hutter, who designed a theory of universal AI, argued that 'the human mind… is connected to consciousness and identity which define who we are… intelligence is the most distinct characteristics of the human mind… enables us to understand, explore and considerably shape our world, including ourselves'.[18] AI research, Hutter indicates, reflects this sentiment, since the 'grand goal of AI is to develop systems that exhibit general intelligence on a human-level or beyond'.[19]

The next important invention in the history of AI and the first major challenge to GOFAI and the hopes that machines could be trained to 'represent' the world in the ways that humans do, was the invention of the first artificial neural network. Frank Rosenblatt, a psychologist, is said to have invented the first one in 1958, just two years after this first conference. This neural network was called Perceptron. It modelled the ways that human brains process visual data and learn how to recognize objects at the same time as picking similar cases: The first time this could be done in parallel (which differentiates it from the PSS). Neural networks allow computers to make decisions based on information within domains that is collected from various silos which result in conclusions from either supervised or non-supervised processes. That is what sets neural networks apart from GOFAI and brings us into the 'cognitive' period of AI research, where scientists are moving away from comparing machines so directly with humans and expecting them to think in the ways that humans do. Indeed, the invention of neural networks raised a number of philosophical questions about how a theory of domain is formulated.

About a decade later, in 1966, Joseph Weizenbaum, a German American MIT computer scientist who is also considered one of the forefathers of AI, invented the predecessor for today's Chatbots, naming this computer programme 'Eliza', after the ingenue in George Bernard Shaw's Pygmalion. Pygmalion is a character in Greek mythology who develops a love interest in his own sculpture which comes to life. This seemed an appropriate name for this chatbot given 'her' quickly observed capacity to induce emotion from those speaking to her. Weizenbaum took this response from humans seriously and was genuinely surprised when people responded so genuinely to Eliza. Indeed, Weizenbaum was very sceptical about the integration of computers into society and saw the dark sides that it introduced.[20] Alan Turing would have probably found this finding quite interesting, given the experiments he pursued, where humans project their own assumptions onto machines. Indeed, Alan Turing is one of the only theorists during the early discussions of AI to thoroughly interrogate the question 'can machines think?'.[21] His illumination of the words 'machine' and 'think', in the first paragraph of 'Computing Machinery and Intelligence'[22] asks a similar question to mine, i.e. 'what is intelligence' when we talk about AI, and so on. In designing the Imitation Game, Turing was also careful to state that 'no engineer or chemist claims to have been able to produce material which is indistinguishable from the human skin… we do not wish

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18 Marcus Hutter, 'One Decade of Universal Artificial Intelligence', *Theoretical Foundations of Artificial General Intelligence*, Vol.4 (2012), pp. 67–88, p. 1.

19 Hutter (2012), p. 1.

20 Weizenbaum (1972) supra note.

21 Alan M. Turing 'Computing Machinery and Intelligence' *Mind* Vol. 49 (1950), pp. 433–460.

22 Turing (1950).

to penalise the machine for its inability to shine in beauty competitions, nor to penalise a man for losing in a race against an aeroplane'.[23] It is interesting that this particularly important researcher, who was himself punished for his homosexuality, alludes in this quote that the difference between the human and machine is very much corporeal and by extension, human intelligence cannot be separated ontologically from our physicality. Philosophically, this could be linked to later new materialist research.

The next section reveals the practical sides of the integration of AI into everyday lives in the workplace and the risks that emerge when intelligence is assumed from the tools and applications implemented.

The Intelligence of Machines, by Machines

AI has reached a stage now where it is expected to somehow transform societies forever, with contrasting visions from the late Stephen Hawking who declared that AI was the 'worst event in the history of our civilization' and Elon Musk who noted that 'AI is a fundamental risk to the existence of human civilization', to enthusiastic predictions about its ability to facilitate superpower status for countries. Advanced countries are currently very active in integrating AI across industry and as many spheres of society as possible, allocating significant pots of funding in the order of billions to research and development in AI, with the United States in the lead, closely followed by China and Israel.[24] AI is predicted to provide a 26 % boost to gross domestic product (GDP) by 2030 in China. North America is predicted to see a 14.5% boost,[25] and some predictions indicate that AI will create as many jobs as it eliminates.[26] In most cases, high-level governmental and organisational reports are predicting that AI will improve productivity. However, discussions seem to not link productivity with workers and workplaces, despite this is precisely where AI is being introduced in order to improve productivity, in the factories, in gig work and in office contexts.

This section identifies explicitly the ways that AI is being ascribed with forms of intelligence that are at points being prioritised over human intelligence and thus used to make workplace decision-making. Human resource decision making, or people analytics and filmed interviews, is where humans expect machines to show predictive intelligence. Where cobots are applied, the implementers assume that these machines are both assistive and collaborative in their intelligence capacities. Call centre chatbots are given assistive intelligence capacities. Wearable technologies in factories likewise are assistive. Algorithms in platform work are predictive and proscriptive, where clients and customers are matched better than humans could do. Within all of these categories, machines are given calculation intelligence beyond and superior to any level of

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23 Turing (1950), p. 434.

24 Laura Delponte, *European Artificial Intelligence leadership, the path for an integrated vision*. Brussels, Policy department for Economic, Scientific and Quality of Life Policies (European Parliament 2018).

25 Price Waterhouse Cooper (PwC) *Artificial Intelligence in HR: A No–Brainer*, (2018), *available at:* https://www.pwc.com/gx/en/issues/data-and-analytics/publications/artificial-intelligence-study.html

26 PwC, *AI will create as many jobs as it displaces by boosting economic growth*, (2018), *available at:* https://www.pwc.co.uk/press-room/press-releases/AI-will-create-as-many-jobs-as-it-displaces-by-boosting-economic-growth.html

human intelligence, which fits well with the capitalist schema of abstracting concrete value of labour, where 'assistance', 'collaboration' and so on, are simultaneously enhanced with metrics producing activities against which human workplace performance are judged.

A) Predictive intelligence

In the area of HR business execution, AI integration is called 'people analytics', defined broadly as the use of big data and digital tools to 'measure, report and understand employee performance, aspects of workforce planning, talent management and operational management'.[27] Computerisation, data-gathering and monitoring tools allow organisations to conduct 'real-time analytics at the point of need in the business process ... [and allow] for a deeper understanding of issues and actionable insights for the business'.[28] Prediction machine algorithms applied for these processes often reside in a 'black box',[29] and people do not fully understand how they work, but, even so, computer programs are given the authority to make 'prediction[s] by exception'.[30] 'Prediction by exception' refers to processes whereby computers deal with large data sets and are able to make reliable predictions based on routine and regular data and also to spot outliers and even send notifications 'telling' the user that checks should be made or that human assistance or intervention should be provided.

Also called 'human analytics', 'talent analytics' and 'human resource analytics', in an era of 'strategic HR', this application of AI-enabled tools is defined broadly as the use of individualised data about people to help management and HR professionals make decisions about recruitment, i.e. who to hire, for performance appraisals and promotion considerations, to identify when people are likely to leave their jobs and to select future leaders. People analytics are also used to look for patterns across workers' data, which can help to spot trends in attendance, staff morale and health issues at the organisational level.

'People problems' are also called 'people risks',[31] and are divided into seven dimensions in a Chartered Institute for Personnel Development (CIPD) report by Houghton and Green as:

1. talent management,
2. health and safety,
3. employee ethics,
4. diversity and equality,
5. employee relations,
6. business continuity, and
7. reputational risk.

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27 Laurence Collins; David R Fineman; Akio Tshuchica, *People analytics: Recalculating the route* (Deloitte Insights 2017), *available at:* https://www2.deloitte.com/insights/us/en/focus/human-capital-trends/2017/people-analytics-in-hr.html

28 Collins et al. supra note

29 Frank Pasquale, The Black Box Society: The Secret Algorithms That Control Money and Information (Boston, MA: Harvard University, 2015).

30 Ajay Agarwal, Joshua Gans & Avi Goldfarb, *Prediction Machines: The Simple Economics of Artificial Intelligence* (Boston, MA: Harvard Business Review Press 2018).

31 Edward Houghton, Melanie Green, *People analytics: Driving business performance with people data* (Chartered Institute for Personnel Development 2018) *available at:* https://www.cipd.co.uk/knowledge/strategy/analytics/people-data-driving-performance

But perhaps people are not the only 'problem'. Based on the original definition of AI, in which machinic intelligence will be demonstrated when they behave as a human would: If humans are discriminating and biased, then we should not be surprised when AI provides biased answers. In other words, machine learning operates only on the data that it is fed, and if those data reveal past discriminatory hiring and firing practices, then the results of the algorithmic process are likely to also be discriminatory. If the information gathered about workers is not buffered with qualitative information about individuals' life experiences and consultation with workers, unfair judgements could be made. Cherry has shown that management's "search for new pools of quantitative data are correlated with business and employment success" and data is used to "make workplace decisions and to replace subjective decision-making by managers".[32]

Not all people analytics have to be, strictly speaking, AI. However, programmes' intelligent responses to algorithmic equations allow machine learning, which generates predictions and asks associated questions that emerge without human intervention except at the data input phase. Big data has been seen as a lucrative growth area for some years, whereby the collection of information about everything, all the time, has been an attractive investment. Now, the big data era is paying off in HR circles, because the extensive pools of data now available can be used to train algorithms to form analyses and make predictions about workers' behaviour via machine learning and thereby assist management decision-making. On the basis of the patterns identified, AI enables an algorithm to produce solutions and responses to enquiries about patterns across data much more quickly than people could. Machine learning responses are often unlike those that a human alone would, or perhaps even could, generate. Data about workers can be gathered from various sources both in and outside the workplace, such as number of keyboard clicks, information from social media, number of and content of telephone calls, websites visited, physical presence, locations visited outside the workplace through GPS (global positioning system) tracking, movements around the office, content of emails and even tone of voice and bodily movements in sociometrics.[33]

AI-enhanced HR practices can help managers obtain seemingly objective wisdom about people even before they hire them, as long as management has access to data about prospective workers, which has significant implications for tailoring worker protection and preventing occupational safety and health risks at the individual level. Indeed, algorithmic decision-making in people analytics could be used to support workforces by aligning employee performance feedback and performance pay — and workforce costs — with business strategy and support for specific workers. Workers should be personally empowered by having access to new forms of data that help them to identify areas for improvement, that stimulate personal development and that achieve higher engagement.

However, if processes of algorithmic decision-making in people analytics do not involve human intervention and ethical consideration, this machinic human resource tool could expose workers to heightened structural, physical and psychosocial risks and stress. How can workers be sure that decisions are being made fairly, accurately and honestly, if they do not have access to the data that their employer holds and uses? The risks of stress and anxiety arise if workers feel that

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[32] Miriam A. Cherry, People analytics and invisible labor *Saint Louis University Law Journal* Vol. 61, No. 1, pp. 1–16 (2016).

[33] Moore (2018) supra note.

decisions are being made based on numbers and data, where the machinic intelligence takes precedence over that of the human, in particularly in cases where they have no say in the processes selected to gather data about themselves, nor access to the data itself.

This is particularly worrying if people analytics data leads to workplace restructuring, job replacement, job description changes and the like. People analytics are likely to increase workers' stress if data are used in appraisals and performance management without due diligence in process and implementation, leading to questions about micro-management and workers feeling 'spied on'. If workers know that their data are being read for talent spotting or for deciding possible layoffs, they may feel pressurised into improving their performance and begin to overwork, posing occupational safety and health risks. Another risk arises with liability, in which companies' claims about predictive capacities may later be queried for accuracy or personnel departments held accountable for discrimination.

Another form of people analytics involves filming job interviews. This practice is carried out by organisations such as Nike, Unilever and Atlantic Public Schools. These companies are using products that allow employers to interview candidates on camera, in which AI is used to judge both verbal and non-verbal cues. One such product is made by a group called HireVue and is used by over 600 companies. The aim is to reduce bias that can arise if, for example, an interviewee's energy levels are low or if the hiring manager has more affinity for an interviewee based on similar, for example, age, race and related demographics. However, there is evidence that preferences from previous hiring managers are reflected in hiring, and heterosexual white men are, a report by Business Insider reveals, the hiring preference, other things being equal.[34] If the data provided to an algorithm reflect the dominant bias over time, then it may score someone with 'in group' facial expressions higher and give a lower rating to other cues tied to sexual orientation, age and gender that do not resemble a white male. Therefore, the expected intelligence of the machine has in no way excelled against human 'intelligence', which for the activities of recruitment, hiring, firing and talent management in human resources has been repeatedly demonstrated to be discriminatory and make biased decisions.

B) Collaborative and assistive intelligence: Cobots

Robots were at first built to carry out simple tasks, they are increasingly enhanced with AI capabilities and are being 'built to think, using AI'.[35] Cobots' intelligence is seen to be both assistive and collaborative, in the following ways. Incredibly large orange robot arms have replaced workers in factories in many parts of the world, where building car parts and assembling cars have reaplced conveyor belts lined with humans. AI should not be confused with automation, however. Automation in its pure sense involves, for example, the explicit replacement of a human's arm with a robot arm. Lower skilled, manual work has historically

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3434 Richard Feloni, 'I tried the software that uses AI to scan job applicants for companies like Goldman Sachs and Unilever before meeting them, and it's not as creepy as it sounds' Business Insider UK 23/08/2017 *available at:* https://www.uk.businessinsider.com/hirevue-ai-powered-job-interview-platform-2017-8?r=US&IR=T/#in-recorded-videos-hirevue-employees-asked-questions-like-how-would-you-describe-your-role-in-the-last-team-you-worked-in-4

35 Jari Kaivo-oja, *A Review on the Future of Work: Robotics.* Discussion Paper. Bilbao, European Agency for Safety and Health at Work (2015), *available a*t: https://osha.europa.eu/en/tools-and-publications/seminars/focal-points-seminar-review-articles-future-work

been most at risk and is still at a high risk of automation. Now, automation can be augmented with autonomous machine behaviour or 'thinking'. So, the AI dimension of automation reflects where workers' brains, as well as their limbs, may no longer needed.

Cobots are integrated into factories and warehouses where they work alongside people in a collaborative way. They assist with an increasing range of tasks, rather than necessarily automating entire jobs. Amazon has 100,000 AI-augmented cobots, which has shortened the time taken to train workers to less than 2 days. Airbus and Nissan are using cobots to speed up production and increase efficiency. AI-permitted pattern and voice recognition and machine vision mean that not only are unskilled jobs at risk of replacement but now a range of non-routine and non-repetitive jobs can be carried out by cobots and other applications and tools.

In that light, AI-enhanced automation enables many more aspects of work to be done by computers and other machines.[36] As a recent Netherlands Organisation for Applied Scientific Research (TNO) report states, there are three types of risks in human-cobot-environment interactions:

(a) robot-human collision risks, in which machine learning can lead to unpredictable robot behaviour;

(b) security risks, in which robots' internet links can affect the integrity of software programming, leading to vulnerabilities in security; and

(c) environmental risks, in which sensor degradation and unexpected human action in unstructured environments can lead to risks to the environment.[37]

Cobots can reduce some physical risks, as they allow AI systems to carry out other types of mundane and routine service tasks in factories, which historically create stress, overwork, musculoskeletal disorders and even boredom as a result of repetitive work. However, AI-augmented robots in factories and warehouses can create stress and a range of serious problems if they are not implemented appropriately. Indeed, one UK-based trade unionist indicated that digitalisation, automation and algorithmic management when 'used in combination … are toxic and are designed to strip millions of folks of basic rights' (interview with Maggie Dewhurst of the Independent Workers Union of Great Britain, 2017). Workplace issues include psychosocial risk factors if people are driven to work at a cobot's pace (rather than the cobot working at a person's pace) and the very real risk of robots' unpredictable behaviour, where collisions between cobots and people have no obvious solution in terms of regulation and liability (i.e. who is responsible, the manufacturer, designer, manager or worker herself if a collision occurs?).

Another cobot-related case of machine-human interaction creating new working conditions and possible risks in assigning superior intelligence to machines is when one person is assigned to 'look after' one machine and is sent notifications and status updates about machines on a

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[36] Carl Frey & Michael A. Osborne, *The future of employment: How susceptible are jobs to computerisation?* (Oxford: University of Oxford, Oxford Martin School 2013), *available at:* https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

[37] Netherlands Organisation for Applied Scientific Research (TNO). *Emergent risks to workplace safety; Working in the same space as a cobot*. Report for the Ministry of Social Affairs and Employment, The Hague, Netherlands, p. 18-19 (2018).

personal device such as a smartphone or a personal laptop. This can lead to risks of overwork, whereby workers feel compelled to take note of notifications in out-of-work hours and their work-life balance is disrupted. The requirement to constantly respond to factory notifications is a clear demonstration of the prioritisation of machinic intelligence over humans', at least where a human is not fully focussed on productivity and efficiency or may want a work/life balance that does not require notification responses over weekends!

Sensors, software and connectivity can be faulty and unstable, and all vulnerabilities raise questions about who is legally responsible for any damage that emerges. Is it a cobot's fault if it runs into a worker, the worker's fault, the company who manufactured the cobot originally or the company that employs the worker and integrates the cobot? Again, there is no immediate answer to questions around liability, ethics nor intelligence as we explicitly attribute intelligence to machines in the current world of work.

It is thought that cobots may someday have the competences to reason, a final point in the development of machinic intelligence perhaps, and therefore, it is reported by the TNO, must make humans feel safe. To achieve this, cobots will have to demonstrate perception of objects versus humans and the ability to predict collisions, adapt behaviour appropriately and demonstrate sufficient memory to facilitate machine learning and decision-making autonomy.[38]

C) Assistive intelligence: Chatbots

Chatbots are another AI-enhanced tool that can deal with a high percentage of basic customer service queries, freeing up humans working in call centres to deal with more complex questions. Chatbots work alongside people but in the back end of systems where they are used to deal with customer queries over the phone using natural language processing. Dixons Carphone uses a conversational chatbot now named Cami that can respond to first-level consumer questions on the Currys website and through Facebook Messenger. Insurance company Nuance launched a chatbot named Nina to respond to questions and access documentation in 2017. Morgan Stanley has provided 16,000 financial advisers with machine learning algorithms to automate routine tasks.

Call centre workers already face extensive risks because of the nature of the work, which is repetitive and demanding and subject to high rates of micro-surveillance and extreme forms of measurement.[39] An increasing number of activities are already recorded and measured in call centres. Words used in emails or stated vocally can be data-mined to determine workers' moods, a process called 'sentiment analysis'. Facial expressions likewise can be analysed to spot signs of fatigue and moods that could be used to make judgements and thus lower the risks of overwork. But chatbots, while designed to be assistive machines, still pose psychosocial risks around fears of job loss and replacement. Workers should be trained to understand the role and function of workplace bots and to know what their collaborative and assistive contributions are.

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38 TNO (2018) supra note 16.

39 Jamie Woodcock, *Working the Phones: Control and Resistance in Call Centers* (London: Pluto Press, 2016).

D) Assistive intelligence: Wearables

Wearable self-tracking devices are increasingly seen in workplaces. This is already happening in warehouses and factories where GPS, radio-frequency identification and now haptic sensing armbands, such as that patented by Amazon in 2018, have replaced the use of clipboards and pencils.

Wearable technologies with AI augmentation are seen to offer a level of intelligence that again, excels over human intelligence in assistive capabilities. One new feature of automation and Industry 4.0 processes in which AI-enhanced automation is under way, is the practice of training workers to perform productive tasks within lot size manufacturing. This process involves workers being provided with glasses with screens and virtual reality functionality, such as HoloLenses and Google Glasses, or computer tablets on stands within the production line, which are used to carry out on-the-spot tasks on production lines. The assembly line model, in which a worker carries out one repeated, specific task for several hours at a time, has not disappeared completely, but the lot size method is different. Used in agile manufacturing strategies, this method involves smaller orders made within specific time parameters, rather than constant bulk production that does not involve guaranteed customers.

Visual on-the-spot training enabled by a HoloLens screen or tablet means that workers are required to carry out new tasks that are learned on-the-spot, in augmented reality situations, where tasks are required instantaneously and carried out only for the time required to manufacture the specific order a factory receives. While at first glance these assistance systems may *appear* to provide increased autonomy, personal responsibility and self-development, this is not necessarily the case.[40]

The use of on-the-spot training devices, worn or otherwise, means that workers need less pre-existing knowledge or training, because they carry out the work case by case. The risk of work intensification thus arises, as head-mounted displays or tablet computers become akin to live instructors for unskilled workers. Furthermore, workers do not learn long-term skills, because they are required to perform on-the-spot, modular activities in custom assembly processes, needed to build tailor-made items at various scales. While this is good for the company's efficiency in production, lot size methods have led to significant risks of deskilling workers, because skilled labour is needed only to design the on-the-spot training programmes used by those workers who no longer need to specialise. The wearable technologies used are assistive, but also lead to explicit risks that can emerge because of the lack of communication with e.g. specialists. If workers are not able to comprehend the complexity of the new technology quickly enough, particularly if they are also not trained to prepare for any hazards arising, they are at risk of being replaced or disciplined, where the machine again is seen to hold all intelligence in the workplace.

Next, we turn to another arena in which machines are being ascribed intelligence, is namely in 'gig work' environments.

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[40] Florian Butollo, Ulrich Jürgens & Martin Krzywdzinski, *From lean production to Industrie 4.0: More autonomy for employees?* WZB Berlin Social Science Center Discussion Paper SP III 2018-303 (2018).

E) Prescriptive intelligence: Algorithms

'Gig work' is obtained by using online platforms, made available by companies such as Uber, Upwork or Amazon Mechanical Turk (AMT). The work can be performed *online*, obtained and carried out on computers in homes, libraries and cafes, for example, and includes translation and design work; or *offline*, i.e. obtained online but carried out offline, such as taxi driving or cleaning work.

Not all algorithms utilise AI, but the data produced by client-worker matching services and customer assessment of platform workers provide data that train profiles that then result in overall higher or lower scores that then lead, for example, clients to select specific people for work over others. So, algorithms are used to match clients with workers in online gig work (also called microwork) and thus are expected to hold prescriptive intelligence. One platform called BoonTech uses IBM Watson AI Personality Insights to match clients and online gig workers such as those gaining contracts using AMT and Upwork. Issues of discrimination have emerged that are related to women's domestic responsibilities, when carrying out online gig work at home, such as reproductive and caring activities in a traditional context.

In gig work, workers have been forced to register as self-employed workers, losing out on the basic rights that formal workers enjoy such as guaranteed hours, sick and holiday pay and the right to join a union. Gig workers' online reputations are very important because a good reputation is the way to gain more work. Digitalised customer and client ratings and reviews are key to developing a good reputation and these ratings determine how much work gig workers obtain. Algorithms learn from customer rankings and quantity of tasks accepted, which produces specific types of profiles for workers that are usually publicly available. Customer rankings are deaf and blind to the consideration of workers' physical health, care and domestic work responsibilities, and circumstances outside workers' control that might affect their performance, leading to further risks, where people feel forced to accept more work than is healthy, or are risk of work exclusion. Customer satisfaction rankings, and number of jobs accepted, can be used to 'deactivate' taxi drivers' use of the platform, as is done by Uber, despite the paradox and fiction that algorithms are absent of 'human bias'.[41]

Overall, while there are benefits for integrating AI into gig work including driver identity protection and allowing flexible hours of work, good for people's life and work choices, these same benefits can result in rising risks, such as the case of the DiDi driver and the case of a double burden of work for women online workers. Worker protections are generally already scarce in these working environments and the risks are many and involve low pay and long hours,[42] endemic lack of training[43] and a high level of insecurity.[44] Nonetheless, the almost blind

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41 Carl Frey & Michael A. Osborne *The future of employment: How susceptible are jobs to computerisation?* (Oxford, University of Oxford, Oxford Martin School 2013), *available at:* https://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

42 Janine Berg, *Income security in the on–demand economy: Findings and policy lessons from a survey of crowdworkers*. Conditions of Work and Employment Series No. 74. Geneva, ILO. Inclusive Labour Markets, Labour Relations and Working Conditions Branch. (2016).

43 Chartered Institute for Personnel Development (CIPD). To gig or not to gig? Stories from the modern economy. (2017), London, *available at*: www.cipd.co.uk/knowledge/work/trends/gig-economy-report

faith in the capability of the algorithm and its prescriptive intelligence witnessed in newly designated platform business models and management methods[45] demonstrate the endemic trend to look to machines for intelligence, perhaps forgetting the word that directly precedes: that being 'artificial'.

Towards a conclusion

The difference with AI and other forms of technological development and invention for workplace usage is that because of the intelligence projected onto autonomous machines, they are increasingly treated *as* decision makers and management tools themselves, because of their seemingly superior capacity to calculate and measure. Where many recent reports on AI try to deal with the questions of 'what can be done' or 'how can AI be implemented ethically', the issue is greater. A move to a reliance on machinic calculation for workplace intelligent decision-making actually introduces extensive problems for any discussion of 'ethics' in AI implementation and use, at all.

In Locke's *An Essay Concerning Human Understanding*, this empiricist philosopher wrote that ethics can be defined as "the seeking out [of] those Rules, and Measures of humane Actions, which lead to Happiness, and the Means to practice them" (Essay, IV.xxi.3 1689).[46] This is of course just one quote, by one ethics philosopher, but it is worth noting that the *seeking out* of and setting such rules, as are the parameters for ethics depiction, has only been carried out and conducted, so far, by humans. When we introduce the *machine* as an agent for rule setting, as AI does, the entire concept of ethics falls under scrutiny. Rather than talking about how to implement AI without the risk of death, business collapse or legal battles, which are effectively the underlying concerns that drive ethics in AI discussions today, it would make sense to rewind the discussions and focus on the question: Why implement AI at all? Will the introduction of AI into various institutions and workplaces across society really lead to prosperous, thriving societies as is being touted? Or will it deplete material conditions for workers and promote a kind of intelligence that is not oriented toward e.g. a thriving welfare state, good working conditions or qualitative experiences of work and life?

In China, the government has started to give people individual citizen scores, or an economic and personal reputation scoring, which will look at people's rent payments, credit rankings, phone use, and so on. It will be used to determine conditions for obtaining loans, jobs and travel visas. Soon, people analytics could be used to give people 'worker scores' to be used for decision-

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44 Matthew Taylor, *Good work: The Taylor Review of Modern Working Practices* (London, United Kingdom: Department for Business, Energy and Industrial Strategy 2017), *available at:* https://www.gov.uk/government/publications/good-work-the-taylor-review-of-modernworking-practices

45 See Phoebe V. Moore and Simon Joyce. Black Box or Hidden Abode? The Expansion and Exposure of Platform Work Managerialism. *Review of International Political Economy* (in press, 2019); Prassl, Jeremias. 2018. *Humans as Service: The Promise and Perils of Work in the Gig Economy*. Oxford, UK: Oxford University Press.

46 John Locke. An Essay concerning Human Understanding' Vol. 1 Part 1 *The Works of John Locke*, vol. 1. London: Rivington, (1824), 12th ed. P. 1639–1689. *available at:* https://oll.libertyfund.org/titles/761

making in appraisals, which would introduce all sorts of questions about privacy and surveillance as machinic reasoning is again prioritised over human. While machines can perform some tasks faster than humans in calculation and statistical generation, they cannot understand context. While machines have more memory and processing power than ever before, which is how they can participate in machine learning, they lack empathy and full historical knowledge. The problem is that machines do not and cannot see the qualitative aspects of life, nor the surrounding contexts. Cathy O'Neil, author of *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy*, made an insightful observation in a recent interview with the current author. While watching Deliveroo riders hurtle past her in the rain, Dr O'Neil considered the platforms directing the riders' work, which operate on the basis of efficiency and speed and thus instigate riders to cycle in unsafe weather conditions. This clearly puts riders' very lives at risk. Dr O'Neil calls algorithms 'toy models of the universe', because these seemingly all-knowing entities actually only know what we tell them, and thus they have major blind spots.

If is accepted that machines hold the same competences of humans, or even better competences than us, what will be left for us? Are all machines intelligent, or only some? How is intelligence defined? Driving the thinking for this exposition lies the following questions: Why do we want machines to behave 'intelligently'? What do we mean by 'intelligence'? And what is at risk for workers, when we ask machines to behave in our own image? Can there be an ethical use for AI, given the complexity of rulemaking, when something besides an intelligent human mind is expected to make rules? Where will the final say in intelligence lie? Why do we want machines to behave as we do, given evidence already shows that machine learning can only learn as much as already exists in the data that trains it, and if the data reflects humans' discriminatory behaviour, then the algorithms, almost necessarily, will demonstrate or promote discrimination. The mythical invention of E. M. Forster's all-encompassing machine in his classical science fiction story[47] was not, of course, subject to a range of ethical and moral review panels before all of humanity began to live within it under the Earth's crust. As we enter a new era of AI it will remain important to recall the tension points in positioning technologies into places of power in workplaces and maintain rather than the looming horizon where machines are in command, a 'human in command' approach[48] to rolling out any new technologies into workplaces. As this Special Issue acknowledges, human responses to this trend should involve careful regulation, where human intelligence takes precedence, as the machine becomes increasingly evident in our working lives.

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47 E. M. Forster, *The machine stops* (London: Penguin Books, 1928/2011).

48 Valerio De Stefano, *Negotiating the algorithm: Automation, artificial intelligence and labour protection*, ILO Working Paper No 246 (Geneva: International Labour Organization, 2018).

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