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Algorithmic regulation: A maturing concept for investigating regulation *of* and *through* algorithms

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Abstract

This paper offers a critical synthesis of the articles in this Special Issue with a view to assessing the concept of "algorithmic regulation" as a mode of social coordination and control articulated by Yeung in 2017. We highlight significant changes in public debate about the role of algorithms in society occurring in the last five years. We also highlight prominent themes that emerge from the contributions, illuminating what is distinctive about the concept of algorithmic regulation, reflecting upon some of its strengths, limitations, and its relationship with the broader research field. In closing, we argue that the core concept is valuable and maturing. It has evolved into an analytical bridge that fosters cross-disciplinary development and analysis in ways that enrich its early "skeletal" form, thereby enabling careful and context-sensitive analysis of algorithmic regulation in concrete settings while facilitating critical reflection concerning the legitimacy of existing and proposed regulatory regimes.

Keywords: accountability, data protection, ethics, platform capitalism, surveillance.

1. Introduction

Over the last 40 years, computational algorithms have started to appear in almost all areas of contemporary life. From the advent of personal computers in the 1980s, the creation of the commercial internet in the 1990s, the subsequent emergence of cloud data storage, the release of Apple's iPhone in 2007, through to continuing advances in task-specific artificial intelligence ("AI") enabled by the application of machine learning techniques (particularly those applied to large data sets), and contemporary environments have now become increasingly digitized and "smartified." Daily life in advanced industrialized societies now routinely depends on internet-enabled devices that continuously collect and exchange data, parsed by algorithms of varying degrees of sophistication. Societal transformation precipitated by the turn to digitization is strikingly reflected in the transformation of global economic power. The tech sector (including Microsoft, Facebook, and Alphabet, Google's parent company) including those engaged in e-commerce (such as Alibaba, Amazon, and Walmart) has dethroned Big Oil and Big Pharma, occupying prominent positions among the world's 50 largest companies (Statista 2020). The transformations wrought by the wholesale embrace of networked communications technology across the globe have precipitated an explosion of scholarly interest in the intersection between algorithms and society.

An algorithm is an abstract, formalized description of a computational procedure intertwined with other computational forms such as data, data structures, programs, and processes (Dourish 2016) – which, in their entirety, we refer to in this Special Issue as algorithms. This volume focuses on "algorithmic regulation," referring to the concept as articulated by Yeung in this journal in 2017 entailing sustained, intentional attempts to employ algorithmic decisionmaking (ADM) in order to influence behavior or manage risk (Yeung 2017). The conjunction of algorithms and data can lead to, and be involved in, other forms of social ordering whether in intentionally

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imposed forms or those that emerge organically. When algorithms are originally designed and deployed for a pre-specified regulatory purpose to facilitate the performance of a designated set of tasks or functions, typically to shape, constrain, and coordinate the behavior of others and/or to manage particular kinds of risk, we are in the presence of algorithmic regulation.

The primary aim of this Special Issue is to examine the concept of algorithmic regulation, critically reflecting upon its strengths, limitations, and overall value as a conceptual vehicle for critical investigation of computational forms of coordination and control that often feature in the continuing embrace of digitization. In this introductory essay, we begin by explaining the origins of our shared interest in algorithmic regulation and the gestation of this Special Issue. We then identify several significant changes to the focus and tenor of public debate about the role and impact of algorithms in society since the publication of Yeung's article in 2017. An explanation of how the contributions to this volume have been grouped together follows, highlighting prominent themes that emerge from looking across the contributions as a whole. Finally, we reflect on some of the strengths, limitations, and development potential of the concept of algorithmic regulation as a vehicle for critical investigation and inquiry within the larger field of research concerned with the on-going digital revolution.

This Special Issue originated from a four-day academic "hot-housing" retreat hosted by the Volkswagen Foundation in October 2017. During that time, we discovered and discussed our mutual interest in critical scholarly inquiry via Yeung's concept of algorithmic regulation, which resonated powerfully with Ulbricht's on-going scholarly investigations. Our hunch was that the concept was ripe with potential as an analytical vehicle for scrutinizing an important element of various life domains through which algorithms were being employed intentionally to coordinate and control individuals, objects, and populations. Algorithms are applied in manifold contexts, ranging from the production and distribution of online content, informing and shaping the conduct of police work, social work, fraud detection, stock trading, transport, and employee assessment, to name but a few. This prompted us to organize several panels about algorithmic regulation for the seventh Biennial Conference of the ECPR Standing Group on Regulatory Governance that took place in Lausanne, Switzerland, in July 2018. We invited participants from a range of disciplines, subsequently issuing a wider call for contributions for this Special Issue.

1.1. A rapidly evolving context for studying algorithmic regulation

In the five years following the submission of Yeung's manuscript on algorithmic regulation for publication in August 2016, several significant changes have occurred, attesting to the dynamic socio-political context which the concept of algorithmic regulation must contend with in proving its analytical value and continuing salience. We briefly highlight and elaborate on three: (i) the explosion and diversification of scholarship about algorithms, data, and digital transformations within and across numerous disciplines; (ii) the increasing take up of algorithmic regulation in the public sector, accelerated by the COVID-19 pandemic; and (iii) growing anxiety and awareness of the manifold hazards and risks of algorithmic regulation raised in academia and public debate, including recognition of the need for meaningful limits on their hitherto largely unrestrained deployment.

First, academic interest in data and of networked digital technologies in society has exploded over the preceding five years. Critical investigations of digital technologies have become mainstream, as public awareness of machine learning applications has gathered pace and data-driven services have proliferated. In their literature review, Katzenbach and Ulbricht (2019) highlight the width and range of overlapping and dynamic research streams that engage with algorithmic regulation and governance. These includes studies that aim to *develop*, *evaluate*, *and optimize technical systems* including the burgeoning literature within the FAccT (Fairness, Accountability, and Transparency) and XAI (Explainable AI) communities, behavioral research, and studies from human-computer interaction (HCI) (Bader & Kaiser 2019; Biswas *et al.* 2020; Gray & Suzor 2020; Polack 2020). Other analyses explore the *lawfulness* of algorithms, offering proposals for legal reform, including the potential adaptation of existing legal doctrine and causes of action to address distinct kinds of harm and other adverse impacts arising from their implementation in specific contexts (Gorwa *et al.* 2020). This work often focuses on the *legitimacy and acceptability* of algorithms, by reference to a range of normative values and benchmarks, including literature that now proceeds under the rubric of "AI ethics" (Cristianini & Scantamburlo 2020). Another research community investigates *digital communication and social media*, including critical examination of political micro-targeting, with the field of online speech generating the most developed initiatives for formal regulation. These

studies have widened more recently to embrace digital platforms of all kinds which the EU's proposed Digital Markets Act and accompanying Digital Services Act seek to bring within its remit (Seering *et al.* 2019; Thorson *et al.* 2019; Walker *et al.* 2019). A growing research stream examines the use of algorithms in *public sector services and citizen management*, including investigations of smart cities and about "AI/data for humanitarian aid" (Dudhwala & Larsen 2019; Hong *et al.* 2019; Park & Humphry 2019; Veale & Brass 2019; Young *et al.* 2019), algorithms for *labor management* and "the future of work" (Jarrahi & Sutherland 2019; Shafiei Gol *et al.* 2019; Gal *et al.* 2020; Newlands 2021), scholarly investigations of the *platform economy* (or "gig" economy) and its companies, business models, and how they transform markets (Cheng & Foley 2019; Fenwick *et al.* 2019; Glaser *et al.* 2019; Leoni & Parker 2019; Wu & Taneja 2020). One conceptual challenge that arises from this rich and diverse profusion of research lies in the wide variety of rubrics whose relation to the concept of algorithmic regulation is uncertain and yet to be interrogated.

Secondly, recent years have witnessed an acceleration of enthusiasm for, and take-up of, digital automation in the delivery of public services, including AI. Advocates claim that these technologies will provide "users" with a more personalized, responsive, and efficient experience, while offering decisionmakers user-friendly tools capable of producing better and fairer recommendations (Misuraca & Van Noordt 2020). Yet opponents point to their indiscriminate and insensitive deployment, highlighting ways in which these systems introduce new dangers and vulnerabilities, including their capacity to perpetuate and reinforce existing forms of injustice (including but not limited to invidious discrimination on the basis of race, ethnicity, gender, and socio-economic status), particularly for vulnerable populations (Criado & Such 2019; UN Special Rapporteur 2019; Yeung & Lodge 2019). At the same time, the opacity and apparent objectivity of algorithms may undermine the protection of fundamental rights and freedoms, redistributing economic and political power while eroding the foundations and integrity of democratic institutions and processes (Ulbricht 2020). Particularly prominent are critiques highlighting their implications for historically marginalized groups, epitomized by the concepts of "social sorting" and "surveillance of the poor." In this respect, the blistering report of the UN Special Rapporteur on Extreme Poverty (2019), Philip Alston, stands in stark contrast to the celebratory Silicon Valley rhetoric that largely held sway when these technologies first acquired public prominence. His report draws attention to the highly intrusive and unjust ways in which digital tools serve to dismantle the welfare state while individualizing social security and responsibility, accompanied by harsher sanction regimes while narrowing the beneficiary pool, even as proponents of these systems justify their adoption in the language of modernization, personalization, and responsiveness (UN Special Rapporteur 2019, pp. 4–5).

The embrace of digital tools by governments all over the world has accelerated as the COVID-19 pandemic has unfolded, with many states turning to digital technologies to assist in pandemic management, including the use of apps for contact tracing and self-diagnosis, rule-implementation, and mobility control. The appearance of "COVID-19 apps" has provoked familiar tropes and controversies in which new technology is presented as a magic bullet, capable of addressing the most pressing problems of the age through "smart," precise, targeted, and largely instantaneous "freedom-preserving" public health management services (Braithwaite *et al.* 2020) while downplaying the highly intrusive forms of surveillance and control they entail. These applications have intensified debates about the social implications of public sector algorithmic regulation, particularly in relation to the handling of highly sensitive personal health data[1] (Roberts 2019; Schneider & Creemers 2020; Taylor *et al.* 2020). Other pandemic-related algorithmic services including digital "immunity certification" and "vaccine passports" currently used or under consideration in various jurisdictions (Ng 2020; Nuffield Council of Bioethics 2020; Ada Lovelace Institute 2021; Ferguson & Mitnick 2021; Rawlinson & Geddes 2021).[2]

In these contexts, the role of the tech industry and private sector providers has been central. While "COVID-19 apps" are new insofar as they have been developed for specific pandemic-related purposes, their reliance upon data, networked digital technologies, and public-private-partnerships build upon a well-established heritage. Taken together, these might come to be understood as a "Public Health-Digital Industrial complex," a COVID-19 inspired, data-driven reincarnation of the "Military-Industrial complex," a term that gained currency during the 1960s to describe the informal alliance between a nation's military and the defense industry that supplies it, with a vested interest exerting considerable influence over the direction of public policy generating mutual benefits for both. These links between government and the digital tech industry, particularly the "Digital Titans," had already been put in place by other state-sponsored projects of algorithmic regulation, often at great expense

and with uncertain effectiveness. These range from the Chinese Social Credit Systems through to the accelerating roll-out of smart cameras and other real-time surveillance systems at train stations, airports, and other public spaces around the world (including within self-described liberal democracies) including those that continuously capture and process highly sensitive facial biometric data remotely and at scale.

The promise of COVID-19 apps and their enthusiastic embrace in the early stages of the pandemic has subsequently given way as it became increasingly apparent that the contribution of these Apps to reducing the spread and virulence of the infection was far more limited than their proponents had expected. These experiences expose the widely held yet plainly mistaken belief that these networked digital systems will provide easy, scientifically grounded, politically neutral, and effective "solutions" to complex social problems. Yet many studies have raised serious doubts about the effectiveness of the apps in preventing infection (Braithwaite *et al*. 2020; AlgorithmWatch 2020, pp. 11–13; Stanley & Granick 2020, Yeung 2020a). This expansion of algorithmic regulation into the public sector provokes further questions worthy of investigation, including whether the experience of algorithmic regulation in the private sector (including their dangers, risks, and benefits) also appears in the public sector. Another question is whether (and in what ways) the enhanced demands of legitimacy that apply to public sector can be adequately secured given the state's monopoly over the legitimate exercise of coercive power and its increasing reliance on private sector services and expertise in the digital realm.

Thirdly, the proliferation of academic interest in datafication and digitization has occurred in tandem with rising public concern about their adverse individual and societal impacts, and concomitant calls for accountability, normative assessment, and legally enforceable limits. As this Special Issue goes to press, we observe growing public recognition about the voracious appetite for electricity that many data-driven services consume such that the "hidden costs" of digitization may contribute to, rather than help to mitigate, the urgent climate and environmental emergencies we now face. At the same time, the Digital Titans are struggling to maintain the public-spirited image that they spent decades nurturing and propagating. In particular, public debate questioned the solidity of the Digital Tech industry's ethical credentials, including its failure to grapple effectively with AI's continuing "White Guy" problem (Crawford 2016). These public concerns were recently nurtured by the dismissal of one of Google's most celebrated AI ethics experts, Dr Timnit Gebru, a black female computer scientist, after she co-authored a paper indicating that large language models could adversely impact marginalized communities (Hao 2020) and the dismissal of other key Google employees who raised concerns about the potential adverse societal impacts of advanced machine learning techniques. In this context, there has been a notable change in the tenor and orientation of policy-level discussions about the need to regulate algorithms since 2016, with an emerging consensus that the potential adverse impacts of many networked systems powered by machine learning algorithms justify the need for some kind of independent, external regulation. In other words, the term "regulation," when used to express the need to ensure that risky algorithmic applications are subject to meaningful and effective independent institutional oversight, has ceased to be a dirty word. Proposals to regulate data-driven applications powered by AI are no longer immediately dismissed within policy circles as the enemy of innovation. Instead, effective regulation is increasingly regarded as a precondition for the successful acceptance of algorithms in society and markets.

However, serious challenges persist concerning how regulation is best achieved, raising questions about the appropriate design, scope, trigger points, content, enforcement, and architecture of regulatory frameworks. Particularly noteworthy is the release of the EU's proposed AI Regulation as this Special Issue goes to press, purporting to offer a "risk-based" approach. The essential concept underpinning the idea of risk-based regulation posits that the level of protection offered to those who are "at risk" from the regulated activity should be proportionate to the severity, scale, and magnitude of that risk (Black 2010a; Yeung 2020b). Yet the proposed AI Regulation adopts a fairly blunt form of risk stratification, albeit a more "proportionate" and "risk-based" approach in comparison with the White Paper proposals that preceded it (Yeung 2020b), but rather less nuanced than the theoretically grounded approach offered by Krafft, Koenig, and Zweig (this volume). Although the proposed Regulation raises many questions, particularly concerning how it will be understood and operationalized, the turn to legal regulation nevertheless marks a significant and important departure from the prevailing view in 2016 in which reliance on voluntary self-regulation by the digital tech industry was considered by many to be adequate protection against the abuse of algorithmic power. These debates about the need to tame algorithmic power form part of the larger socio-political, technical, and economic context, which have continued to evolve since the

contributions to this Special Issue were written, and which highlight the relevance of the topic, its future importance, the need for on-going academic investigation and analysis.

1.2. A word about terminology

The study of algorithms falls under the banner of various rubrics: critical data studies, software and algorithm studies, surveillance studies, internet governance, platform governance, various forms of applied ethics (e.g., digital ethics, data ethics, machine ethics, AI ethics, etc), history and philosophy of science and technology, digital society and innovation, science and technology studies (STS), data justice, as well as data protection and information law, to name but a few. The wide range of "labels" attached to these strands of scholarly inquiry is indicative of an expanding research field still in its infancy, characterized by considerable overlapping interests and lines of investigation which the wide variety of lenses and specific preoccupations may, on a cursory glance, appear to conceal. Accordingly, one of the aims of the concept of algorithmic regulation generally, and of this Special Issue in particular, is to help identify and illuminate these points of integration, overlap, and divergence.

Although the title of this Special Issue is "algorithmic regulation," it includes articles that use the term "algorithmic governance." It is important to note that there is no clear-cut difference between these two terms, and that the definitions adopted by authors that use them reveals substantial overlap. Both terms, regulation and governance, have no canonical definition and the choice is often motivated by the historical and contextual use within specific research areas (Bevir 2008; Koop & Lodge 2017; Stoker 2018). Such research areas include, for example, "global governance" (Zürn 2018), "multi-level governance" (Hooghe & Marks 2001), "internet governance" (Denardis *et al*. 2020), "the regulatory state" (Majone 1994), "regulatory capitalism" (Braithwaite 2005), and "financial regulation" (Black 2010b). The choice of term is, in our view, often a product of the intellectual history and the disciplinary enculturation of authors. There are elements that concepts of regulation and governance often share: both focus on the norms, structures, institutions and practices of social ordering, both formal and informal, both envisage a scope that covers wider collectives ("collective interest," "common good"), and the inter-relation between state and non-state actors. Apart from this, conceptions differ widely: sometimes regulation is understood a subset of governance, reflected in the concept of "regulatory governance" (Levi-Faur 2011); sometimes there is no intersection, for example, when "regulation" refers only to state-related social ordering while governance refers to ordering in the non-state realm (Offe 2009).

This Special Issue chooses "algorithmic regulation" rather than algorithmic governance for two reasons. The first is to remain faithful to Yeung's original publication (Yeung 2017), which is commonly cited and has inspired further scholarly analyses. On this reading, algorithmic regulation encompasses the "intentional attempts to manage risk or alter behavior in order to achieve some pre-specified goal" (Yeung 2017, p. 508). Yeung's original definition is based on Julia Black's work (Black 2014) in which regulation, or regulatory governance, is understood as a subset of governance, defined by its *intentional orientation*, seeking to attain and maintain the achievement of a pre-specified purpose and characterized by a triumvirate of cybernetic functions entailing mechanisms for (i) standard-setting, (ii) information gathering and monitoring, and (iii) intervention and sanctioning to align system behavior with the regulator's overarching purpose. A common reason to employ the term "governance" instead of "government" is to denote neoliberal inspired transformations of the public sector (marked by the Thatcher administration in the United Kingdom and Reagan administration in the United States) beginning from the early 1980s onward. These reforms, particularly the widespread privatization and contracting out of service provision to the private and non-state actors and institutions, marked a shift in state functions which Osborne and Gaebler memorably referred to as a shift from "rowing to steering" denoted by a terminological shift from "government to governance" (Osborne & Gaebler 1992). We avoid using the term "algorithmic governance" to reduce the scope for misunderstanding and confusion that could arise if it was taken to imply something distinct and different from "algorithmic regulation." Instead, we consider regulatory governance as a subset of governance and see social ordering mechanisms that constitute forms of algorithmic regulation as a subset of the broader enterprise of regulatory governance.

The second reason is that computer-and-data-driven forms of social ordering currently in use appear to engage in "rowing" rather than merely "steering" (Osborne & Gaebler 1992; Hood 1995; Ferlie 2017). If we consider, for instance, the relationship between rule-givers and rule-takers, they are often unilaterally imposed rather than voluntarily or bilaterally negotiated and agreed, undertaken intentionally, in ways that are dynamic in form,

yet rigid (albeit programmable) in purpose. However, we welcome our contributors' (and others who share our sphere of inquiry) use of the terms "governance" and "regulation" in ways that differ from our chosen understandings. Given the wealth and interdisciplinarity of the field, we see no need to align the terminology provided that authors use their preferred terms clearly to avoid confusion. This Special Issue is not dogmatic in its terminology given our editorial ambition to forge and foster links between a variety of strands of academic discourse concerned with common or closely related phenomena. Thus, our contributions ground their research in a variety of scholarly discourses while linking them to similar or related concepts such as algorithmic governance (Gritsenko & Wood 2020), software as institution (Festic 2020), algorithmic surveillance (Kosta 2020), and algorithmic security (Bellanova & de Goede 2020).

Our use of the term "algorithmic regulation" was also partly motivated by its productive interpretative ambiguity, capable of encompassing both regulation *by* algorithms, as well as the regulation *of* algorithms. While Yeung's (2017) concept of algorithmic regulation focuses primarily on regulation *by and through* algorithms, she also foreshadowed the regulation *of* algorithms in drawing attention to serious concerns expressed about the legitimacy of algorithmic modes of coordination and control. This duality is alluded to in earlier work by Yeung concerned with "regulating technologies," seeking to invoke the capacity of technologies to be harnessed in the service of regulation, and the way in which technologies themselves might be subject to regulation (Brownsword & Yeung 2008). Other conferences[3] and publications (Ziewitz 2015; Brownsword *et al.* 2017) have also underlined the way that algorithms and regulation are closely intertwined and benefit from a holistic analysis: technologies are shaped by regulation; and regulation is shaped by technologies. Accordingly, both dimensions are important and worthy of rigorous scholarly investigation and analysis from a multiplicity of disciplinary perspectives.

2. The structure and organization of this Special Issue

The primary aim of this Special Issue is to critically investigate, refine, and build upon the concept of algorithmic regulation. The volume opens with a set of articles that critically engage with and offer refinements to the concept. These are followed by several contributions that interrogate related, complementary concepts. The third set of contributions explores a range of possibilities and perspectives on the challenges associated with seeking to regulate algorithms, in some cases drawing upon existing legal regimes, in other cases drawing on a wider range of non-statutory mechanisms and enriched by concepts that are of central importance in legal scholarship that may be less familiar to scholars from other disciplines. The collection is not representative of all research fields and topics that claim affinity or association with algorithmic regulation. Many of the contributions provide insights acquired through an exploration of a wide range of applications, whether applied by public or private sector actors and their intersections.

2.1. Developing further the concept of algorithmic regulation

The first group of articles interrogate, extend, and deepen the concept of algorithmic regulation, reflecting critically upon and refining elements of Yeung's (2017) concept and taxonomy (Bellanova & de Goede 2020; Eyert *et al.* 2020; Festic 2020) to provide additional theoretical insight, drawing upon STS, social theory (Eyert *et al.* 2020), and media studies (Festic 2020). Eyert, Irgmaier, and Ulbricht (2020) build on Yeung's concept of algorithmic regulation by linking it to quantification, classification, evaluation research, and STS. Their aim is to provide a deeper understanding of how numeric descriptions of the world, on the one hand, and material artifacts on the other, are involved in processes of social ordering. They propose a conceptual framework that analyzes the three components of algorithmic regulation as representation ("information-gathering" in Yeung's taxonomy), direction ("standard-setting"), and intervention ("behavior-modification"). This re-labeling also reflects their aim of connecting the concept of algorithmic regulation to various points of contact within social and political theory, including democratic theory, tools of government research, governmentality studies, and behavioral governance research. Importantly, the sub-dimensions and specifications for each of the three dimensions they identify are intended to facilitate comparative empirical studies in a manner which the skeletal frame sketched by Yeung does not, on its face, readily lend itself to. To illustrate the value of their framework, both as an analytical tool for empirical analysis and as a springboard for critique, they apply it to the algorithmic governance of drivers by the Uber app. Despite Uber's public statements, which emphasize the autonomy of drivers which they claim the app

enables, non-compliant behavior by Uber drivers is almost impossible in practice due to sophisticated technical means for measuring compliance and influencing driver behavior as well as the constant threat of exclusion from the Uber platform. Drivers are therefore left with little room for professional discretion and everyday resistance, hindering the development of trust, corporate identification, socialization, and self-organization.

Similarly, Bellanova and de Goede (2020) also flesh out Yeung's conceptual frame in a richer, full-bodied form capable of more readily offering an analytical vehicle for investigation of specific applications of algorithmic regulation. They draw attention to limitations arising from Yeung's definition of algorithmic regulation in purposive terms, observing that the goal of "securing" within algorithmic security may not be clearly articulated or pre-specified in advance, often characterized by uncertain and malleable goals and interventions. They connect Yeung's concept to the rich literature concerned with algorithms in security studies (e.g., Amoore 2013) through case study analysis of the PNR (passenger name record) system and the TFTP (Terrorism Finance Tracking Program), which is fed by data from the SWIFT (Society for Worldwide Interbank Financial Telecommunication) system. By taking an "infrastructural perspective," with its historical origins in STS, they enrich gaps in, and provide more nuanced development of, Yeung's conception of algorithmic regulation. They highlight three dimensions of infrastructures: data structuring, architectural constraints, and interfaces. From their careful reading and analysis of "Joint Reports" of the TFTP, they show how data infrastructures provide security agencies with swift access to commercial data without interference by a judge and nor the need to repeatedly lodge extra-jurisdictional requests. Their analysis demonstrates that, although data infrastructures appear to represent the institutionalization of public accountability and privacy-protection, they are in practice very difficult to contest. Despite the existence of formal redress procedures, they argue that in the context of algorithmic security, data and privacy protections are mainly defined as data security and accountability "fixes" rather than offering meaningful, practically operationalizable mechanisms for redress.

Bellanova and de Goede also highlight the practice of "risk flagging" in algorithmic security as a vehicle for enforcement, which they suggest occupies the middle ground between Yeung's two categories of enforcement either as recommendations or fully automated sanctions (Yeung 2017). Individuals are singled out for further scrutiny by human officers in ways that are experienced as inconvenient and anxiety-provoking, yet not explicitly punitive in orientation and intention. Their rich case study also highlights the duality of algorithmic regulation, in which algorithms serve as both *vehicle for regulating* the movement of human bodies as they seek to travel across national boundaries, while also providing an entry point for the regulation *of* algorithms, in so far as rights to privacy and redress may be hard-wired into the system infrastructure according to a very particular and formalistic understanding of what those rights require.

While Bellanova and de Goede draw attention to the use of algorithmic "flags" to single out individuals for attention, Festic (2020) also takes up this theme of algorithms as tools for sorting, selecting and singling out particular items of data. However, her analysis focuses on algorithmic sorting and distribution of informational content, rather than of individual travelers, referring to the automated assignment of relevance to selected pieces of information which Festic calls "algorithmic selection." Her inquiry and methodological approaches are, however, rather different from those of Bellanova and de Goede. Rather than seeking to look *inside* the algorithmic black box to understand its data structures, architectural constraints, and interfaces, she focuses her attention on the way in which algorithmic selection processes are *experienced* by users, offering a user-centered perspective of algorithms as a complement to studies that focus on developers, platforms, and their impacts. Festic offers an enriched take on conventional understandings of the "user experience" that goes beyond the convenience and ease that is central to the work of contemporary UX designers. She offers a unique empirical investigation of the volume and frequency with which computer applications are employed by users in different "life domains," ranging from those concerned with social and political information and orientation, recreation, commercial transactions, and socializing. The study scrutinizes the subjective significance users assign to these applications, their awareness of their functioning and risks they generate, and coping strategies they employ relative to their assessment of risk. She points out that, as a complement to studying apps and platforms in isolation, considerable insight can be acquired by adopting a wider perspective in seeking to understand how various algorithmic applications are used in and for a diverse set of everyday activities. Perhaps surprisingly, Festic finds that users do not follow algorithmic recommendations blindly. Rather, she identifies a range of coping strategies that (the few) risk-aware users deploy in the face of perceived algorithmic risks. Insights about how and in what contexts users

deal with algorithmic regulation and its associated risks deserve more attention, particularly in seeking to develop adequate governance mechanisms and regulation. Nevertheless, the relatively high degree of user awareness about algorithmic selection in information applications indicates that public controversies as those concerning Google and Facebook may have the effect of raising general concerns about the importance of algorithms in the allocation of information in online contexts.

2.2. Complementary concepts to algorithmic regulation

A second group of papers (overlapping with the first) focus their attention on concepts associated with algorithmic regulation such as "data jurisdictions" (Johns & Compton 2019), "modes of governance" (Gritsenko & Wood 2020) and the "infrastructural perspective" of Bellanova and de Goede (2020) alluded to above. Rather than focusing on "what algorithms do," Johns and Compton (2019) focus on the variety and sources of data that are brought together under the banner of two related initiatives of the United Nations (UN) – Haze Gazer and CycloMon. They propose the concept of "data jurisdictions," referring to domains characterized by distinct normative claims and concerns that, through algorithmic operations and data formatting, authorize specific types of speech and action. In particular, they differentiate between three types of data jurisdictions with different normative valences and logics: market jurisdictions; public science jurisdictions; and jurisdictions of humanitarianism. They argue that the overlap between these jurisdictions that occurs when data sourced from different jurisdictions is brought together in a single integrated platform results in the diffusion of responsibility and reduction of accountability, while their embeddedness in seemingly benign infrastructures facilitates the spread of contentious yet authoritative norms.

Bellanova and de Goede also focus on the sources and flows of data brought together for a particular social purpose. But unlike the TFTP examined by Bellanova and de Goede, the two UN-sponsored digital platforms examined by Johns and Compton do not engage in explicit decisionmaking functions. Thus, while the TFT system entails the algorithmic parsing of data to "flag" individuals algorithmically assessed as "suspicious," the UN's Haze Gazer and CycloMon are data visualization and mapping tools intended to help users understand and respond to specific types of environmental risks (haze pollution, on the one hand, and cyclones on the other), thus offering "algorithmic surveillance" rather than automated decisionmaking. In this respect, they lie outside Yeung's original conception of algorithmic regulation because neither platform engages in any "decisionmaking" either in terms of offering recommendations or in automatically executing decisions. Yet their analysis demonstrates that even in the absence of automated decisionmaking, the construction and deployment of data with the aim of offering users data-driven tools and services for specific kinds of risk visualization entails a complex amalgamation of data practices, norms, and flows. These are mediated via the software and infrastructure through which the data are collected, parsed, and processed in ways that can serve to conceal or obfuscate normative tension and conflict, yet is often understood as the product of mundane work of data technicians.

Gritsenko and Wood (2020) take a different approach, placing the concept of algorithmic governance within the framework of the well-known "modes of governance" strand of literature in political science, referring to a typology of hierarchy/bureaucracy, markets, and networks as Weberian ideal types of theorizing authority, effectiveness, accountability, and power relations in state-society relations within policy processes (Powell 1990). Their point of departure is Kooiman's refinement of those ideal types, focusing on the "governance mixes" generated by combining different governance modes (Kooiman 2003) which Kooiman claims entails a distinct form of coordination due to formal and informal institutions that limit and enable interactions. Drawing on this model, Gritsenko and Wood adopt a bottom-up approach to theoretical development, comparing three concrete cases in which algorithms have been introduced – the governance of speeding, disinformation and social sharing. By focusing on how the introduction of algorithms "alters the hybridity of governance modes already present," they argue that these cases suggest that, in general, introducing algorithms into hierarchical, market, and network governance forms creates significant, potentially transformative, changes to the core features of those modes of governance. By altering the way in which rule-making and rule-taking work in practice, they argue that algorithmic logics change the way actors relate, thereby affecting their commitment to coordinating responses to a common problem. By taking a bottom-up approach that focuses on the interactions between algorithms and other more familiar forms of ordering in specific contexts, their approach can be distinguished from Yeung's, who sought to interrogate algorithmic ordering through theoretical inquiry by drawing upon insights from a wide range of literatures from different disciplinary approaches rather than

the single lens of political science. By investigating "mixed" forms of ordering prevalent and unavoidable in real-world settings, Gritsenko and Wood show how algorithmic ordering mechanisms intersect with and alter the operation of conventional mechanisms of governance in specific contexts.

All these conceptual contributions draw upon different case studies offering rich and invaluable insight across sectors, policy fields, life domains, regions, etc. Two studies analyze public authority use of commercial data: in security policy (Bellanova & de Goede 2020) and in humanitarian policy (Johns & Compton 2019). Analyzing algorithmic regulation in the security sector reveals how data infrastructures overcome legal limitations such as national jurisdictions, boundaries between private and public organizations, and the principle of purpose limitation mandated by data protection laws that restrict personal data collection and use. It also demonstrates how legal constraints intended to protect particular values such as privacy and accountability are reconfigured and institutionalized as "technical fixes" of questionable fidelity to their substantive normative and individual dignity-respecting purposes. In humanitarian policy, the blurring of boundaries between various "data jurisdictions" (commercial, scientific, and humanitarian) from different norms and cultures may obfuscate and dilute accountability and responsibility. Although this may diffuse political tensions, it may be at odds with commitments underpinning humanitarian agendas. In both areas, the "public good," be it the provision of domestic security or humanitarian aid, arguably purports to legitimize regulatory overlap and rule evasion; especially in humanitarian projects where the data are "volunteered" by private companies such that, as Johns and Compton (2019) argue, "not-for-profit" implies "little scrutiny."

Two other contributions provide insights about individual users' exposure to algorithmic regulation: consumers (Festic 2020) and Uber drivers (Eyert *et al.* 2020). Common to both is the invisibility of algorithmic influence accompanied by low levels of awareness and understanding of how algorithms actually function in specific contexts and their importance. Another is the lack of meaningful alternatives to these data-driven functionalities, and the concomitant lack of leverage that users perceive in resisting their influence and power. In the case of the Uber drivers, this also results in side-lining conventional forms of institutional protection reflected in the de-institutionalization of workers' rights and company co-determination. More generally, algorithmic regulation often implies a re-institutionalization of close social relations where interpersonal trust is replaced by impersonal scores and ratings in the form of commodified platform-based services (housing, individual transport, crowdfunding, etc.) (Gritsenko & Wood 2020). Taken together, context-specific analyses illuminate processes of de- and re-institutionalization that result in the hardening and commodification of social norms due to highly partial and particular understanding of these norms, reinforcing and entrenching existing power asymmetries in new ways, and introducing novel, multi-dimensional accountability and responsibility challenges.

2.3. The regulation of algorithms and the quest for "algorithmic accountability"

These accountability and responsibility challenges are the third theme that unites a further set of contributions. These contributions acknowledge the wide range of threats, risks, and adverse societal and individual impacts that algorithms may produce, justifying the need for effective institutional mechanisms for their prevention, mitigation, and redress. They form part of a growing debates among and between policymakers, industry, civil society, and academia about the regulation of socio-technical systems that rely upon algorithmic processes, particularly those involving the collection and processing of personal data. These papers concern the on-going quest to secure meaningful algorithmic accountability, based on increasing recognition that algorithmic regulation not only expands its power and reach but also produces a wide range of unwanted impacts that threaten to erode and destabilize foundational social institutions that are essential for vital collective goods, including democracy, solidarity, justice, and individual freedom.

At the conceptual level, Krafft *et al.* (2020) draw on principal-agent theory to differentiate regulatory requirements for "ADM" applications that produce risks of different kinds and magnitudes, suggesting that a risk-based approach to regulation is potentially well-suited. By viewing the challenge of algorithmic accountability from the point of view of data subjects as the "principal," and the relevant ADM system as the corresponding "agent", they argue that instruments aimed at securing the accountability of ADM applications can be systematically matched to the potential harms they generate for data subjects. By focusing on vulnerabilities in the principal-agent relation, including the well-known problem of information asymmetry that often results in the failure of the agent to faithfully give effect to the goals and values of the principal ("agency loss"), they argue that specific ADM systems can be classified by reference to the

relative level of risk that they pose, indicating the stringency of regulatory oversight needed to safeguard the principal's interests. Their analysis draws directly on a strand of literature familiar to readers of *Regulation & Governance* concerned with risk management and "risk-based regulation," as well as ideas which scholars of policy studies and public administration will be well-acquainted.

Matus and Veale (2020) draw on a different yet familiar strand of regulatory governance literature, concerned with investigating non-state or "private" certification systems intended to foster standards of "good" or "ethical" practice. Voluntary oversight systems of this kind developed to promote adherence to fair labor standards and/or environmentally sustainable production processes have been subjected to scholarly investigation in studies of global supply chain governance. To this end, Matus and Veale suggest that experience of these non-state governance systems offers insights for evaluating the prospects of utilizing similar kinds of voluntary certification systems for machine learning models. Studies of some of the wide variety of private certification schemes for sustainability demonstrate that establishing a virtuous (and effective) cycle via sustainability certification has proven difficult in practice, with no single program successfully addressing the full range of sustainability concerns effectively. Accordingly, they conclude that although private certification regimes do have potential value in promoting best practice in machine learning model development, this value is rather limited. Nonetheless, it offers a tool that might contribute toward a more comprehensive "toolkit" or perhaps an intermediate point in the move from voluntary digital industry initiatives toward more formal legal regulation.

Certification systems and other forms of private "voluntary" regulation typically lack meaningful and effective oversight mechanisms, which many critics consider a fundamental flaw. In contrast, conventional forms of state regulation typically confer upon public authorities a suite of investigative and enforcement powers, combined with a statutory mandate and legal duty to monitor and enforce compliance with regulatory standards. Accordingly, conventional state regulation offers institutional guarantees and mechanisms through which enforcement action may be pursued, grounded ultimately in the state's legitimate monopoly over coercive power. In contrast, private certification systems and other voluntary initiatives rely instead on market forces, which are often directly at odds with the interests of the general public and collective welfare. It is therefore not surprising that contemporary data protection law, which in Europe acquired a new lease of life following the entering into force of the General Data Protection Regulation in 2016, is widely expected to play a critical role in securing algorithmic accountability, at least in relation to algorithmic processes that rely on the collection and processing of personal data.

Yet data protection law and scholarship has hitherto been largely conducted through a particularly narrow and rather conventional legal frame. The resulting form of "tunnel vision" often manifests itself in discussions about the content and contours of data protection by legal experts in a technical manner that is terse and inaccessible to non-legal experts. To overcome this limitation, the contribution from Yeung and Bygrave (2021) attempts to bridge the gap between two scholarly communities. Their analysis draws on insight from several strands of literature in regulatory governance studies, including analyses of policy instruments and "tools of government" undertaken by scholars of public policy and public administration as well as academic investigations of risk-based regulation, on the one hand, and from data protection law, constitutional law, and human rights scholarship on the other. In so doing, they seek to demonstrate how insights from regulatory governance studies can help to "demystify" a number of elements of the GDPR that remain obscure and uncertain. Despite its complex and arcane character and continuing uncertainty about the precise scope of its requirements, they argue that the regulatory regime established under the GDPR offers an innovative approach with a significant degree of in-built "future-proofing" that should help render it more resistant to being rapidly overtaken or outpaced by organizational-technological developments. They also suggest that their methodological approach that draws on academic insights from two distinct but related disciplinary perspectives – legal scholarship and regulatory governance studies – can offer a potentially fruitful vehicle for deepening and enriching understandings of the European data protection regime in particular and of the mechanics, efficacy, and legitimacy of regulatory governance regimes more generally.

The GDPR's innovative potential is drawn out in Bayamlıoğlu's (2020) careful analysis of "the right to contest" solely automated decisions arising under Article 22 of the GDPR, demonstrating how this right can be fleshed out in order to operationalize the GDPR's transparency provisions. For him, the right to contestation is the core legal weapon against automated decisionmaking through which the transparency of automated decisionmaking systems under the GDPR can be secured. In particular, Bayamlıoğlu identifies two core "layers of

protection" offered by the GDPR, the first concerned with access and notification (formulated as individual rights in Articles 13, 14, and 15) while the second mandates administrative and technical measures such as design choices facilitating interpretability, institutional oversight, and algorithmic scrutiny. By focusing on the right to contest automated decisions, Bayamlıoğlu side-steps earlier heated yet often rather arid legal debates about the existence and scope of a right to an "explanation" under the GDPR. For him, the right to contestation is foundational to the protection of due process rights, and to this end he offers a series of concrete proposals about what, precisely, this right would require in terms of technical and organizational measures.

With a similar impetus to scrutinize algorithms in the world of data protection, Gellert (2020) turns to information theory in order to understand how data and information are conceptualized within data protection and machine learning discourses. He challenges the common assumption that machine learning processes are simply "yet another data processing operation to be regulated." The notion of personal data, which is central to data protection, but notoriously under-defined, is shaped by a logic of knowledge *communication*, meaning the assessment and control of existing data and thus an "*information* technology." In contrast, machine learning relies on a logic of knowledge *production*, meaning the creation of new data based on existing data, and is therefore a "*knowledge* technology." Gellert mounts a persuasive argument that, as a consequence, data protection falls short of grasping the specificities of machine learning, which he illustrates with the Article 22 GDPR, which contains the so-called right to explanation, developing suggestions for alternative regulatory strategies.

These three papers can be situated within a growing maturation within conventional data protection law scholarship, moving beyond traditional doctrinal analysis of data protection laws (and the GDPR in particular) to acquire a deeper and more nuanced understanding of both the nature of the threats posed by algorithms, and the way in which data protection laws may offer specific mechanisms that offer the promise of effective protection. Yet data protection law constitutes merely one vehicle through which the law may serve as a counterweight against the unwanted and unwelcome effects of algorithms that rely upon the collection and processing of personal data. In addition, both legal scholars and civil society groups have called into question the way framing of public debate and academic discourse about the adverse social and individual impacts of AI systems in terms of "ethics" rather than couched in the language of power, justice, rights, and meaningful redress (Yeung 2019). In this respect, international human rights law offers a promising approach through which many of the concerns about the unwanted impact of ADM systems, particularly for core values anchored in respect for individual autonomy, liberty, and freedom, may be vindicated. However, these laws were forged in the postwar reckoning with the mass atrocities committed during the Holocaust at a time when computational systems were in their infancy and the functionality provided by networked digital technologies to which we have become accustomed could scarcely be imagined. Seen in this light, Kosta's (2020) examination of the extent to which current interpretations of the notion of agency, as traditionally perceived under human rights law, serves as a reminder of the radically different technological era in which human rights norms and remedial mechanisms originally emerged. Kosta argues that the capacity to use machine learning algorithms to classify individuals in categories depending on specific parameters may lead to the creation of "algorithmic groups" that share some common characteristics, which may be dynamic in their formation and application, particularly when developed by law enforcement and security and intelligence agencies. By examining the interpretation of the case law of the European Court of Human Rights' pertaining to human agency as a criterion for invoking human rights claims (defined under the ECHR as either a natural or legal entity or "victim"), Kosta argues that the Court's current approach is ill-suited to safeguarding against the dangers posed by secret algorithmic surveillance because individuals are unable to identify whether they have been or might be subject to surveillance. By creating new surveillance methods, machine learning algorithms challenge fundamental presuppositions upon which human rights protection rests, particularly notions of human agency and the need for a specific identifiable "victim" who can claim human rights protection. Accordingly, she identifies questions for further research and calls for a new way of thinking about agency for the legal protection of human rights in the context of algorithmic surveillance.

Binns' (2020) paper also draws on the law's foundational commitment to demonstrate respect for the agency of the individual. He critically reflects on the ideal of "individualized justice" that is central to legal understandings of the appropriate role of human discretion in decisionmaking that may adversely affect individuals in the context of ADM systems. He highlights tensions arising between the desire for individual justice on the one hand, and other claims of justice (particularly notions of consistency that are grounded in the principle of equal

treatment) and non-discrimination on protected grounds on the other. Binns critically reflects upon the commonly shared proposition that machines might more faithfully adhere to the principle of individual justice in comparison with the exercise of human judgment, particularly given that humans invariably bring their own substantive conceptions of justice to the task of decisionmaking. He concludes that machines might be able to give expression to individual justice understood in terms of consistency, but cannot, in and of themselves, protect individual justice. He emphasizes the need for context-sensitive application and evaluation on a case-by-case basis as algorithms are deployed in particular settings, warning that if individual justice is worth protecting, we cannot assume that it will be secured by simply putting a human in the algorithmic loop.

This set of papers all draw on legal discourse and the vocabulary of "rights" in various ways that could enable those placed "at risk" by algorithms to assert against those who wield algorithmic power. The growing interest in algorithms by legal scholars and the invocation of claims of *justice* and of *right* signal a move away from the "soft" ethics approach, which held sway when concerns about the adverse impacts of algorithms first emerged. At the same time, they move beyond the focus of data subject rights that continues to be a preoccupation of data protection law experts, to encompass a wider set of legally protected rights and interests. In this respect, Yeung and Bygrave's (2021) comment on the paucity of academic literature concerned with critically investigating the relationship between rights and regulation is particularly salient, a lacuna that might be explained by the relatively low level of cross-disciplinary engagement between legal scholars and regulatory scholars – the latter operating primarily from the perspective of political science and public administration. Taken together with Kosta's (2020) contribution, this suggests a need for deeper investigations of the limitations of rights-based approaches to securing algorithmic accountability.

In particular, the highly individualized orientation of rights-based claims may fail to protect the wide variety of collective goods and group interests that might be threatened by the cumulative and aggregate impact of widespread use of algorithms over time, while provoking questions about what it is that is distinctive and valuable about human decisionmaking that cannot be adequately replicated by our increasingly "intelligent" machines (Yeung 2019). While policy debates have often been discussed in terms of whether the regulation of AI systems is best undertaken at a sector-specific level or whether some kind of general regulator is needed, there is a need for academic scholarship to move beyond these general parameters. Such a perspective has to critically evaluate whether and in what ways our existing conceptual and institutional apparatus is capable of adequately addressing the full range of concerns associated with the use of algorithms given the speed, scale, sophistication, and opacity of their operation.

3. Algorithmic regulation: Conceptual strengths and shortcomings

Before concluding, we consider how examining these contributions across a single volume sheds light on the strengths, limitations, and potential value of algorithmic regulation as an analytical concept, understood in terms of its two faces (the regulation *by* and *of* algorithms) and offer suggestions for further research. We argue that the core concept is valuable and productive, particularly by foregrounding the intentions associated with algorithmic regulation and the variety of unintended consequences that it may produce. The concept provides multiple entry points through which it has been enriched by other scholars, serving as an analytical bridge for facilitating cross-disciplinary insight by scholars who have built upon and enriched its original conceptual "skeleton," adding "flesh" from a variety of disciplinary perspectives. It is in careful and *context-sensitive* analysis of algorithmic regulation that we see enormously fruitful lines for future of research about algorithmic regulation. It offers a conceptual vehicle that links directly with, and can be situated within, regulation and governance research, while facilitating critical investigations of existing and potential regulatory regimes for our unfolding digital age that move beyond traditional conceptions of data-protection law. Finally, we suggest that the political dimension of algorithms and regulation, be it with regard to justice, solidarity, capitalism, or democracy, offer a fertile source of inspiration for research.

As a conceptual lens, algorithmic regulation directs attention toward the ways in which computational systems are *intentionally* designed, configured, and implemented by those seeking to deploy them to further a particular social purpose, while helping to bring into view their multifarious and often hidden and/or *unintended* social and other impacts for individuals, groups, and society more generally. In this way, algorithmic regulation implies a springboard for analysis that takes as its point of departure the perspectives of the developers and

designers of computational systems, rather than the perspective of users or others who come into direct (or indirect) contact with these systems "on the ground." By beginning with the specific motivations or "social intent" of those who develop and configure the computational systems through which algorithmic regulation seeks to effect coordination and control in real-world contexts, this necessitates considerable "translational work" to enable the technical functionalities, protocols, and operations of the computational system to be rendered operationalizable in concrete social settings in order to achieve the desired coordination and control. Yet these attempts do not always succeed in achieving their intended purpose and, as these contributions have amply demonstrated – invariably produce unintended effects. In other words, viewing contemporary and on-going digital transformations through the lens of algorithmic regulation focuses on the points of contacts between the technical, computational realm with the social realm in which humans live, move, and go about their daily lives.

While interdisciplinary and context-sensitive analyses may enrich understandings of algorithmic regulation, the contributions to this Special Issue also reveal some limitations in the scope and contours identified in Yeung's original articulation. While Yeung's conception of algorithmic regulation is rooted in the intentional use of ADM systems, the socio-technical systems focused upon by Jones and Compton and by Bellanova and de Goede, call into question the notion of clear, pre-specified "aims" and conventional understandings of what constitutes a "decision," on the one hand, and a "sanction" on the other. For example, Bellanova and de Goede show how the algorithmic "flagging" of individual travelers as potentially suspicious through the TFTP is intended to inform human security officials about which individuals should be subject to more searching scrutiny. These interventions are invariably experienced by these individuals as unwanted and anxiety-provoking, suggesting that they might be characterized as "sanctions" which are punitive in their effects even if not their explicit intent. The two UN-sponsored digital platforms examined by Jones and Compton – HazeGazer and Cyclomon – are even further removed from decisionmaking of any kind, offering what are effectively data visualization tools that help users observe where haze or cyclone activity, respectively, is taking place in real time. Although the provision of information systems in a visually appealing and readily comprehensible form may well help users of those platforms to make decisions, the algorithmic systems involved do not execute any decisions nor offer any recommendations about how users should decide anything. Accordingly, both might be more appropriately and productively understood as "algorithmic surveillance" systems, rather than as examples of algorithmic regulation, at least on Yeung's conception. On the other hand, it is also clear from the analysis of these platforms that a huge amount of work is needed to convert input data into a user-friendly visual interface, which entails normative judgments and decisions that directly affect the presentation of data to users. These procedures determine what users "see" and how they are therefore likely to understand the phenomenon of interest which these digital platforms purport to track, even though no decisions are directly informed by, automatically executed, as a result of this algorithmic processing.

Various contributions to this volume demonstrate how the concept of algorithmic regulation is in being employed as an *analytical bridge* by bringing together a wide variety of scholarly work concerned with digital technologies and their implications, particularly for social ordering and coordination. Accordingly, the lens of algorithmic regulation points toward and opens up opportunities for rich and varied inter- and transdisciplinary investigation between, on the one hand, the computational sciences and the technical knowledge and understandings needed to build and maintain computational systems, and wide-ranging and diverse perspectives from the social sciences and humanities on the other. For example, scholars from many disciplines, including law, political science, applied ethics, critical geography and so forth, may find it productive and generative to examine the links, convergences, and tensions between analytical concepts from their own disciplinary backgrounds with the design, operations, and outputs generated by computational systems for the purposes of control and coordination. An algorithmic regulatory framing departs from more familiar conventional approaches to the social sciences and humanities, which might focus on seeking to understand, for example the "law of" or "ethics of" algorithms or the "economics of predictive analytics" (Mittelstadt *et al.* 2016; Agrawal *et al.* 2018; Barfield 2020), which would typically begin with concepts that are familiar and well established in legal scholarship, applied ethics, and economics, respectively, seeking to investigate how those familiar concepts and constructs apply to and are affected by the operation of computational systems in specific social settings. In contrast, viewing the same socio-technical systems through the lens of algorithmic regulation prompts consideration of the interactions between the "interior" of these complex socio-technical system as a focal point for analysis. Accordingly, an algorithmic regulatory perspective offers a different vantage point: rather than beginning from the disciplinary

perspective of a given field in the social science or humanities, it draws attention to the interactions and connection points between the technical system and the social world, focusing upon and following decisions and consequences arising from its design, infrastructure, configuration, protocols, parameters, and operating mechanisms, routines, and practices.

At the same time, several contributions to this Special Issue illuminate ways in which algorithmic regulation presents itself as a "skeleton" concept, which will often need to be complemented with additional theoretical "flesh" in order to provide deeper analytical traction. The generalized, highly abstract perspective offered by algorithmic regulation opens up possibilities for interrogation from a diverse and wide range of lenses from the arts, humanities, and social sciences, whether from a traditional disciplinary perspective and/or from expertise in specific contextual domains (health and medicine, transportation, criminal justice, security, media studies, sharing economy, and so forth). The way in which generality and abstraction enables diverse perspectives is clearly evident in the rich and varied range of applications and application domains examined by our contributors. But although this generality offers considerable scope and flexibility for diverse approaches to critical investigation and thus a source of analytical strength, it might be considered a shortcoming of the framework in so far as it implies that this thicker conceptual "flesh" may be a necessary precondition for those wishing to undertake deeper, contextual examination of specific application contexts. In our view, however, this openness to more detailed conceptual development is not necessarily a drawback for scholars. Rather, what we see in this collection is a plurality and diversity of the approaches to this task, thereby paving the way for cautious theory development. Accordingly, Yeung's relatively "thin" conceptual presentation of algorithmic regulation enables and makes possible a range of ways to "thicken" its analytic capabilities. To achieve this, however, our contributors pray in aid concepts from a range of disciplinary perspectives, ranging from feature selection, data point production, interpretation modes, incorporation, and excorporation, as employed by Eyert, Irgmaier and Ulbricht by drawing from scholarship on quantification and STS; the "infrastructural lens" adopted by Bellanova and de Goede who also build on STS and the insights offered by scholars of critical security studies; through to Johns' and Compton's concept of "data jurisdictions," which invokes legal conceptions of jurisdiction with the way in which data are collected by organizations with specific objectives and normative commitments. In each case, we see how particular forms of conceptual enrichment enable critical investigation of particular instantiations of algorithmic regulation that link the computational systems to the social world involving the algorithmic parsing of data to produce outputs for specific, albeit sometimes vaguely defined, social purposes.

Johns and Compton's study of these real-time data visualization platforms also points to another distinctive facet and significant limitation of the concept of algorithmic regulation as a vehicle for critical investigation: its orientation toward decisionmaking and coordination by and through algorithms may result in a tendency to downplay the larger socio-technical ecosystem (including data supply chains) that is necessary conditions for the existence and operation of algorithmic regulation in practice. As Manovich (1999, p. 84, cited in Gillespie 2014, p. 169) observes, "together, data structures and algorithms are two halves of the ontology of the world according to the computer." By viewing these diverse digital applications through the analytical lens of algorithmic regulation, only one half of the computer's ontological world is necessarily opened up for analysis: largely proceeding on the assumption that there *are* available and usable data sets that can be fed into the computational system needed for algorithmic regulation. But if we are to understand the larger socio-technical assemblage in which algorithmic regulation forms part, then we must understand *both* halves of the computer's ontological world, *and* what Bourdieu referred to as the wider "field" in which they are situated and operationalized. To this end, an analogy might be drawn with conventional industrial manufacturing processes in which data constitute the crucial "inputs" or basic factors of production that must be gathered and transported to the "factory" where those inputs are processed and transformed into some kind of usable product or service. On this model, scholarly analyses of the data that must be generated, gathered, and made "algorithm ready" (Madsen *et al.* 2016) refer to the factor inputs of the algorithmic production process, while algorithmic regulation tends to refer to what happens inside the factory itself. This depiction may, however, but overly simplistic when it comes to the production of digital services, in so far as the distinction between factor *inputs* and the factory *processes,* to which they are subjected, is unlikely to be quite so clear cut: data inputs may need to be "treated" and made usable inside the factory, but which may then be algorithmically parsed to create additional knowledge, which is then subject to further algorithmic parsing. Nevertheless, this two-dimensional ontology helps to situate the concept of

algorithmic regulation within the proliferating literature in critical data studies and critical algorithm studies, for its orientation focuses on the computational systems that seek to facilitate coordinate and control of and within the social world, rather than the processes, practices, and dynamics associated with "bringing the inputs to the factory door" or even "building the factory." Here the growing scholarly interest in "infrastructures" from which Bellanova and de Goede draw has much to offer, given that the existence of infrastructure of various kinds, data, electrical, real estate, etc., provides the foundation on which algorithmic regulation can thrive. In short, the relationship between the concept of algorithmic regulation and overlapping and adjacent fields of inquiry are important and worthy of further critical examination, yet left largely unaddressed in Yeung's 2017 rather simple conceptual framework. However, the contributions to this volume amply demonstrate thoughtful and analytically productive ways on how the concept itself may be given further theoretical and conceptual "flesh" that are capable of generating valuable insight and understanding.

Although Yeung's 2017 paper did not explicitly discuss the regulation *of* algorithms, she stated in closing that her aim had been to "identify what is at stake in the rise of algorithmic power." Both faces of algorithmic regulation contribute toward this endeavor, revealing how they are direct and inextricably intertwined. In this vein, several of the contributions to this volume focus on various facets of data protection law as a legally mandated institutional regime, which regulates forms of ADM that rely upon the processing of "personal data." Their contributions open up data protection law in a range of analytically thoughtful and creative ways, in contrast to many of the debates that occur between data protection law scholars as highly specialized and technical, typically focusing on the meaning of particular statutory terms and phrases. Together, they reveal the way in which, at least in Europe, contemporary data protection law remains in its infancy, rich with potential as a vehicle for enhancing algorithmic accountability but is yet to be fully realized. However, the regulation of algorithms is already casting its net more widely beyond those that rely upon the collection and processing of personal data, exemplified in the EU's proposed Artificial Intelligence Act. By thinking in terms of the regulation *of* algorithms (understood as the regulation of automated decisionmaking systems operating in real world contexts whether or not they entail personal data processing), algorithmic regulation offers a bridge between narrow data protection perspectives and broader, more varied oversight regimes, institutions, norms and practices. The concept also illuminates gaps and lacuna in existing sources of oversight and protection. By reflecting critically on the regulation *of* ADM systems, our attention becomes more sharply focused on the forms, nature, and impact of algorithmic power in concrete social contexts, including its intended and unintended impacts, whether direct or indirect, and the ways in which these systems exercise and distribute power between institutions, populations, groups, and individuals. In so doing, these logics and processes may result in exclusion, exploitation and abuse, often in a manner that is highly opaque and, in many cases, without the awareness of those directly affected.

One fruitful way in which the concept of algorithmic regulation might gain considerable critical impetus is by combining it with existing literature that focuses on the political dimensions of algorithms. For example, there is significant scholarly work concerned with the way in which algorithmic applications may systematically threaten fundamental values essential for democracy, justice, individual freedom, and human rights protection, including work that proceeds under the rubric of "data justice" or "digital justice" exemplified in the important work undertaken by the Data Justice Lab at Cardiff University (Dencik *et al.* 2018) and related investigations by scholars who draw attention to attempts to resist the forces of algorithmic control, including the strategies practices adopted by various NGOs engaging in digital rights activism, raising public awareness of the "dark side" of algorithmic power (Beraldo & Milan 2019; Kazansky & Milan 2021; Velkova & Kaun 2021). We also have in mind the high-level political critiques of digitalization, including the kind of clarion "call to arms" of the kind issued by Shoshana Zuboff, Christian Fuchs, and other critical scholars who warn of the conjunction of capitalism and sophisticated algorithms that feed on the continuous collection of digital data produced in ever-growing volumes. This alliance between neoliberalism, capitalism, colonialism, and algorithms, they argue, is propelling contemporary societies along a trajectory in which individual freedom and authentic human self-creation will be rendered impossible due to the powerful, pervasive, and inescapable destruction of human capacity for genuinely independent thought and action (Foster & McChesney 2011; Fuchs 2019; Zuboff 2019). These dangers arise in democratic and authoritarian societies, albeit in different forms, indicated in recent reports documenting the way in which Chinese authorities have embraced surveillance and internment on an industrial scale in order to control and oppress the minority Uighur population (Graham-Harrison 2020). As a consequence, while the political

dimensions which several contributions to this volume draw attention to are subtle and locally situated, further research will benefit from linking nuanced analyses of real-world algorithmic regulation to the major social debates and theories about our unfolding Digital Age.

4. Concluding thoughts

By taking together and reflecting critically upon the contributions to this Special Issue, we have sought to illuminate more clearly what is distinctive about algorithmic regulation as a conceptual vehicle for facilitating critical investigation and analysis. We have shown that the concept of algorithmic regulation offers a valuable lens for directing attention to the multiplicity of subjective, value-laden human decisions that must be made in order to construct and implement algorithmic regulation in specific settings. This invariably calls for cross-disciplinary interrogation in order to understand how these computational systems meet and are embedded in messy, dynamic, and sometimes highly unpredictable social worlds. We have also seen how careful and penetrating examinations of algorithmic systems in particular contacts reveal the problematic features of Yeung's conception of algorithmic regulation, which focused on the use of algorithms for decisionmaking while failing to elaborate upon what, precisely, constitutes a "decision" for this purpose. Yeung's conceptualization appears to imply that systems of algorithmic surveillance that are not specifically designed to inform or automate particular kinds of decision fall outside its conceptual scope. However, the production of data visualization platforms entails the generation of algorithmic outputs, and also invariably entails the making of subjective judgments about data inputs, how they are integrated, and the inescapable subjectivity that informs how the phenomenon which the platform seeks to visualize is understood by its developers and made accessible to users. At the same time, because the concept of algorithmic regulation understood as a mode of regulatory coordination and control focuses largely (albeit not exclusively) on one half of the computer's ontology, taking the system's "data inputs" largely as given, the growing literature on data ownership and data governance more generally lies largely outside the boundaries of algorithmic regulations' conceptual reach. In our view, however, this is not in itself a limitation. Rather, it points to the importance of drawing together both sides of the computer's ontological world in ways that productively draw on scholarly insights to offer a richer, more holistic, and integrated account.

Just as the contributions to this volume help to illuminate the limits and limitations of algorithmic regulation as an analytical construct, they also reveal the breadth and porosity of its observational horizon and boundaries. They demonstrate how close attention to specific application contexts is enabled through the lens of algorithmic regulation, while also offering multiple entry points for critically reflecting upon the various regulatory institutions, mechanisms, or legal rights and regimes through which particular forms of algorithmic accountability might be secured. Taken together, the contributions highlight the value and need to study algorithms in context, in ways that attend to the embeddedness of these computational systems within larger socio-technical and organizational infrastructures, legal frameworks, political cultures, and user communities as well as the technical architectures, protocols, and configurations through which they are designed to function. Our contributors admirably bring these subtleties and contingencies to light, drawing on a wide range of academic lenses, including strands of scholarly literature with which readers of *Regulation & Governance* are likely to be well-acquainted. This attention to context also demonstrates how critical reflection upon the findings of these contextual investigations and exploring links and discontinuities with existing academic work enables cautious theory development, which can offer genuine conceptual and theoretical advances. Likewise, they offer more focused, deeper investigations of the specific accountability mechanisms through which the adverse impacts of algorithmic regulatory systems may be mitigated and redressed in ways that might, it is hoped, prompt those responsible for the design and deployment of algorithms to take active steps to address them.

In order to deepen and demonstrate its analytical value, more work is needed to add further flesh to its conceptual bones, while critically interrogating its relationship with adjacent and overlapping fields of activity and action that occur both prior to the processing of data on the algorithmic "factory floor" and its subsequent journey upon release into the social world. There is much that remains unknown about the ways in which particular applications of algorithmic regulation affect the lived experience of individuals, communities, and populations, in potentially profound and human-rights critical ways that may not be readily observable or measurable. While our hope is that the concept proves itself to be a durable and invaluable lens for critical

explorations of algorithms in society, we also welcome diverse analytical perspectives for scholarly investigation. What matters is that such investigations are rigorous, penetrating, and uncompromising in their commitment to deepening and furthering the bounds of our limited understanding of these increasingly pervasive systems in ways that move beyond a focus on their technical dimensions to embrace their multifaceted human, organizational, and societal embeddedness. This requires methodological integrity, conceptual rigor, and sound theory-development, irrespective of the "camps" and discourses into which particular scholars may locate their investigations to collectively illuminate how algorithmic regulation functions in society. Our hope is that this collection will help to stimulate and encourage further inquiries of this kind.

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Data availability statement

The data that support the findings of this study are available in literature data banks and public media.

Endnotes

[1] Apps are a subset of computer programs that seek to solve particular user needs (Light *et al.* 2018) offering specific ways in which software is developed, used, and monitored (Gerlitz *et al.* 2019).

[2] These services offer individuals who have been positively tested for COVID-19 antibodies, or have received the prescribed dosage of COVID-19 vaccines, a digital certificate entitling them to access opportunities (e.g., international travel) and access physical spaces (e.g., their workplace), which are not accessible to uncertified persons.

[3] Governing Algorithms. A conference on computation, automation, and control, https://governingalgorithms.org/.

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