ANNUAL REVIEWS

Annual Review of Sociology

What's New with Numbers? Sociological Approaches to the Study of Quantification

Andrea Mennicken*,[1] and Wendy Nelson Espeland*,[2]

[1]Department of Accounting, London School of Economics and Political Science, London WC2A 2AE, United Kingdom; email: a.m.mennicken@lse.ac.uk

[2]Department of Sociology, Northwestern University, Evanston, Illinois 60208, USA

Annu. Rev. Sociol. 2019. 45:223–45

First published as a Review in Advance on May 13, 2019

The *Annual Review of Sociology* is online at soc.annualreviews.org

https://doi.org/10.1146/annurev-soc-073117-041343

*The authors contributed equally to this article.

Keywords

quantification, commensuration, economization, quantified self, politics of visibility

Abstract

Calculation and quantification have been critical features of modern societies, closely linked to science, markets, and administration. In the past thirty years, the pace, purpose, and scope of quantification have greatly expanded, and there has been a corresponding increase in scholarship on quantification. We offer an assessment of the widely dispersed literature on quantification across four domains where quantification and quantification scholarship have particularly flourished: administration, democratic rule, economics, and personal life. In doing so, we seek to stimulate more cross-disciplinary debate and exchange. We caution against unifying accounts of quantification and highlight the importance of tracking quantification across different sites in order to appreciate its essential ambiguity and conduct more systematic investigations of interactions between different quantification regimes.

INTRODUCTION

In 2018, Mark Koester, a software developer, published "A Year in Numbers: My Data from 2017" (Koester 2018). In eye-catching visuals he reveals that he completed 2,137 tasks for 33 projects, checked his email about nine times an hour, ran 2,941 km, watched 54 minutes of TV or movies per day, and read 21,687 pages of 62 books. September was his peak reading month. These are just some of the 18 variables he measured. Mark is part of the quantified self or self-tracking movement, people who collect and analyze data about themselves for fun or self-improvement. The quantified self movement was launched in 2007 by Gary Wolf and Kevin Kelly; there are now millions of people who use some form of tracking device that allows them to measure everything from blood biomarkers to daily productivity (Neff & Nafus 2016). Such calculative practices can transform how we understand our selves, what we attend to, and how we organize our lives.

Calculation and quantification have always been a critical feature of modern societies, closely linked to science, markets, and administration. In the past thirty years, the pace, purpose, and scope of quantification have greatly expanded. Administration, management, and even mundane daily activities are increasingly structured around performance measures, cost-benefit analyses, risk calculations, ratings, and rankings. Proprietary algorithms routinely track our buying, web activity, and political affiliations to shape what we buy, where we go, and what we read.

There has been a corresponding increase in scholarship on quantification, which, dispersed among many fields, investigates themes such as governance by numbers, performance measures, and the relationship between valuation and quantification in sociology and related disciplines, including anthropology, socio-legal studies, public administration, science and technology studies, and accounting (Adkins & Lury 2012; Beckert & Aspers 2011; Berthoin Antal et al. 2015; Biagioli 2018; Bruno & Didier 2013; Davis et al. 2012; Dussauge et al. 2015; Espeland & Sauder 2007; Fourcade 2011; Higgins & Larner 2010; Hood 2007; Kornberger et al. 2015; Lamont 2012; Merry 2016; Miller 2001; Power 2004, 2007; Rottenburg et al. 2015). Such heightened interest in quantification, to paraphrase the French sociologist Luc Boltanski (Boltanski & Esquerre 2015, p. 76), is accompanied by a crisis of faith in quantification, intensified by the global financial crisis of the late 2000s and attending debates about financialization (Davis & Kim 2015), economization (Çalışkan & Callon 2009, Miller & Power 2013), and neoliberalism (Brown 2015, Davies 2014). This crisis of faith also reflects our increasing awareness of how proprietary algorithms structure our own opportunities, choices, and relationships (O'Neil 2016, Pasquale 2015).

We offer an assessment of the literature on quantification across these domains of personal life, organizations, and markets; how it evolved in the past twenty years or so (since Desrosières 1998, Espeland & Stevens 1998, Hacking 1990, Miller & O'Leary 1987, Miller & Rose 1990, Porter 1995, Power 1997); and its implications for sociology. This assessment is timely because many new forms of quantification have been deployed, producing new social relations that must be investigated. Through quantification, many contemporary societies have experienced a shifting from government by rules to "governance by numbers" (Supiot 2015), and more recently, as Pasquale (2015, p. 9) puts it, "authority is increasingly expressed algorithmically." This change has produced important new subjectivities and groups, and has raised questions about the nature of political order, citizenship and democracy.

There is an open question of whether quantification studies constitute a field of study in its own right (Berman & Hirschman 2018, Diaz-Bone & Didier 2016). Quantification studies cross disciplines and geography. A core part of quantification scholarship is hardly visible to Anglo-American scholars, especially the burgeoning German and French quantification literatures

(e.g., Beckert & Musselin 2013, Bruno & Didier 2013, Bruno et al. 2014, Desrosières 2014, Didier 2009, Dorn & Tacke 2017, Heintz 2010, Juven 2016, Kalthoff 2005, Karpik 2010, Mämecke et al. 2018, Mau 2017, Mennicken & Vollmer 2007, Passoth & Wehner 2013, Supiot 2015, Vormbusch 2012). Our article summarizes and positions this far-flung literature. We hope to stimulate more cross-disciplinary conversations about quantification across fields; help orient sociologists with related interests; and, importantly, bring European scholars and scholarship to the attention of North Americans and vice versa.

Over the past twenty years the literature on quantification has vastly expanded. Necessarily we will not be able to offer a comprehensive review of all new works. We also had to make some choices regarding where our main focus lies. For example, the expansion of quantification is closely linked to the development of science into a world institution (Drori et al. 2006). Yet, in the context of this article, we cannot discuss in great depth the intricate relationship between quantification and science (for this see, e.g., Daston & Galison 2007, Porter 1995). Instead, we offer brief historical context for the emergence of scholarship on quantification and organize subsequent sections around four different institutional locations where quantification and quantification scholarship have flourished, emphasizing administration, democratic rule, economics, and the penetration of quantification into mundane, everyday life. For each location we emphasize three questions: What problem or uncertainty is quantification supposed to address? How does quantification affect power and politics? How does it shape relations of visibility: What is noticed and what is not? We conclude by addressing what new social relations and objects are brought about through quantification.

Throughout, we underscore the significance of unpacking the multifaceted characteristics of quantification and commensuration, defined as the comparison of different entities according to a common metric (Espeland & Stevens 1998). We trace the implication of quantification in shifting modes of power and governing styles and call for a more systematic investigation of the changing relations and dynamics unfolding between classification, measurement, and aggregation. Measurement, the process of ascertaining a magnitude or quantity by the application of an instrument marked in standard units, is based on classification, negotiated conventions determining agreement on the thing to be measured (Beckert & Musselin 2013, Bowker & Star 2000, Desrosières 1998, Power 2004). At the same time, measurement can result in new classifications, for example of race, prosperity, or inequality. The aggregation of numbers (quantified qualities) via statistical and mathematical operations into indices, ratios, ratings, or rankings, referred to by Power (2004) as meta- or second-order measurement, enables new forms of comparison and knowledge creation. Such measures of measures (Power 2004) often take on a life of their own and are circulated and removed from their origins of production. Although not necessarily precise in themselves, they reproduce ideals of precision and accuracy connected to quantification.

We highlight the importance of understanding the plurality of quantification, involving varying degrees of mathematical and statistical formality, abstraction, aggregation, and political work. We also highlight the importance of tracking the circulation of metrics across different sites. The quantified self movement may have been started by users and tool makers who share an interest in self-knowledge through self-tracking. Yet such information can be linked up and fed into actuarial risk assessments, thereby changing not only the lives of those who track themselves, but also potentially healthcare insurance politics and how healthcare is administered. As sociologists, we need to understand such interactions between different quantification regimes and their broader implications for the (re)creation of social and political order.

INTELLECTUAL TRADITIONS IN SCHOLARSHIP ON QUANTIFICATION

To paraphrase Hacking (1990, p. 16), states have always been statistical in their own way and scholarship reflects this.[1] Many of the most important scholars of quantification were also practitioners or had close ties to quantification practice. Alain Desrosières and Laurent Thévenot were administrators at the French National Institute of Statistics and Economic Studies (INSEE), the French census bureau, when they were charged with updating the social and professional categories the agency used. This prompted their interest in the social history of those classifications and the statistics they made possible. The French school of quantification was launched by Desrosières and a group of like-minded researchers, including Laurent Thévenot, Robert Salais (also of INSEE), and the sociologist Luc Boltanski. Their work interrogated the concepts and classifications undergirding quantification and the production, use, and consequences of statistics, always with an eye toward their implications for reflexivity and how power is exercised (Bardet 2014, Bruno et al. 2016, Diaz-Bone 2016, Didier 2016).

Key contributions of this group related to their emphasis on the practice of statistics, including the crucial work of creating and coding concepts and categories, and recovering the decisions that these entail (Boltanski 1987); the refusal to privilege realist over constructivist approaches to quantification (Desrosières 1998); and the development of a conventionalist approach that examines how multiple shared interpretive schemes, or conventions, are used by actors in uncertain situations to coordinate action, evaluate worth and value, and make things equivalent. Some prominent contributors include Boltanski & Thévenot (2006) and Storper & Salais (1997) [useful overviews are provided by Diaz-Bone & Didier (2016), Diaz-Bone & Salais (2011)].

The influence of these early architects of the French school generated a vibrant body of work in which conventionalist insights, sometimes in conversation with actor-network theory, were applied broadly. Today, the French school is central in studies of relations between quantification and valuation, and measure and worth (Adkins & Lury 2012, Berthoin Antal et al. 2015, Fourcade 2011, Karpik 2010, Lamont 2012, Vatin 2013). It has also been influential in studies that examine how forms of quantification have proliferated under financial capitalism and various neoliberal regimes (Chiapello & Walter 2016, Lengwiler 2016, Supiot 2015), including crime statistics (Didier 2018), benchmarking (Bruno & Didier 2013), and political activism (Bruno et al. 2014). Where earlier scholarship emphasized the depiction of features of the state (e.g., crime statistics), new scholarship examines how numbers are used to manage the state (e.g., deploy police based on current crime locations) (Didier 2018).

Other scholars, many with backgrounds in the history and philosophy of science and ties to North America and Germany, were working on the production and influence of statistics at roughly the same time. In 1982, an international group in Bielefeld launched a series of important studies of probability and statistics, including those of Krüger et al. (1987), Hacking (1990), Daston (1988), Porter (1986), and Gigerenzer et al. (1989). Like their French counterparts, they emphasized the applications and practical consequences of probability and statistics for fields such as administration, public health, insurance, politics, law, and the economy; they also investigated the resources, classification, and coordination that were required to produce statistics, what Bowker & Star (2000) might call the informational infrastructure of statistics; and they considered how quantification changed how people understood their worlds and acted in them.

Critical accounting studies form another important center of quantification scholarship. Accounting has long been recognized for its fundamental and tangled role in the development of

[1] Didier (2016), Bruno et al. (2016, pp. 1–14), and Bardet (2014) offer helpful histories of research on quantification that have informed this review.

capitalism. Accounting is crucial for apprehending the cognitive infrastructure of capitalism, including how standardized methods for valuing and pricing are created. Beginning in the United Kingdom in the 1970s, a group of accounting scholars led by Anthony Hopwood, a professor of accounting and highly accomplished institution-builder, challenged the view of accounting as a technical, objective enterprise, insisting instead that the sociological, organizational, and social-psychological dimensions of accounting practice were crucial for understanding how accounting techniques are created and used (Hopwood 1983, Hopwood & Miller 1994). Deeply informed by social theory, particularly Foucault, but also actor-network theory, New Institutionalism, and political economy, this scholarship was framed as an alternative to the narrow specialization and brand of positivism in accounting scholarship that dominated in the United States.

In 1976, Hopwood founded this group's flagship journal, *Accounting, Organizations and Society*. Influential early work included Miller & O'Leary's (1987) analysis of standardized costing as a mechanism of labor control at the turn of the twentieth century, and Hoskin & Macve's (1986) work on the historical interrelationships between accounting and educational examinations. Ten years later, Michael Power published his seminal book *The Audit Society: Rituals of Verification* (Power 1997). These and later works (e.g., Chapman et al. 2009) show how quantification is at the heart of the making up (Hacking 2002) of economic entities, corporations and markets, and the persons that inhabit them (Miller & Power 2013). Critical accounting scholarship has close linkages with the sociology of finance (Carruthers & Kim 2011, Vollmer 2007), which underscores the performativity of quantification in financial markets, tracing how financial models are enacted so that they can become more or less true (MacKenzie & Millo 2003; see also MacKenzie & Spears 2014, who trace the development of the Gaussian copula family models that created the financial markets that gave rise to the 2008 crisis).

Within sociology, Espeland & Stevens's (1998) examination of commensuration provided a springboard for subsequent works on metric power (Beer 2016, Dorn & Tacke 2017, Heintz 2010, Mau 2017, Passoth & Wehner 2013, Vormbusch 2012) (see also Espeland & Sauder 2007 on rankings' reactivity). Quantification allows for comparison of different entities according to a common metric (e.g., rankings or ratings), which has important implications for how we categorize and make sense of the world (Dorn & Tacke 2017). Carson (2007), for example, examines the role of standardized testing in defining merit in the French and US republics and how this shaped the structure of opportunities. Igo (2008) shows how surveys of communities, sexual behavior, and political opinion shaped how Americans understood themselves as individuals, citizens and objects of social scientific research.

More recently, scholarship has turned to quantification and commensuration in transnational governance (Mehrpouya & Samiolo 2016, Merry et al. 2015, Rottenburg et al. 2015, Shore & Wright 2015) and what some have termed algorithmic society (see, e.g., Bradbury 2016 and **https://medium.com/the-algorithmic-society**) to explore how algorithms and big data computation analysis, data-driven decision making, data mining, and machine learning reorder our choices, lives, and institutions (Lazer & Radford 2017, Mämecke et al. 2018). Katz (2013), for example, shows how law is changing with data-driven prediction and analysis; Dunleavy et al. (2005) argue that digital governance is supplanting new public management in some countries; Lupton (2016) and Nafus (2016) investigate how digitized self-tracking is changing subjective understandings of the body and the self as projects to be optimized and decontextualized abstractions (see also Neff & Nafus 2016).

With new metrics and technologies, quantification scholarship also grows. We focus on four locations (administration, democratic rule, economics, personal life) in which quantification and quantification scholarship have particularly expanded over the past few years. We do not seek to offer a theoretical synthesis. Although some regret the lack of cumulative theory building, we argue

that the diversity of quantification studies demonstrates the need to take the plurality of quantification seriously. We caution against unifying accounts in order to embrace the essential ambiguity of quantification practices; to track shifts in relations between measurement, classification and aggregation; and to examine the different spaces of contestation where quantification operates.

QUANTIFICATION AND ADMINISTRATION

Calculation produces knowledge that is useful for administering and governing and that has often been a motive for quantification. Calculation can help answer three broad kinds of questions: How many? How valuable? What can we expect? Surveys and censuses tell governments and churches how many people there are and what their assets are. Cost-benefit analyses and decision trees show which plans are most efficient. Accounting techniques help track resources and estimate future trends. And demography and actuarial techniques help predict people's morbidity and mortality.

The link between quantification and administration is an old one. As Deringer (2018) shows, governing long included the calculation of public numbers related to production, taxation, and conscription. In an example provided from 70 BC, Cicero, when charging Gaius Verres with corruption, warns his audience to attend to his figures because, even if they are tedious and dull, they show that Verres made indecent profits in tax collection. Though his calculations were suspect and the numeracy of his audience questionable, Cicero clearly considered his quantitative evidence as convincing rhetoric (Cioffi 2011) that could play a role in the art of persuasion.

A major turning point occurred in the seventeenth century when we see the emergence of a systematic science of social numbers to create social policy. In England, this was termed "political arithmetic" by William Petty, who championed the superiority of quantitative knowledge as crucial for England's efforts to colonize Ireland and for public finance (McCormick 2009). Petty's friend, John Gaunt, analyzed weekly mortality statistics to assess the population of London and create life tables that estimated the probability of survival for each age. Both men were convinced that the development of the state depended on the size, health, and distribution of its population and that this could be known through numbers (Kreager 1991, p. 221). For Petty and Gaunt, colonial rule, taxation, and public health were motives for creating quantitative knowledge. Their work began the merging of two kinds of authority that previously had been kept separate: those of science and the state (Desrosières 1998, p. 17). Yet, as the historian McCormick (2009) points out, Petty and Gaunt's ambitions for political arithmetic were not embraced by elites until later.

It was not until the nineteenth century that "statistics" as the term is understood today came into use: as unique techniques based on mathematical probability used to study wide-ranging subjects where one did not need to know about particular individuals in order to calculate broad laws about collectivities. For Porter (1986, p. 6), "the doctrine that order is to be found in large numbers is the leitmotif of nineteenth century statistical thinking," and it was this ordering that helped to form the concept of society as an entity with regular properties. We also note the important roles played by German cameralism in the eighteenth and early nineteenth centuries (Foucault 2007, Johnson 1964, Tribe 1988).

The nineteenth century produced an avalanche of printed numbers about population, health, crime, suicide, trade, and labor and other resources (Hacking 1990). In sharp contrast to earlier numbers, these were public. The roots of many numbers lie in administration and politics, but their uses did not remain there. These statistics made it possible to apply the mathematics of probability to large and varied kinds of social data. This spelled an "erosion of determinism," replacing thinking that presumed that the full complex of causal connections of social phenomena could be known, with "a model of normal people with laws of dispersion" (Hacking 1990, pp. vii, 1–2).

The census is the most familiar, and likely the oldest, form of administrative calculation. The word derives from the Latin *censere*, "to assess." The first known census was taken in Babylonia in 3800 BC. In addition to population and livestock, it included resources like butter, honey, and wool (Kuhrt 1997, p. 695). The Domesday Book of 1086 is a famous example of a regime's effort to extend surveillance and control. The culmination of the Great Survey launched by William the Conqueror in order to ascertain the fiscal rights of the king, it was a detailed recording of the settlements, their tenants, and resources. Such knowledge expressed and helped consolidate William's rule. To know how many requires that we know who counts and who does not count, and how to parse these categories. These are not easy to know; classification is hard and consequential, and the census is often bound up with notions of identity, citizenship, and belonging. In the United States, the link between the census and apportionment gave rise to the question of whether and how much enslaved persons counted as human. In many cases, the expansion of enumerating changed understandings of what was being counted.

The production of census data is demanding, not only politically but also administratively. Standardization, the bedrock of quantification, often requires a centralized bureaucracy, with regular funding and a trained, disciplined work force. Kula (1986), Alder (2002), Timmermans & Epstein (2010), Lampland & Star (2009) and others show that producing standardized measures was a crucial, if arduous and politicized, part of this undertaking. Porter (2018) shows how efforts to report credible cure rates by insane asylums in the nineteenth century gave rise to detailed record keeping that became the basis for modern genetics research.

Early efforts to produce a census without bureaucratic support failed spectacularly (Bourguet 1987). Only later did states create the needed administrative apparatus sufficient to produce accurate counts. Germany was the first country to institutionalize a census. The United States was the first state to require a regular census, but it only belatedly created a permanent agency in 1902 (Anderson 1988).

There has been a recent flourishing of scholarship on censuses (Rodríguez-Muñiz 2017, p. 387). While scholars have long used censuses as sources of information, there is a growing recognition of their importance not just for aiding our understandings of politics, culture, and national identities but also as constituent of them (Anderson 1988). Loveman (2014) examines the long and complicated histories of racial classification in nineteenth-century Latin American censuses, showing how conceptions of national progress and modern statehood shaped these classifications and why, in many countries, racial statistics were first dropped and then reinstated as populations became increasingly white. The results of these racial categories still inform contemporary Latin American policy and politics, as well as how skin pigmentation is experienced (Telles 2014).

In their comparative analysis of the censuses of Italy, the United Kingdom, and the United States, Emigh et al. (2016a,b) show the complex ways that states and societies interact to affect when and how a census is produced and how its information is used. They aim to counter what they contend is the prevailing view: a state-centric approach to understanding the census as a top-down exercise of state formation and control. Instead, they depict a more interactionist, enumerative project where societal actors and interests shape the census, and the public information that the census affords is used in economic and political struggles to shape society. This pattern varies historically and contextually. For example, in the first half of the twentieth century, elite lobbies were influential in promoting classification and enumeration that supported their interests and expertise. Later, more populist social groups played a bigger role.

One important strand of research interrogates the relationship between statistical knowledge and colonial power. The anthropologist Cohn (1987, 1996), beginning in the 1980s, helped to pioneer this approach with his investigation of the role the census played in how caste was understood and reified in South Asia. Other studies examine how statistics and enumeration helped

produce colonial understandings of categories such as "tribe" (van den Bersselaar 2004) and other modes of characterizing difference. Kalpagam (2010) elaborates the central role played by statistical knowledge and enumerative practices in India during colonial rule and how their proliferation gave rise to particular forms of modern statehood. Studies of the census in the Qing Dynasty (Lam 2011), the hut tax in South Africa (Redding 2006), and the use of statistical knowledge in post–World War II Japan (Hein 2004) show how ideas about what was modern—and its relationship to classification, enumeration, and statistics—shaped state-building, apartheid, and colonial power.

Other scholars have analyzed the role of quantification in governance among international organizations. Many global institutions, including the World Bank, the United Nations, and the European Union have been inspired to create indicators to encourage accountability or economic development or to discredit regimes. Davis et al. (2012), Rottenburg et al. (2015), and Merry et al. (2015) document how indicators and rankings have become an important form of global governance, with mixed results. The anthropologist Merry's (2016) analysis of human rights, sex trafficking, and gender violence shows how the aura of objectivity fuels the investment in indicators, which work best when accompanied by detailed qualitative knowledge of local contexts. Didier (2018) explains the globalizing of indicators measuring crime and policing effectiveness. Yet, no single center of statistical knowledge has emerged at the global level (Speich Chasseé 2016).

Calculation was not always motivated by public administration and governance. McCormick (2013) describes how demographic calculations were deployed in polemical debates in England during the Enlightenment. Moreover, as the historian Deringer (2018) demonstrates, after the Glorious Revolution of 1688, quantification flourished in Britain and became a central feature of public discourse. It was not state concern for control or generalized distrust that drove calculation in the eighteenth century, however, but rather its usefulness as a weapon in political argumentation. In debates about the fiscal crisis following the South Sea Bubble of 1720, questions about the size of the national debt and the best means for addressing it enlisted calculations by partisans. Deringer argues that the authority that became invested in calculation was driven by its link to politics and gave rise to a distinctive civic epistemology that expanded the possibilities for quantification.

The census provides clear examples of the complex relationships between classification, measurement and aggregation. In the United States, for instance, the politics of classification and its link to visibility and political power have been central in definitions of personhood, citizenship, race, and, more recently, gender. The census has produced a new standardized geographical unit of measurement, the census tract, an aggregation of individual and household data that then can be further aggregated into an enormous variety of statistics and indicators that are used in social scientific research, business strategy, and policy making.

QUANTIFICATION AND DEMOCRATIC RULE

Enthusiasm for quantification is often driven by the desire to hold to account, to counteract despotism and arbitrariness, and to make visible social and economic inequality. Numbers have come to be integral to how democracy is justified and operationalized as a particular set of mechanisms of rule (Rose 1991; see also Alonso & Starr 1989, Desrosières 2014, Didier 2009), and the relation between politics and numbers is mutually constitutive. As Rose (1991, p. 675) writes, numbers are always preceded by political judgment of what to measure, and our images of political life are shaped by numbers—by the realities of our society that statistics appear to disclose.

Cohen (1982) shows how, in early America, numeracy was a central element in the constitution of a democratic polity. Here, statistics were seen as a means for reducing the fear of unchecked power. To govern legitimately was not to govern at the mercy of opinion and prejudice, but to

govern in the light of (quantifiable) facts (Rose 1991, p. 684). Numbers promise a depoliticization of politics (see also Alonso & Starr 1989, Gigerenzer et al. 1989, Miller 1992, Porter 1995).

Yet, numbers can also be repoliticized. Quantification has been an important means in the organization of political activism, social movements, and protest. Activists use numbers as a means of denunciation and criticism (Bruno et al. 2014). They use numbers to fight climate change, Wall Street finance, and neoliberalism more generally. The recent protest movements that brought attention to the 1% (defined as the top 1% of the wealth distribution), versus other Americans (the other 99%) (Keister 2014) is one example. Although the study of top incomes and wealth creates unique data challenges (Keister 2014, p. 349), statistical representations of inequality are nevertheless critical to drawing attention to issues of social stratification, inclusion and exclusion, and class and social mobility (or the lack thereof). Such representations make visible the negative consequences of neoliberalism, for example, with regard to rising precarity. In so doing, they contribute to the articulation of political voice and dissent.

We should also not forget that numbers, including the 1%, can generate emotional attachments that stimulate collective identity and thereby aid social mobilization. Numbers help make up people (Hacking 2002), or, as Igo (2008) put it, they help build and make visible new statistical communities. For example, Alfred Kinsey's groundbreaking surveys of sexual behavior of white men in the United States reported that 37% had had at least one overt homosexual experience to the point of orgasm since adolescence, and that 10% had had more or less exclusively homosexual relations for at least three years between ages 16 and 55 (Kinsey et al. 1948). These figures shaped the development of the modern gay rights movement. Kinsey's statistics helped make visible homosexuality as a minority group that could be organized politically (Michaels & Espeland 2006). Rodríguez-Muñiz (2017) analyzes how Latino political activism promoted participation in the US Census in order to secure greater political and economic power. He shows the importance of the bottom-up consent-building process for voluntary censuses that is necessary to produce state legibility (Scott 1998). Writing about an earlier period, Mora (2014) describes the role the census played in helping produce the pan-ethnic Hispanic identity among Mexican, Puerto Rican, and Cuban Americans. Advocates lobbied bureaucrats to consolidate various categories in order to strengthen claims for federal resources. Groups use statistics to appeal to and resist state and economic power in a variety of ways. Visibility is both a product of power and a strategy to rectify it.

Recent work on statactivism explains the use of statistics by political activists, highlighting the double role of statistics in representing and criticizing reality (Bruno & Didier 2013, Bruno et al. 2014, Didier 2018). These studies examine how activists use statistics as a means of emancipation in the collective organization of resistance, for instance, to criticize and influence the police (Didier 2018), challenge national price indices (Samuel 2014), or fight for gender equality (De Rosa 2014). In the United Kingdom in 1975, the Radical Statistics Group (Radstats) was founded to create awareness of the actual and potential misuse of statistics within and outside of government. The group still exists and believes that statistics can be used as part of campaigns for progressive social change. Radstats members seek to counteract the lack of control by the community over statistical investigations and are committed to helping build "a more free, democratic and egalitarian society" (see **http://www.radstats.org.uk/about-radical-statistics/**).

In the United States in the mid-1960s, the social indicators movement (Bauer 1966, Land & Michalos 2018) originated as a critical response to the rising spread, influence, and limitations of macroeconomic indicators such as the gross national product. The social scientists of this movement aimed to establish a "system of social accounts" that would expand cost-benefit analysis beyond the market-based national income and product accounts (Land 1983, p. 2). The movement, which has matured into an established field with its own professional organizations, journals, and meetings, is concerned with the development of indicators measuring quality of life and individual

well-being. Although the movement started in the United States (Bauer 1966), it quickly became international in scope and reach, and scholars and practitioners in other countries (west and east, including the Soviet Union) joined in (Land & Michalos 2018, p. 839). Today, the quality of life concept has gained widespread political and academic appeal, and composite indices developed by the field, such as the Human Development Index, Gender Inequality Index, Social Progress Index, or Child Well-Being Index, have come to be widely accepted and used in transnational governance and aid coordination (Land & Michalos 2018).

Of course, critical quantification scholars remind us that such indicators, which rest on multiple levels of aggregation, are seductive as they allow for easy comparison and ranking of countries, organizations, and much else, which can lead to oversimplification and homogenization if not grounded in qualitative, locally informed systems of knowledge production (Dorn & Tacke 2017, Espeland & Sauder 2016, Merry 2016). As Jerven (2013) has shown for African development statistics, aggregate numbers are often arbitrary, uncertain, and error-ridden. At the same time, these uncertain, composite numbers take on a misleading air of accuracy and play a key role in allocating scarce resources.

This makes it all the more important to understand how numbers, including the social indicators referred to above, are produced, measured, calculated, and aggregated, and with what consequences for classification—the making up of organizations, states and individuals—as well as democratic participation. Numbers, and their presumed transparency, both illuminate and obscure relations of power (Miller & Rose 2008; Power 1997, 2004; Strathern 2000). The increased availability and abundance of data about the performances of states, organizations, and individuals can enable watchful vigilance from underneath. Yet, how such potentially empowering data are produced is often invisible, and citizens are left guessing what has been overlooked or deliberately excluded and why. As studies on statactivism demonstrate, assessing and critiquing government through numbers requires a reasonable level of numerical literacy (see also Bruno et al. 2016). Quantification may be motivated by a democratizing ambition. Yet, we need to be careful to understand how quantification and the complex relationships between classification, measurement, and aggregation change possibilities for democratic participation and political engagement (Kurunmäki et al. 2016).

In the interest of moving the study of relations between quantification and democratization forward, we propose that one might usefully distinguish between the following research foci. The first concerns the incorporation of voice in numbers: an examination of conditions and possibilities (as well as limits) of public participation and inclusion of local knowledge in (uncertain) indicator design, including classification, measurement, and aggregation (Jerven 2013, Merry 2016, Morgan 2010, Salais 2016). As Morgan (2010) might put it, how can quantification express citizens' experience about political, economic, and social arrangements that affect them? Tracing the construction of indicators—the statistics, conventions, groupings, and complex weighting choices involved in their production and circulation—provides insight into the largely hidden practices of classification and aggregation that support them and the intricate relations between quantification, voice (or the lack thereof), and desires for impartial, long-distance control.

The second research dimension relates to a pluralization of quantification: the development of alternative measures—counter-quantifications, as the literature on statactivism has highlighted (see also Salais 2016)—to irritate, unsettle, and destabilize existing quantifications [e.g., gross domestic product (GDP), poverty and equality indices, crime statistics, and much else]. Aggregated indicators, such as GDP or poverty or equality indices, often lack statistical exactness and are removed from (first-order) measurement, yet they reproduce ideals of precision and accuracy, which furthers their attractiveness. We need to open up the black box of their production to escape from any assumed technical determinism and stimulate more plurality in, and debate on, quantification.

Relatedly, the third research dimension concerns the relationship between quantification and public debate: What role do numbers play in generating and framing public discussion and deliberations about public goods such as higher education, poverty, sustainability, migration, incarceration, and health? Finally, we ought to attend to how changes in the technologies of quantification, the rise and spread of social media and big data, have shaped and changed possibilities for citizen voice and engagement with quantification.

Democracy, in its modern mass liberal forms, Rose (1991) argues, requires numerate and calculating citizens, numericized civic discourse, and a numericized programmatics of government. In so doing, citizens and governments are made visible, accountable, and governable in particular ways, displacing others. Such numericization opens up not only new ways of political engagement; it also encourages economization by moving governments and citizens closer to principles of rational calculation, efficiency, competition, and market making, which in turn can run the risk of hollowing out democratic rule.

QUANTIFICATION AND ECONOMIZATION

Quantification has always been a crucial feature undergirding markets (take the example of credit ratings) (Carruthers 2013, Poon 2009). More recently scholarship has begun to track the roles of quantification in attempts to extend the rationality of the market to domains previously viewed as nonmarket and noneconomic (Kurunmäki et al. 2016). Especially in the past twenty years, scholarship has emerged that investigates the roles of quantification in economization, particularly neoliberal, market-oriented reforms aimed at, as Brown (2015) puts it, the remaking of everything and everyone in the image of *homo oeconomicus* (see also Davies 2014, Muniesa 2014, Supiot 2015). Following Miller & Power (2013) and Çalışkan & Callon (2009), one can define economizing as the processes through which individuals, activities, and organizations are constituted or framed as economic actors and entities. Emphasis is placed on the process by which a supremacy of the economic over society, including politics and domestic life, is articulated and established (Miller & Power 2013). Of course, the distinction between the economic and noneconomic itself is historically contingent and contextually variable, and it is the task of the sociologist to empirically scrutinize the construction of such a distinction and its shifting boundaries.

Power wrote two influential books that describe the emergence of the audit explosion (Power 1997) and risk management (Power 2007) as a response to issues of trust. He showed how organizations begin to conform to the dictates of being audited and how performance measures and targets become paramount in management, something often referred to as new public management. To quote Miller & Power (2013, p. 560), "a museum must be made into an economic entity, and its managers constituted as economic agents, before its costs can be revealed, acted upon and, eventually perhaps, reduced."

Quantification and commensuration are key conditions for economic calculation and action. Quantification makes individual and organizational performance visible, trackable, and comparable, thereby allowing for organizing in accordance with principles of efficiency. Critical accounting scholars have long emphasized the mutual interrelationship between accounting and economics, considering the ways in which accounting calculations facilitate the construction of (shifting) spheres of economic activity (Hopwood 1992). More recently, scholars outside accounting have begun to scrutinize links between quantification and the expansion of the economic into areas previously deemed noneconomic. In this context, specific attention has been given to relations between quantification and the rise and spread of neoliberalism (Centeno & Cohen 2012).

A distinguishing feature of quantification in neoliberalism is its close link to market and (capital) investment rationales (Brown 2015; Bruno & Didier 2013; Davies 2014; Kurunmäki et al. 2016;

Muniesa 2014, 2017). Performance measurement, benchmarks, rankings, and ratings disseminate the market model to economic and noneconomic domains of activity, (re)configuring human beings, organizations, and states as market actors (see also Jeacle & Carter 2011). As Brown (2015) highlights, that does not mean that neoliberalism and neoliberal quantification, respectively, literally marketize all spheres. Rather, organizational entities, such as hospitals, prisons, or universities, as well as nation-states, with the help of commensurable performance metrics, are remade in the image of the market, "involving appeals to the virtues of competitive behavior, culture and mindset" (Davies 2014, ix).

Espeland & Sauder (2016) show how the *U.S. News and World Report* invoked the language of the marketplace to frame its law school rankings, highlighting that they would provide consumers with useful information about the specialized product market of legal education. Newfield (2016) demonstrates the damages done to American higher education in its corporatization. In France, Musselin (2017) illustrates how international university rankings, combined with national performance metrics, contributed to the dismissal of a political discourse in favor of uniformization, equality, and equivalence and the establishment of a discourse aimed at enhancing vertical differentiation, competition, and competitiveness (see also Brankovic et al. 2018, Münch 2014). Similar market-oriented utilizations of performance metrics, rankings, and ratings can be observed in other public services, including health and social care, and the correctional services. Rankings and ratings are also used to regulate the provision of public goods via market pressures, stimulate competition and performance, and render ideas of market coordination operable (see e.g., Juven 2016, Kurunmäki & Miller 2006, Mehrpouya & Samiolo 2016).

Such market-oriented quantifications involve the creation of new subjectivities. Citizens, patients, students, prisoners, and other public service users are turned into (quantifiable) consumers, who are to be satisfied and fought over [see also the rise and studied effects of patient, student, and prisoner experience surveys (e.g., Pflueger 2016)]. These users are enmeshed in networks of calculation as active participants. They are reconstituted as entrepreneurial, "calculating selves" (Miller 1992) who have to actively manage and realize their (human) capital, not just for themselves, but also for firms, states, and public institutions, including universities and hospitals, concerned with their own competitive positioning (Brown 2015). French scholars in particular have drawn attention to quantification in such processes of capitalization, where things (e.g., higher education) and human beings (e.g., prisoners) are turned into assets evaluated in their capacity to create value from the perspective of an investor who expects calculable future returns (Muniesa et al. 2017). In charitable work we observe the rise and spread of quantified social impact assessments, such as social return on investment figures, aimed at making the added value of charity work knowable and visible from an investor's perspective (Barman 2016, Hall et al. 2015, Norman 2014). Financial instruments of quantification and profit determination are applied to the valuation of extrafinancial gain (e.g., environmental and social value not currently reflected in conventional financial accounts). In doing so, people are redefined as entrepreneurs and investments (Brown 2015, Muniesa et al. 2017). The French sociologist Chiapello argues that such neoliberal economization of social and political life is intertwined with a shift in the conventions underpinning (economic) quantification (Chiapello 2015, Chiapello & Walter 2016). Chiapello stresses the progressive diffusion of financialized conventions. Such conventions have been developed and spread by finance professionals in and outside financial accounting, for instance in the form of net present value calculations, probability-based estimates of value, and market prices as true value benchmarks. They constitute key building blocks of calculative reason in terms of capital.

What are implications of the above for changes in interrelations between quantification and uncertainty? What are consequences for relations of visibility, power, and politics?

Uncertainty, under the "arc of neoliberalism" (Centeno & Cohen 2012), is something to actively embrace and act upon, rather than to be protected from (Power 2007). Quantification, in this context—for instance, via rankings and ratings—is supposed to help make uncertainty calculable and manageable, and to facilitate choice and investment in opaque markets (for example, the market for higher education or healthcare) (see also Esposito & Stark 2019). As Davies (2014, p. xi) argues, the fact that the future is undetermined—is yet to be made, is what allows us to dream, reinvent, and reorganize—is at the heart of (neoliberal) entrepreneurial innovation. Yet, uncertainty in neoliberalism refers to multiple, competing actors operating according to various conflicting strategies (Davies 2014, p. xi). League tables, rankings, and ratings make visible an individual's, organization's, or state's competitive positioning. They address goal uncertainty by specifying what counts and ought to be maximized. At the same time, such new competition-oriented visibilities also introduce new uncertainties, anxiety, and stress (Espeland & Sauder 2007, 2016). For Strathern (2000), it is the "tyranny of transparency."

Such neoliberal quantification alters power relations and possibilities for political action. It influences the capacities of agents, organizations, and the connections among them, and can enable new ways of acting upon and influencing the actions of individuals (Foucault 1991; Miller 1992, 2001). For example, new forms of expertise and experts, particularly financial managerial experts and expertise, take hold of social and political relations. The capacities to aspire and achieve are never evenly distributed (Appadurai 2011). For Gilbert, what matters is not only the scenarios in which the capitalizing gaze is activated but also who has the capacity to capitalize (Gilbert 2017, p. 98).

Finally, the realm of politics itself is altered. Neoliberal quantification supports the meshing of political, market, and business lexicons. As a consequence, the democratic promise of shared rule is transformed into the promise of enterprise and portfolio management (Brown 2015, but see also Muniesa et al. 2017, Supiot 2015). Of course, we need to be careful not to equate quantification with economization, for not all quantification implies economization (Kurunmäki et al. 2016). Yet, the scope of quantification, and potentially also economization, has expanded massively over the past twenty years across states, markets, organizations, and everyday life.

QUANTIFICATION IN PERSONAL LIFE

We live in a metric culture. Social media has made likes, hits, and retweets its currency. Entities from corporations to political campaigns are constructing data portraits of users and their friends. It seems that no trace of social media is left unmodeled and unexploited. Individuals are quantifying themselves more than ever, turning themselves into experiments and self-help projects as they generate and scrutinize their own data. Our focus here is on the growing literature examining new cultures of quantified self-tracking, including the quantified self community (Ajana 2017, Beer 2015, Lupton 2016, Mau 2017, Nafus 2016, Neff & Nafus 2016).

Self-tracking encompasses recording and measuring "in which people knowingly and purposively collect information about themselves, which they then review and consider applying to the conduct of their lives" (Lupton 2016, p. 2). Self-tracking is not new, as the history of diaries and bathroom scales attests. Yet, computerized quantification and digitization equip self-tracking with new qualities and possibilities. Digitization and automation facilitate an ever more detailed and accelerated measurement and monitoring of the body and everyday life in real time (Ajana 2017, Lupton 2016, Mau 2017, Neff & Nafus 2016). This affords new possibilities for data circulation (Beer 2016) as the data become accessible to the developers of digital tracking devices such as smart watches, wristbands, and phones, and as the data move onto social media sites, self-tracking platforms, or the archives of the computing cloud. As a consequence, notions of privacy are

challenged and transformed and new possibilities for surveillance and commercial exploitation are created (Lupton 2016, p. 84, but see also Ajana 2017, Beer 2016, Pasquale 2015, Mau 2017).

Pasquale (2015) describes the notion of the black box society to highlight how digitized self-tracking, and the tracking of the self by others,[2] is implicated in new politics of visibility. Digitized self-tracking creates new visibilities, while the data infrastructures in which we live, the analytics operated on the data, become increasingly invisible (Beer 2016). Such data offer new possibilities for classification, targeting, profiling (e.g., of criminals or potential offenders), economization, and commercial exploitation (e.g., of consumers); in most cases, people are not aware of what data they help produce, where their data are stored, or how the data are being used by third parties.

Neff & Nafus (2016) highlight the embeddedness of such data in biomedicalization, which is the extension of medical or biological explanations for the way things are. Biomedicalization is a distinctive feature of digitized self-tracking, a "mental model, a habit of thought that makes medicine the most readily available explanation for why things are the way they are" (Neff & Nafus 2016, p. 18). It makes close measurement of the body conceivable and desirable. It intertwines bodily practice with measurement and governance of "life itself," as Rose (2007) would put it. Of course, Foucault has shown that biometrics and biopolitics have played a key role in the governing of life since before the advent of digitized self-tracking (Foucault 2008). Yet, as Beer (2016, p. 71) writes, in the case of digitized self-tracking, enthusiasm for numbers has converged with the possibilities of new types of data infrastructures to enable the scope and depth of body measurement to increase and intensify.

Gamification is another key aspect of digitized self-tracking (Fuchs et al. 2014, Hammarfelt et al. 2016, Whitson 2013). Through the introduction of game-like features into tracking devices and the use of playful data visualizations, engaging with numbers is meant to become a fun part of everyday consumption as well as facilitate a state- and market-based accumulation of information about individual lives (Beer 2016). Akin to games, digitized self-tracking provides users with precise real-time feedback charting their progress and determining how to advance themselves in competition with others, or against themselves (Whitson 2013). In so doing, these tools do not merely seek to entice their users into continued participation. Gerlitz and Lury show in their study of Klout, a measure of influence, how quantified self technologies are intended to actively modify the behaviors they track: "They expect and exploit reactivity" (Gerlitz & Lury 2014, p. 174). Gamification thus affords self-tracking tools agency.

Motives for users to participate in self-tracking are varied (see in particular the ethnographic fieldwork with members of the quantified self movement by Nafus & Sherman 2014, but see also Ajana 2017, Lupton & Smith 2018, Nafus 2016). Many take up self-tracking to manage their health and well-being or to enhance their productivity. Others engage in it out of sheer curiosity or vanity. People with health problems and chronic illnesses might be pushed, nudged, or coerced into self-tracking by their doctors. Companies use digital, wearable devices to track employees' physical activity, hours of productivity, and subjective sense of well-being and stress in order to manage their performance.

Quantified self-tracking promises self-reflexivity and control in a world characterized by increased levels of uncertainty in the age of "reflexive modernization" (Beck et al. 1994) (see also Jeacle & Carter 2011, Lupton & Smith 2018). It can be "a strategy for empowering by making contributions visible, or to contest auditing done by others" (Hammarfelt et al. 2016, p. 8; see also Nafus & Sherman 2014). Rettberg (2014) shows how truck drivers use self-tracking data to

[2] Lupton (2016) distinguishes between self-tracking and the tracking of the self by others. In the case of dedicated self-tracking, some or all of the collected information is available to the subjects tracking themselves (and potentially others). In the case of the tracking of the self by others, people often have no knowledge at all of what data are collected on them.

challenge estimations of the time it took them to perform certain procedures. Academics may employ self-tracking to undermine the influence of audit regimes within their organization (Hammarfelt et al. 2016). At the same time, it can also make people feel as if they are losing control; it can lead to obsession and the feeling of inadequacy (Lupton 2016).

Moore & Robinson (2016) examine how the introduction of quantified self-tracking in workplaces was accompanied by an intensification of competition, precarity, and feelings of anxiety. While self-tracking practices may appear to be highly individualistic and agential, they are underpinned by broader issues of power, security and insecurity, and the governing of lives. Scholars have drawn on Foucault to highlight these political and biopolitical dimensions of self-tracking and to show how neoliberal ideals of entrepreneurial selfhood, self-optimization, economization, and competitiveness are deeply intertwined with it (Ajana 2017, Beer 2015, Lupton 2016, Moore & Robinson 2016, Whitson 2013).

The literature on digitized self-quantification suggests significant implications for our broader thinking about relations between data and measurement, classification and aggregation, and the making up of people (Hacking 2002). The datafication of everyday life offers new possibilities for quantification, and it accelerates and intensifies the roles of numbers in our lives. At the same time, the relationship between classification and measurement is turned on its head. At least to some extent, datafication dissolves the importance of classification in measurement (in Desrosières's sense). The relationship between classification and measurement is turned upside down. Contrary to what Desrosières (1998) stated twenty years ago, classification does not precede measurement but becomes a result of it.

Datafied quantification contributes to making up people in new ways. As Whitson (2014, p. 343) notes, information—such as shopping habits, user preferences, bank account numbers, voting preference, and location—is separated from individuals, recombined, and quantified in new ways, outside of their control. Such datafication of information produces novel forms of commensuration, classification, and stratification by tracing, as Whitson writes, the aggregated desires of shoppers and system users, finding patterns in their flocking behaviors like those of a group of birds. Such aggregated data recombinations are employed to create new user, customer, voter, or crime profiles. Moor & Lury (2018) and Whitson (2014) highlight that individuals become dividuated, drawing on Deleuze. As Whitson (2014, p. 554) writes, for Deleuze (1992), dividuation refers to the internal division of individuals into malleable bits of coded information that are more amenable to being measured, recombined, and aggregated into populations of other dividuals. Digitized tracking of the self via loyalty cards, smartphones, smart watches, and the like leads to new, often highly opaque personalized pricing techniques that make it harder for consumers to identify themselves, or be identified by others, as part of a recognized group (for example, groups that can be mapped onto existing sociodemographic classifications) (Moor & Lury 2018). A related example is Google gender and age assignments, which are not based on voluntary identification, but on the collection of web pages that one has visited (Cheney-Lippold 2017).

Fourcade & Healy (2017) discuss how digitized metrics (credit scores, loyalty points, self-tracked health data, etc.) lead to new classification schemes that crisscross traditional census classifications laid down by the state. These new classification schemes cannot be determined in advance and are utilized by corporations for market-making (e.g., credit market making or the pricing of insurance), which, in turn, affects people's life-chances (see also Mau 2017). Such datafied and often short-lived classifications make up "what's new with numbers;" it is their production and circulation from the economic to the political, from civic to personal life (and back), that need to be tracked to understand what new visions of the social have come to be created by quantification, measurement, and aggregation, and with what consequences.

CONCLUSION

We have described four institutional contexts in which scholarship on quantification has flourished. As this work shows, the context, scope, and form of quantification are crucial for understanding its effects. One clear trend is the increasing expansion of quantification into all realms, including into people's personal lives. We have also argued that in addition to a careful accounting of context and contingency to understand the impact of quantitative technologies, it is also important to assess the motives that give rise to these technologies, how they are legitimated, how relations of power are influenced by them, and how, relatedly, conditions of visibility and obscurity are shaped.

Not surprisingly, long-standing motives for quantification—governing, profitability, assessment, politics, and prediction—still propel its development and use. The means to achieve these goals, of course, are constantly evolving. For example, beginning in 1841, firms enlisted local reporters (Carruthers 2013) to address the character and credit worthiness of local merchants. Gradually these became formalized and quantified, and eventually these character sketches evolved into scores that can change at any moment and are shaped by the models that are continually devised by analysts at large credit companies using data from myriad sources, many nonfinancial.

Likewise, the census has evolved from intermittent secretive efforts to count a population to elaborate, ongoing surveys that inform politics, policy, and business decisions. Emigh et al. (2016a,b) find that social conditions powerfully shape how regimes or states count. Sometimes motives are mixed. For example, Tencent, China's technology conglomerate and most valuable company, recently announced its new individual credit scoring system based on its globally popular WeChat app. Aggregating data from social media, employment records, and legal histories, its new system creates personal scores for 1.4 billion Chinese that range from 300–850 and can affect not only someone's credit but also a wide variety of government and corporate services, including education and housing. As one reporter put it, it might be time to unfriend those human rights lawyers (Holland 2018).

One of the challenges for scholars of quantification is to keep pace with changing technologies, especially in data design, modeling, artificial intelligence, and the production of new financial instruments. Science studies scholars have shown how important it is to understand how new forms of technologies are produced and how they enlist constituents who use them to all kinds of unanticipated ends. There seems to be no alternative but to specialize. Two areas also ripe for research are the role of the aesthesis of visualization and how numbers mediate emotions.

This observation leads to the related point that literature on quantification is spread across many fields. The question as to whether the sociology of quantification has achieved the status of a subfield is one addressed by several scholars (Berman & Hirschman 2018, Bruno et al. 2016, Diaz-Bone & Didier 2016). Some see an emergent field; others wish for a more encompassing theory. We think there are some general conclusions one can draw about quantification. Most broadly, quantification is always an intervention, and understanding how much of one it is requires detailed knowledge. While there are different terms for this—performativity, reactivity, echo chambers, feedback loops—they all imply the constitutive potential of quantification.

Another general feature of quantification is that to count or calculate accurately on a big scale often is resource intensive and requires training, discipline, and standardization, especially in classification. We know, too, that motives for quantification vary, but often they amount to some means for redressing uncertainties, exerting control, overcoming distrust, or improving communication and coordination among entities or self-improvement. Once numbers are created, moreover, they become enrolled and translated by different users and built into institutions in ways that may make them difficult to change or abandon.

As we have already discussed, one broad pattern is that we tend to exclude from measurement things that may be important but are hard to measure or things for which there are no existing data. A final feature of most quantification is that people have ambivalent reactions about it that often take the form of a tension between our wanting to believe in the objectivity and precision of calculation while also understanding that there are assumptions, biases, and ways to lie with statistics as well as with words. What is different about calculation is that our capacity to check on its accuracy is often limited or even nonexistent, requiring training, skill, and access.

But despite these broad patterns we think it is premature to declare quantification a subfield of sociology, and we are not convinced that this is a bad thing. The breadth of scholarship highlights that we ought to be careful with unifying accounts of the inner workings and effects of quantification. Rather, we stress the importance of following the numbers across different sites to uncover changing dynamics between measurement, classification, and aggregation and to investigate more systematically interactions between different quantification regimes. Given the complexity of how quantification is generated, used, and represented, it demands specialists in the same sense that it is far better to have trained accountants deconstructing audits and computer scientists unearthing bias in machine learning. The challenge remains, however, for scholars of quantification to find each other, and this will always demand breadth in reading and, perhaps, articles like this.

DISCLOSURE STATEMENT

The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

ACKNOWLEDGMENTS

The authors thank Bruce Carruthers, Rita Samiolo, Liisa Kurunmäki, Peter Miller, Mike Power, and Doug Massey for their helpful comments and discussions. Mennicken gratefully acknowledges the financial support provided by the Economic and Social Research Council (Grant Ref: ES/N018869/1) under the Open Research Area Scheme (Project Title: QUAD—Quantification, Administrative Capacity and Democracy), cofunded by the Agence Nationale de la Recherche (ANR, France), Deutsche Forschungsgemeinschaft (DFG, Germany), Economic and Social Research Council (ESRC, United Kingdom), and the Nederlands Organisatie voor Wetenschappelijk Onderzoek (NWO, Netherlands). Espeland thanks the Swedish Collegium for Advanced Study for their generous intellectual and financial support. Both authors thank the Wissenschaftskolleg zu Berlin, especially the quantification group, where the seeds for this article were planted.

LITERATURE CITED

Adkins L, Lury C, eds. 2012. *Measure and Value*. Oxford, UK: Blackwell

Ajana B, ed. 2017. *Self-Tracking: Empirical and Philosophical Investigations*. London: Palgrave Macmillan

Alder K. 2002. *The Measure of All Things*. Princeton, NJ: Princeton Univ. Press

Alonso W, Starr P, eds. 1989. *The Politics of Numbers: Population of the United States in the 1980s*. New York: Russell Sage

Anderson M. 1988. *The American Census: A Social History*. New Haven, CT: Yale Univ. Press

Appadurai A. 2011. The ghost in the financial machine. *Public Cult*. 23:517–39

Bardet F. 2014. *La contre-révolution comptable. Ces nouveaux chiffres qui (nous) gouvernent*. Paris: Les Belles Lettres

Barman E. 2016. *Caring Capitalism: The Meaning and Measure of Social Value in the Market*. Cambridge, UK: Cambridge Univ. Press

Bauer RA, ed. 1966. *Social Indicators*. Cambridge, MA: MIT Press
Beck U, Giddens A, Lash S. 1994. *Reflexive Modernization*. Cambridge, UK: Polity
Beckert J, Aspers P, eds. 2011. *The Worth of Goods: Valuation and Pricing in the Economy*. Oxford, UK: Oxford Univ. Press
Beckert J, Musselin C, eds. 2013. *Constructing Quality: The Classification of Goods in Markets*. Oxford, UK: Oxford Univ. Press
Beer D. 2015. Productive measures: culture and measurement in the context of everyday neoliberalism. *Big Data Soc*. 2:1–12
Beer D. 2016. *Metric Power*. London: Palgrave Macmillan
Berman EP, Hirschman D. 2018. The sociology of quantification: Where are we now? *Contemp. Sociol.* 47:257–66
Berthoin Antal A, Hutter M, Stark D, eds. 2015. *Moments of Valuation: Exploring Sites of Dissonance*. Oxford, UK: Oxford Univ. Press
Biagioli M. 2018. Quality to impact, text to metadata: publication and evaluation in the age of metrics. *KNOW* 2:249–75
Boltanski L. 1987. *The Making of a Class: Cadres in French Society*. Cambridge, UK: Cambridge Univ. Press
Boltanski L, Esquerre A. 2015. Grappling with the economy of enrichment. Luc Boltanski and Arnaud Esquerre in conversation with Fabian Muniesa. *Valuation Stud.* 3:75–83
Boltanski L, Thévenot L. 2006. *On Justification: Economies of Worth*. Princeton, NJ: Princeton Univ. Press
Bourguet MN. 1987. Décrire, compter, calculer: the debate over statistics during the Napoleonic Period. In *The Probabilistic Revolution*, Vol. 1: *Ideas in History*, ed. L Krüger, L Daston, M Heidelberger. Cambridge, MA: MIT Press
Bowker GC, Star SL. 2000. *Sorting Things Out: Classification and its Consequences*. Cambridge, MA: MIT Press
Bradbury M. 2016. There's an algorithm for that. Or there soon will be. *OECD Insights Blog*, May 18. **http://oecdinsights.org/2016/05/18/theres-an-algorithm-for-that-or-there-soon-will-be/**
Brankovic J, Ringel L, Werron T. 2018. How rankings produce competition: the case of global university rankings. *Z. Soziol.* 47:270–88
Brown W. 2015. *Undoing the Demos*. New York: Zone Books
Bruno I, Didier E. 2013. *Benchmarking: L'Etat sous pression statistique*. Paris: Zones
Bruno I, Didier E, Prévieux J, eds. 2014. *Statactivisme: Comment lutter avec les nombres*. Paris: Zones
Bruno I, Jany-Catrice F, Touchelay B, eds. 2016. *The Social Sciences of Quantification: From Politics of Large Numbers to Target-Driven Policies*. Cham, Switz.: Springer
Çalışkan K, Callon M. 2009. Economization, part 1: shifting attention from the economy towards processes of economization. *Econ. Soc.* 38:369–98
Carruthers BG. 2013. From uncertainty toward risk: the case of credit ratings. *Socio-Economic Review* 11:525–51
Carruthers BG, Kim J-C. 2011. The sociology of finance. *Annu. Rev. Sociol.* 37:239–59
Carson J. 2007. *The Measure of Merit: Talents, Intelligence, and Inequality in the French and American Republics, 1750–1940*. Princeton, NJ: Princeton Univ. Press
Centeno MA, Cohen JN. 2012. The arc of neoliberalism. *Annu. Rev. Sociol.* 38:317–40
Chapman CS, Cooper DJ, Miller P. 2009. *Accounting, Organizations and Institutions*. Oxford, UK: Oxford Univ. Press
Cheney-Lippold J. 2017. *We Are Data: Algorithms and the Making of our Digital Selves*. New York: NYU Press
Chiapello E. 2015. Financialisation of valuation. *Hum. Stud.* 38:13–35
Chiapello E, Walter C. 2016. The three ages of financial quantification: a conventionalist approach to the financiers' metrology. *Historical Soc. Res.* 41:155–77
Cioffi RL. 2011. Fuzzy math: the place of numerical evidence in Cicero in Verrem 3.116. *Mnemosyne* 64:645–52
Cohen PC. 1982. *A Calculating People: The Spread of Numeracy in Early America*. Chicago: Univ. Chicago Press
Cohn BS. 1987. *An Anthropologist Among the Historians and Other Essays*. Delhi: Oxford Univ. Press
Cohn BS. 1996. *Colonialism and its Forms of Knowledge: The British in India*. Princeton, NJ: Princeton Univ. Press
Daston L. 1988. *Classical Probability in the Enlightenment*. Princeton, NJ: Princeton Univ. Press

Daston L, Galison P. 2007. *Objectivity*. Cambridge, MA: MIT Press
Davies W. 2014. *The Limits of Neoliberalism: Authority, Sovereignty and the Logic of Competition*. Thousand Oaks, CA: SAGE
Davis GF, Kim S. 2015. Financialization of the economy. *Annu. Rev. Sociol.* 41:203–21
Davis KE, Fisher A, Kingsbury B, Merry SE, eds. 2012. *Governance by Indicators: Global Power Through Classification and Rankings*. Oxford, UK: Oxford Univ. Press
De Rosa E. 2014. Gender activism and NGOs: development and use of gender-sensitive data for mobilizations and women's rights. *PaCo* 7:314–47
Deleuze G. 1992. Postscript on societies of control. *October* 59:3–7
Deringer W. 2018. *Calculated Values: Finance, Politics, and the Quantitative Age*. Cambridge, MA: Harvard Univ. Press
Desrosières A. 1998. *The Politics of Large Numbers: A History of Statistical Reasoning*. Cambridge, MA: Harvard Univ. Press
Desrosières A. 2014. *Prouver et gouverner. Une analyse politique des statistiques publiques*. Paris: La Découverte
Diaz-Bone R. 2016. Convention theory, classification and quantification. *Historical Soc. Res.* 41:48–71
Diaz-Bone R, Didier E. 2016. Introduction: the sociology of quantification—perspectives on an emerging field in the social sciences. *Historical Soc. Res.* 41:7–26
Diaz-Bone R, Salais R, eds. 2011. Conventions and institutions from a historical perspective. *Hist. Soc. Res.* 36(4)
Didier E. 2009. *En quoi consiste l'Amérique? Les statistiques, le New Deal et la démocratie*. Paris: La Découverte
Didier E. 2016. Alain Desrosières and the Parisian flock: social studies of quantification in France since the 1970s. *Historical Soc. Res.* 41:27–47
Didier E. 2018. Globalization of quantitative policing: between management and statactivism. *Annu. Rev. Sociol.* 44:515–34
Dorn C, Tacke V, eds. 2017. *Vergleich und Leistung in der funktional differenzierten Gesellschaft*. Cham, Switz.: Springer
Drori G, Meyer J, Hwang H, eds. 2006. *Globalization and Organization: World Society and Organizational Change*. Oxford, UK: Oxford Univ. Press
Dunleavy P, Bastow S, Margetts H. 2005. New Public Management is dead - Long live digital-era governance. *J. Public Adm. Res. Theory* 62:467–94
Dussauge I, Helgesson C-F, Lee F, eds. 2015. *Value Practices in the Life Sciences and Medicine*. Oxford, UK: Oxford Univ. Press
Emigh RJ, Riley D, Ahmed P. 2016a. *Antecendents of Censuses from Medieval to Nation States: How Societies and States Count*. London: Palgrave Macmillan
Emigh RJ, Riley D, Ahmed P. 2016b. *Changes in Censuses from Imperialist to Welfare States: How Societies and States Count*. London: Palgrave Macmillan
Espeland WN, Sauder M. 2007. Rankings and reactivity: how public measures recreate social worlds. *Am. J. Sociol.* 113:1–40
Espeland WN, Sauder M. 2016. *Engines of Anxiety: Academic Rankings, Reputation, and Accountability*. New York: Russell Sage
Espeland WN, Stevens ML. 1998. Commensuration as a social process. *Annu. Rev. Sociol.* 24:313–43
Esposito E, Stark D. 2019. What's observed in a rating? Rankings as orientation in the face of uncertainty. *Theory Cult. Soc.* 36:3–26
Foucault M. 1991. Governmentality. In *The Foucault Effect: Studies in Governmentality*, ed. G Burchell, C Gordon, P Miller, pp. 87–104. London: Harvester Wheatsheaf
Foucault M. 2007. *Security, Territory, Population: Lectures at the Collège de France, 1977–1978*. London: Palgrave Macmillan
Foucault M. 2008. *The Birth of Biopolitics: Lectures at the Collège de France, 1978-1979*. London: Palgrave Macmillan
Fourcade M. 2011. Cents and sensibility: economic valuation and the nature of "nature." *Am. J. Sociol.* 116:1721–77
Fourcade M, Healy K. 2017. Seeing like a market. *Socio-Economic Rev.* 15:9–29

Fuchs M, Fizek S, Ruffino P, Schrape N, eds. 2014. *Rethinking Gamification*. Lüneburg, Ger.: Meson
Gerlitz C, Lury C. 2014. Social media and self-evaluating assemblages: on numbers, orderings and values. *Distinktion* 15:174–88
Gigerenzer G, Swijtink Z, Porter TM, Daston L, Beatty J, Krüger L. 1989. *The Empire of Chance*. Cambridge, UK: Cambridge Univ. Press
Gilbert PR. 2017. The anthropology of financial intent. *Finance Soc.* 3:91–98
Hacking I. 1990. *The Taming of Chance*. Cambridge, UK: Cambridge Univ. Press
Hacking I. 2002. Making up people. In *Historical Ontology*, ed. I Hacking, pp. 99–114. Cambridge, MA: Harvard Univ. Press
Hall M, Millo Y, Barman E. 2015. Who and what really counts? Stakeholder prioritization and accounting for social value. *J. Manag. Stud.* 52:907–34
Hammarfelt B, de Rijcke S, Rushforth AD. 2016. Quantified academic selves: the gamification of research through social networking services. *Inf. Res.* 21(2):SM1
Hein L. 2004. *Reasonable Men, Powerful Words: Political Culture and Expertise in Twentieth Century Japan*. Berkeley: Univ. Calif. Press
Heintz B. 2010. Numerische Differenz: Überlegungen zu einer Soziologie des (quantitativen) Vergleichs. *Z. Soziol.* 39:162–81
Higgins V, Larner W, eds. 2010. *Calculating the Social: Standards and the Reconfiguration of Governing*. London: Palgrave Macmillan
Holland T. 2018. China's credit ratings plan: from social media to medium of social control. *South China Morning Post*, Feb. 5
Hood C. 2007. Public service management by numbers: Why does it vary? Where has it come from? What are the gaps and the puzzles? *Public Money Manag.* 27:95–102
Hopwood AG. 1983. On trying to study accounting in the contexts in which it operates. *Account. Organizations Soc.* 8:287–305
Hopwood AG. 1992. Accounting calculation and the shifting sphere of the economic. *Eur. Account. Rev.* 1:125–43
Hopwood AG, Miller P, eds. 1994. *Accounting as Social and Institutional Practice*. Cambridge, UK: Cambridge Univ. Press
Hoskin K, Macve R. 1986. Accounting and the examination: a genealogy of disciplinary power. *Account. Organizations Soc.* 11:105–36
Igo SE. 2008. *The Averaged American: Surveys, Citizens, and the Making of a Mass Public*. Cambridge, MA: Harvard Univ. Press
Jeacle I, Carter C. 2011. In TripAdvisor we trust: rankings, calculative regimes and abstract systems. *Account. Organizations Soc.* 36:293–309
Jerven M. 2013. *Poor Numbers: How We Are Misled by African Development Statistics and What to Do About It*. Ithaca, NY: Cornell Univ. Press
Johnson HC. 1964. The concept of bureaucracy in cameralism. *Political Sci. Q.* 79:378–402
Juven P-A. 2016. *Une santé qui compte? Les coûts et les tarifs controversés de l'hôpital public*. Paris: PUF
Kalpagam U. 2010. *Rule by Numbers: Governmentality in Colonial India*. Lanham, MD: Lexington Books
Kalthoff H. 2005. Practices of calculation: economic representation and risk management. *Theory Cult. Soc.* 22:69–97
Karpik L. 2010. *Valuing the Unique: The Economics of Singularities*. Princeton, NJ: Princeton Univ. Press
Katz DM. 2013. Quantitative legal prediction - or - How I learned to stop worrying and start preparing the data-driven future of the legal services industry. *Emory Law J.* 62:909–66
Keister LA. 2014. The one percent. *Annu. Rev. Sociol.* 40:347–67
Kinsey AC, Pomeroy WB, Martin CE. 1948. *Sexual Behavior in the Human Male*. Philadelphia: W. B. Saunders
Koester M. 2018. A year in numbers: my data from 2017. *LinkedIn Pulse*, Feb. 20. **https://www.linkedin.com/pulse/year-numbers-my-data-from-2017-mark-koester**
Kornberger M, Justesen L, Madsen AK, Mouritsen J, eds. 2015. *Making Things Valuable*. Oxford, UK: Oxford Univ. Press
Kreager P. 1991. Early modern population theory: a reassessment. *Popul. Dev. Rev.* 17:207–27

Krüger L, Daston L, Heidelberger M, eds. 1987. *The Probabilistic Revolution*, Vol. 1: *Ideas in History*. Cambridge, MA: MIT Press
Kuhrt A. 1997. *The Ancient Near East: c.3000–330BC*. London: Routledge
Kula W. 1986. *Measures and Men*. Princeton, NJ: Princeton Univ. Press
Kurunmäki L, Mennicken A, Miller P. 2016. Quantifying, economising, and marketising: democratising the social sphere? *Sociol. Trav.* 58:390–402
Kurunmäki L, Miller P. 2006. Modernising government: the calculating self, hybridisation and performance measurement *Financ. Accountability Manag.* 22:65–84
Lam T. 2011. *A Passion for Facts: Social Surveys and the Construction of the Chinese Nation State, 1900–1949*. Berkeley: Univ. Calif. Press
Lamont M. 2012. Toward a comparative sociology of valuation and evaluation. *Annu. Rev. Sociol.* 38:201–21
Lampland M, Star SL, eds. 2009. *Standards and their Stories: How Quantifying, Classifying, and Formalizing Practices Shape Everyday Life*. Ithaca, NY: Cornell Univ. Press
Land KC. 1983. Social indicators. *Annu. Rev. Sociol.* 9:1–26
Land KC, Michalos AC. 2018. Fifty years after the Social Indicators Movement: Has the promise been fulfilled? *Soc. Indicators Res.* 135:835–68
Lazer D, Radford J. 2017. Data ex machina: introduction to big data. *Annu. Rev. Sociol.* 43:19–39
Lengwiler M. 2016. Risky calculations: financial mathematics and securitization since the 1970s. *Historical Soc. Res.* 41:258–79
Loveman M. 2014. *National Colors: Racial Classification and the State in Latin America*. Oxford, UK: Oxford Univ. Press
Lupton D. 2016. *The Quantified Self: A Sociology of Self-Tracking*. Cambridge, UK: Polity
Lupton D, Smith GJD. 2018. "A much better person": the agential capacities of self-tracking practices. In *Metric Culture: Ontologies of Self-Tracking Practices*, ed. B Ajana, pp. 57–76. London: Emerald
MacKenzie D, Millo Y. 2003. Constructing a market, performing theory: the historical sociology of a financial derivatives exchange. *Am. J. Sociol.* 109:107–45
MacKenzie D, Spears T. 2014. "The formula that killed Wall Street": the Gaussian copula and modelling practices in investment banking. *Soc. Stud. Sci.* 44:393–417
Mämecke T, Passoth J-H, Wehner J, eds. 2018. *Bedeutende Daten: Modelle, Verfahren und Praxis der Vermessung und Verdatung im Netz*. Cham, Switz.: Springer
Mau S. 2017. *Das metrische Wir: Über die Quantifizierung des Sozialen*. Berlin: Suhrkamp
McCormick T. 2009. *William Petty and the Ambitions of Political Arithmetic*. Oxford, UK: Oxford Univ. Press
McCormick T. 2013. *Political Arithmetic and Sacred History: Population Thought in the English Enlightenment, 1660–1750*. Oxford, UK: Oxford Univ. Press
Mehrpouya A, Samiolo R. 2016. Performance measurement in global governance: ranking and the politics of variability. *Account. Organizations Soc.* 55:12–31
Mennicken A, Vollmer H, eds. 2007. *Zablenwerk: Kalkulation, Organisation und Gesellschaft*. Cham, Switz.: Springer
Merry SE. 2016. *The Seductions of Quantification: Measuring Human Rights, Gender Violence, and Sex Trafficking* Chicago: Univ. Chicago Press
Merry SE, Davis KE, Kingsbury B, eds. 2015. *The Quiet Power of Indicators: Measuring Governance, Corruption, and Rule of Law*. Cambridge, UK: Cambridge Univ. Press
Michaels S, Espeland WN. 2006. *Queer counts: measurement and the emergence of gay identity*. Presentation at 101st Annual Meeting of the American Sociological Association, Montreal
Miller P. 1992. Accounting and objectivity: the invention of calculating selves and calculable spaces. *Ann. Scholarsh.* 9:61–86
Miller P. 2001. Governing by numbers: why calculative practices matter. *Soc. Res.* 68:379–96
Miller P, O'Leary T. 1987. Accounting and the construction of the governable person. *Account. Organizations Soc.* 12:235–65
Miller P, Power M. 2013. Accounting, organizing, and economizing: connecting accounting research and organization theory. *Acad. Manag. Ann.* 7:557–605
Miller P, Rose N. 1990. Governing economic life. *Econ. Soc.* 19:1–31

Miller P, Rose N. 2008. *Governing the Present: Administering Economic, Social and Personal life*. Cambridge, UK: Polity

Moor L, Lury C. 2018. Price and the person: markets, discrimination, and personhood. *J. Cult. Econ.* 11:501–13

Moore P, Robinson A. 2016. The quantified self: what counts in the neoliberal workplace. *New Media Soc.* 18:2774–92

Mora C. 2014. *Making Hispanics: How Activists, Bureaucrats, and Media Constructed a New American*. Chicago: Univ. Chicago Press

Morgan MS. 2010. "Voice" and the facts and observations of experience. In *New Methodological Perspectives on Observation and Experimentation in Science*, ed. WJ Gonzalez, pp. 51–69. Oleiros, Spain: Netbiblo

Münch R. 2014. *Academic Capitalism: Universities in the Global Struggle for Excellence*. New York: Routledge

Muniesa F. 2014. *The Provoked Economy: Economic Reality and the Performative Turn*. London: Routledge

Muniesa F, Doganova L, Ortiz H, Pina-Stranger A, Paterson F, et al. 2017. *Capitalization: A Cultural Guide*. Paris: École de Mines

Musselin C. 2017. *La Grande course des universités*. Paris: Presses de Sci. Po

Nafus D, ed. 2016. *Quantified: Biosensing Technologies in Everyday Life*. Cambridge, MA: MIT Press

Nafus D, Sherman J. 2014. This one does not go up to 11: the quantified self movement as an alternative big data practice. *Int. J. Commun.* 8:1784–94

Neff G, Nafus D. 2016. *Self-Tracking*. Cambridge, MA: MIT Press

Newfield C. 2016. *The Great Mistake: How We Wrecked Public Universities and How We Can Fix Them*. Baltimore, MD: John Hopkins Univ. Press

Norman D. 2014. From shouting to counting: civil society and good governance reform in Cambodia. *Pacific Rev.* 27:241–64

O'Neil C. 2016. *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy*. New York: Penguin

Pasquale F. 2015. *The Black Box Society: The Secret Algorithms that Control Money and Information*. Cambridge, MA: Harvard Univ. Press

Passoth J-H, Wehner J, eds. 2013. *Quoten, Kurven und Profile: Zur Vermessung der sozialen Welt*. Cham, Switz.: Springer

Pflueger D. 2016. Knowing patients: the customer survey and the changing margins of accounting in healthcare. *Account. Organizations Soc.* 53:17–33

Poon M. 2009. From new deal institutions to capital markets: commercial consumer risk scores and the making of subprime mortgage finance. *Account. Organizations Soc.* 34:654–74

Porter TM. 1986. *The Rise of Statistical Thinking, 1820–1900*. Princeton, NJ: Princeton Univ. Press

Porter TM. 1995. *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*. Princeton, NJ: Princeton Univ. Press

Porter TM. 2018. *Genetics in the Madhouse: The Unknown History of Human Heredity*. Princeton, NJ: Princeton Univ. Press

Power M. 1997. *The Audit Society: Rituals of Verification*. Oxford, UK: Oxford Univ. Press

Power M. 2004. Counting, control and calculation: reflections on measuring and management. *Hum. Relat.* 57:765–83

Power M. 2007. *Organized Uncertainty: Designing a World of Risk Management*. Oxford, UK: Oxford Univ. Press

Redding S. 2006. *Sorcery and Sovereignty: Taxation, Power and Rebellion in Rural South Africa*. Columbus: Ohio Univ. Press

Rettberg JW. 2014. *Seeing Ourselves through Technology: How We Use Selfies, Blogs and Wearable Devices to See and Shape Ourselves*. London: Palgrave Macmillan

Rodríguez-Muñiz M. 2017. Cultivating consent: nonstate leaders and the orchestration of state legibility. *Am. J. Sociol.* 123:385–425

Rose N. 1991. Governing by numbers: figuring out democracy. *Account. Organizations Soc.* 16:673–92

Rose N. 2007. *The Politics of Life Itself: Biomedicine, Power, and Subjectivity in the Twenty-First Century*. Princeton, NJ: Princeton Univ. Press

Rottenburg R, Merry SE, Park S-J, Mugler J, eds. 2015. *The World of Indicators: The Making of Governmental Knowledge through Quantification*. Cambridge, UK: Cambridge Univ. Press

Salais R. 2016. Quantification and objectivity: from statistical conventions to social conventions. *Historical Soc. Res.* 41:118–34
Samuel B. 2014. Statistics and political violence: reflections on the social conflict in 2009 in Guadeloupe. *PaCo* 7:237–57
Scott JC. 1998. *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*. New Haven, CT: Yale Univ. Press
Shore C, Wright S. 2015. Governing by numbers: audit culture, rankings and the new world order. *Soc. Anthropol.* 23:22–28
Speich Chasseé D. 2016. The roots of the Millenium Development Goals: a framework for studying the history of global statistics. *Historical Soc. Res.* 41:218–37
Storper M, Salais R. 1997. *Worlds of Production: The Action Frameworks of the Economy*. Cambridge, MA: Harvard Univ. Press
Strathern M. 2000. The tyranny of transparency. *Br. Educ. Res. J.* 26:309–21
Supiot A. 2015. *La Gouvernance par les nombres*. Paris: Fayard
Telles E. 2014. *Pigmentocracies: Ethnicity, Race, and Color in Latin America*. Chapel Hill: Univ. N. C. Press
Timmermans S, Epstein S. 2010. A world of standards but not a standard world: toward a sociology of standards and standardization. *Annu. Rev. Sociol.* 36:69–89
Tribe K. 1988. *Governing Economy: The Reformation of German Economic Discourse, 1750–1840*. Cambridge, UK: Cambridge Univ. Press
van den Bersselaar D. 2004. Establishing the facts: P. A. Talbot and the 1921 Census of Nigeria. *Hist. Africa* 31:69–102
Vatin F. 2013. Valuation as evaluating and valorizing. *Valuation Stud.* 1:31–50
Vollmer H. 2007. How to do more with numbers: elementary stakes, framing, keying, and the three-dimensional character of numerical signs. *Account. Organ. Soc.* 32:577–600
Vormbusch U. 2012. *Die Herrschaft der Zahlen. Zur Kalkulation des Sozialen in der kapitalistischen Moderne*. New York: Campus Verlag
Whitson JR. 2013. Gaming the quantified self. *Surveill. Soc.* 11:163–76
Whitson JR. 2014. Foucault's Fitbit: governance and gamification. In *The Gameful World*, ed. SP Walz, S Deterding, pp. 339–58. Cambridge, MA: MIT Press

Annual Review
of Sociology

Volume 45, 2019

Contents

Prefatory Article

The Culminating Crisis of American Sociology and Its Role in Social Science and Public Policy: An Autobiographical, Multimethod, Reflexive Perspective
James S. House 1

Theory and Methods

Machine Learning for Sociology
Mario Molina and Filiz Garip 27

Bayesian Statistics in Sociology: Past, Present, and Future
Scott M. Lynch and Bryce Bartlett 47

Social Processes

Aging Populations, Mortality, and Life Expectancy
Eileen M. Crimmins and Yuan S. Zhang 69

Social Networks and Health: New Developments in Diffusion, Online and Offline
Jingwen Zhang and Damon Centola 91

The Role of Space in the Formation of Social Ties
Mario L. Small and Laura Adler 111

Sexual and Romantic Relationships in Young Adulthood
Kathryn Harker Tillman, Karin L. Brewster, and Giuseppina Valle Holway 133

Theories of the Causes of Poverty
David Brady 155

Institutions and Culture

Assimilation and the Second Generation in Europe and America: Blending and Segregating Social Dynamics Between Immigrants and Natives
Lucas G. Drouhot and Victor Nee 177

Religion and Adolescent Outcomes: How and Under What Conditions Religion Matters
Lisa D. Pearce, Jeremy E. Uecker, and Melinda Lundquist Denton 201

What's New with Numbers? Sociological Approaches to the Study of Quantification
Andrea Mennicken and Wendy Nelson Espeland 223

Moral Cultures, Reputation Work, and the Politics of Scandal
Gary Alan Fine 247

Sociologies of Islam
Charles Kurzman 265

The Cultural Impacts of Social Movements
Edwin Amenta and Francesca Polletta 279

The Social Structure of Time: Emerging Trends and New Directions
Benjamin Cornwell, Jonathan Gershuny, and Oriel Sullivan 301

Formal Organizations

Retail Sector Concentration, Local Economic Structure, and Community Well-Being
Martha Crowley and Kevin Stainback 321

Political and Economic Sociology

Fascism and Populism: Are They Useful Categories for Comparative Sociological Analysis?
Mabel Berezin 345

Differentiation and Stratification

Inequality and Social Stratification in Postsocialist China
Xiaogang Wu 363

Individual and Society

Divergent Destinies: Children of Immigrants Growing Up in the United States
Min Zhou and Roberto G. Gonzales 383

Examining Public Opinion About LGBTQ-Related Issues in the United States and Across Multiple Nations
Amy Adamczyk and Yen-Chiao Liao 401

Technology, Work, and Family: Digital Cultural Capital and Boundary Management
Ariane Ollier-Malaterre, Jerry A. Jacobs, and Nancy P. Rothbard 425

US Labor Studies in the Twenty-First Century: Understanding Laborism Without Labor
Jake Rosenfeld 449

Demography

Analyzing Age-Period-Cohort Data: A Review and Critique
Ethan Fosse and Christopher Winship 467

Family Instability in the Lives of American Children
Shannon E. Cavanagh and Paula Fomby 493

Well-Being at the End of Life
Deborah Carr and Elizabeth A. Luth 515

Urban and Rural Community Sociology

Race, Place, and Effective Policing
Anthony A. Braga, Rod K. Brunson, and Kevin M. Drakulich 535

Policy

Social Background and Children's Cognitive Skills: The Role of Early Childhood Education and Care in a Cross-National Perspective
Nevena Kulic, Jan Skopek, Moris Triventi, and Hans-Peter Blossfeld 557

Historical Sociology

Causality and History: Modes of Causal Investigation in Historical Social Sciences
Ivan Ermakoff 581

Sociology and World Regions

Convergence Toward Demographic Aging in Latin America and the Caribbean
Roberto Ham-Chande and Isalia Nava-Bolaños 607

Education in East Asian Societies: Postwar Expansion and the Evolution of Inequality
Emily Hannum, Hiroshi Ishida, Hyunjoon Park, and Tony Tam 625

Indexes

Cumulative Index of Contributing Authors, Volumes 36–45 649

Cumulative Index of Article Titles, Volumes 36–45 653

Errata

An online log of corrections to *Annual Review of Sociology* articles may be found at http://www.annualreviews.org/errata/soc