After Numbers? Innovations in Science and Technology Studies' Analytics of Numbers and Numbering

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Locating studies of numbers in STS – and the proposed position of this SI

Number studies have featured often in past STS scholarship. Indeed, one might articulate a history of STS analytic concepts and theories by tracking number studies. One might begin such an undertaking by pointing out that studies in STS followed anthropology in proposing numbers as social entities, noting that in anthropology number studies have featured since the end of the nineteenth century. When STS studies generally were focussing on epistemology, the analytic framings of number scholarship in STS reflected that. From the 1970s until the end of the century number studies proliferated. In line with other areas of STS, a focus on ontology began to appear in number studies in the mid 1990s, albeit at first hesitantly (Watson, 1990; Watson-Verran, 1995). But it was not the STS past with its range of number studies that interested us when we set out to assemble this special issue of *Science & Technology Studies*. We were more interested to show how contemporary number studies were deploying new analytics that are emerging in STS. To this end we were concerned to have contributors reflect on the analytic framing they were using to make their STS number study and to comparatively articulate the analytic affordances it offered. In beginning we register our delighted surprise at how this special issue turned out, noting how much we learned along the way from the authors who have contributed.

We offer six papers each of which we see as broaching a novel issue in STS number studies. They attend to a very wide range of sociotechnical situations where numbers and/or algorithms feature. The nexus numbers and/as algorithms is puzzlingly relevant to taking on numbers. Recognising that numbers both are and are not algorithms (and vice versa) we begin by making clear how we see relations between numbers and algorithms. While algorithms mobilise a protocol that elaborates how to work relations between numbers, e.g. embedded in a database, numbers express a protocol that lays out how to work relations embedded within a number as it comes into being in the banal routines of enumeration, as for example in Watson (1990). Seeing things

this way algorithming is a form of numbering and vice versa, albeit that different sociotechnical means are mobilised. There are of course interestingly different sociotechnical characteristics associated with utilising analogue means (cognitive, linguistic and graphic resources) in banal enumeration, and in contriving enumerated value using digital computation. As we see it, whether analysis assumes in beginning that algorithms and numbers are the same, or that they are different, is contingent on analytic method and questions being asked. This nexus serves as a guide into and beyond this collection. Here it is a preface to our contributions' take on numbers; and in the penultimate section this nexus leads to the notion of 'after' numbers.

A commitment to what might be called 'practices theory' unites the contributions in our collection, we propose, although not necessarily identified as such by our authors. Narration of numbering processes, a strategy common to the papers collected here, expresses this. We see practices theory as particularising, relational, and monistic, and include actor-network theory (ANT) and material semiotics, along with other ontologically focussed empirical studies in this. While many social scientists might consider 'practices theory' as a subset of 'practice theory', we do not go along with that. Rather we see 'practices theory' and 'practice theory' as ends of an analytic continuum expressing differing notions of practices: as achieved empirical regularities on the one hand, and as prescriptively normative on the other (Rouse, 2001). Specifying this sort of separation helps to articulate what we see our collection of papers offers. But whilst we suspect STS would profit from exploring its relations to approaches along this continuum, we turn to recent developments in STS numbers studies. First, we note that ours is the fifth social sciences collection, intersecting with STS, with a focus on numbers and numbering to emerge in this decade. We briefly survey the others to offer an overview of number studies in the social sciences, and to locate our collection within that landscape.

In 2010, *Anthropological Theory* published a wide ranging collection of papers that had originally been presented to a workshop with the title 'Number as Inventive Frontier: Equiva-

lence, Accounting, Calculation' facilitated by Jane Guyer et al. (2010). Noting that despite "number be[ing] seen as a foundational cognitive process, a component of all of social life, a convergent and/or transcendent human phenomenon […] by 1990s socio-cultural anthropology [of numbers] boasted only one major book" (Guyer et al., 2010: 36), the collection set out to attend to at least some of the world's "number-grammars [and] current number regimes" noting that these "do not necessarily have the same properties as each other nor work according to established mathematical theory nor resonate similarly across meaning domains" (Guyer et al., 2010: 37). Given the "complexity of numbers-in-practice" it was seen as "an extraordinarily difficult challenge to meet ethnographically", so it was seen as important to not underestimate "the magnitude of the intellectual challenge of thinking about multiplicity, convergence and divergence in number usage and its grammars" (Guyer et al., 2010: 38-39).

Sociologists Lisa Adkins and Celia Lury gathered numbers studies together under the title 'Measure and Value' in a volume published by *Sociological Review Monographs* in 2012. Among the eight papers were studies of valuation, data, and metricisation, and perhaps giving a clue about the origins of the volume, finally a paper concerned about 'Measure, Value, and Current Crises of Sociology' (Gane, 2012). Shortly afterwards, Celia Lury, teaming up with Sophie Day and Nina Wakeford, published 'Number ecologies: numbers and numbering practices' in *Distinktion: Scandinavian Journal of Social Theory* (Day et al., 2014). This collection set out from the reading of earlier studies "consider[ing] numbers in terms of what numbering *does*, rather than what numbering *is*" (Day et al., 2014: 123). To approach the latter, they asked "how we live *with* or *in* numbers" (Day et al., 2014: 123). To organise the contributions to their issue, they turned to ecologising numbers and analysing them as composed, recognising that different ways of participating in numbers are possible. In short, the issues addresses, "how numbers participate in ecologies" (Day et al., 2014: 127). The specific contributions address percentages, different ways of multiplying, reasoning via algorithms, algorithms of an evaluation score, sensors, arts' engagement with number.

Most recently a collection of number studies published in *Science in Culture*, under the title 'Counting on Nature', edited by Kristoffer Whitney and Melanie Kiechle (2017), sought to investigate the role of numbers in society. These authors saw themselves as asking a new set of questions, and as eschewing hopes that the collected papers might answer deep questions about the quantification of humans and their environments, they sought to make available some answers regarding the shifting constellations of authority, expertise, and narratives in contemporary culture. Among other questions they asked

> Who quantifies, and to what purpose? Are numbers merely fact and/or rhetoric, or are they available as meaningful bodily experiences and stories about the past, present, and future? How do conflicting social forces attempt to make different meanings from numbers? How does the practice of quantifying nature differ between corporate, state, and non-state actors? How do narratives and bodies challenge or reinforce the centrality of numbers in understanding, representing, and regulating environments? (Whitney and Kiechle, 2017: 4)

In contrast, as we already stated, in our project we were concerned to find out how contemporary number studies were deploying new analytics that are emerging in STS. Our purpose was to make an investigation of our discipline rather than attend to 'a gap in the discipline' as the anthropologists had sought to do. We did not see ourselves as attending to crises in the discipline, nor as showing the contemporary roles and effects of numbers in society. Further, in making our investigation we had no wish to specify beforehand what we saw as the new analytics emerging in STS. What we offered in our call for papers was a rather vague typology of approaches associated with four analytic clusters. We do not repeat them here, for as it turned out our imagined continuum of approaches was indeed just that. We received a large number of submissions which proposed to evidence the many and varied effects that numbers and numbering have in society. Winnowing out those that actually engaged with simultaneously interrogating numbers and the analytics of that interrogation left us with the six papers that

follow. We relate and introduce these papers first, and subsequently turn back to numbers, algorithms and what STS has to gain from simultaneously interrogating numbers and analytics.

Empirical and Analytical Relations

We cluster this special issue's contributions in two sets and identify that one paper (Ingmar Lippert's) connects these two clusters in its pointing to each of the phenomena foregrounded. As we read them, the first two papers, Daniel Neyland's and Martina Klausner's, with their narratives of algorithmic processes, focus upon scenarios that we characterise as 'after numbers'. The phenomenon we point to with this characterisation concerns managing incompatibilities. As ontological phenomena, gaps, non-fits, and mathematically non-cohering processes are glossed over using the aura that hangs about numbers in modern society. Such is the status of pursuits mobilising enumerated entities that something like 'the smell of numbers' can be used to effect clunky connections and work-arounds. This is a form of connecting effected in ignoring. Participants agree to go on as if things connect up, so in the actual happenings of particular times and places they *are* connected. In Neyland's paper we see an algorithm that does not quite do what it is meant to do sent to the market nevertheless. Klausner reveals how emoji kittens on a smart phone screen connect the actions of reluctant children and an algorithm calculating therapeutic effect.

The papers of Tjitske Holtrop, Radhika Gorur, and Catelijne Coopmans work with 'found' numbers. By narrating the 'lives' of their found numbers in various situations, they propose these found numbers, concepts which have been subject to processes of enumeration, as ontologically multiple. In much the same way, Annemarie Mol (2002) proposed the concept of the disease atherosclerosis as found in various corners of a Dutch hospital as bearing an ontological multiplicity. In oscillations of singularity and multiplicity things hold together. Lippert's paper, comparatively juxtaposes two analytic instruments that fall within actor network theory. He shows that Callon and Law offer particular possibilities and Verran offers others. He shows they are not equivalent in what they reveal, but rather are complementary.

In the process of revealing differential strengths of the techniques Lippert shows that ontological multiplicity of numbered entities offers unexpected flexibilities in carbon accounting practices.

As a way into the study of numbers and incompatibilities within numbers, we introduce Daniel Neyland's (2018) study first. Empirically, he focuses on a process of research and development for a privacy technology. The project he followed attempted to construct an algorithm that would go through CCTV data and automatically delete data, a version of smart CCTV (see also Möllers, 2017). To sell this technology as a privacy technology within the wider security market, the technology needed to be demonstrated as an effective technology. At least this is what we might assume. Deletion, as Neyland shows, is not straightforward, neither technically not analytically for the STS scholar. The resolution of that tension, in his story, is provided by the market: it performs commensurability between different ontotechnical orders, which the algorithmic logic resisted to.

To analyse the making of a technology for deletion, Neyland draws on Michel Callon and John Law's (2005) notion of qualculation, which they drew from Franck Cochoy (2009). This analytics allows Neyland to reconstruct the judgements inscribed in the deletion algorithm, separate out objects, classify them and operate on them. Algorithm building turns into qualculative work. However, Neyland argues that qualculation cannot well handle the disruptive figure of deletion and so he turns to Hetherington and Lee (2000) who provide him with the notions of the blank figure and motility. These notions, he concludes, provide useful analytical means to study dissonance within the project of accountably performing deletion.

Commensurability is an overarching theme in Martina Klausner's (2018) contribution, too. Empirically complementing Langstrup et al.'s (2013) paper in *Science & Technology Studies* on the relations between numbers and patients, Klausner is interested in how numbers participate in inferring from and interfering in patients' lives. Klausner's analysis builds on a study of the development of an e-Health technology, a monitoring device that would help patients note the duration of their implementing a prescribed

therapeutic strategy. The critical empirical contribution concerns the different modes of calculating and measuring these time periods – where Klausner contrasts patients' practical ways of meaning making and the device's learning algorithms' situated ways of inferring and calculating. Her analysis adds onto Neyland's market a clinical case of performing commensurability.

To differentiate different modes and types of inferences and numbers' relating, Klausner draws on Helen Verran's (2001) and Paul Kockelman's (2017) work. She finds in Verran the capacity to engage numbers' performative properties and their alternative modes of ordering as well as generalising. Kockelman's work serves in Klausner's analysis to consider chains of inferences in computer-generated meaning. Klausner recombines both their capacities to focus on the accomplishment of numbers as robust and durable. Where Kockelman specifically is helpful to differentiate types and modes of inferences, Verran allows Klausner to spell out microworlds that generate numbers and are generated by numbers. Klausner's contribution urges us to detail concrete practices without assuming specific mathematical inferences.

Opening up the mathematical presumptions of a seemingly routine calculation, Ingmar Lippert (2018) leads us into the world-making of an equation. The latter consists merely of one division and one multiplication. However, the situated use and performance of these operations connect different universes, Lippert argues. Commensurability between these is established by bringing into being a hitherto non-existing data-point. To zoom into this performative equation, Lippert utilises the genre of mathematics itself and the reader is guided through the equation's unfolding both with ethnographic detail and with mathematical formula. That the formula is not mathematically coherent is not Lippert's point, but rather it illustrates his investment in tracing the situated logic of the calculation within the office context and what the number was for. Empirically, this number was part and parcel to the construction of a corporate carbon footprint. The calculator's accomplishment is reconstructed as managing incompatibility by ignorance that produces comfort in the face of the mathematical tensions

within the enactment of nature. This links into *Science & Technology Studies*' trajectory of critically exploring numbers and data in constructions of or for neoliberal environments (e.g. Granjou and Walker, 2016; Sullivan, 2018).

To analyse the calculation, Lippert comparatively reads two analytics, Callon and Law (2005) on the one hand qualculation, and Verran (2001) on the other. He coined the phrase 'ontologising troubles' to name Verran's technique. Lippert's analysis performs empirical philosophy as a method in this contribution as a means to present three narrations, of the calculation, of analysing the calculation as a qualculation and of the calculation as ontologising and troubling. By comparing the two analytic narrations, Lippert shows how both are clearly connected, in that they express an actor-network analytic sensibility, but also that they are also usefully differentiated. He identifies in qualculation analytics the capacity to reconstruct a teleologically oriented calculative process that is mathematically agnostic. Lippert characterises the technique of 'ontologising troubles' as enabling to identify how within a number multiple versions of certainty and coherence are achieved despite the mathematical troubles.

Continuing the theme of the simultaneous effects of singularity and multiplicity of a number, Tjitske Holtrop (2018) focuses on the number 6.15%. This number was at the centre in Dutch engagement with the enrolment rate of girls in Afghan schools, specifically international intervention in Uruzgan, a region well known for its links to the Taliban. Holtrop, however, turns to counting and accountability as part of mediating what happens on the Afghan ground and various levels of administration. A spreadsheet emerges as a central device for representing education; yet in turning to the singular number, Holtrop also explores its multiple references. With her analysis of work going into the spreadsheet and work based on it, Holtrop's account contributes to *Science & Technology Studies*' attention to the spreadsheet as a central device for organising and transforming data (see also Goëta and Davis, 2016; Lippert, 2018).

Focusing on 6.15%, Holtrop explores how the number relates to various environments. She proposes the notion interface for the character of a number to relate to an environment in which it is used in some way. This reflects the thrust of work by Verran (2001) and Day et al. (2014), addressing numbers as participants in ecologies of social worlds. Using Callon and Law's (2005) qualculation, she suggests that when numbers relate to an environment, they also transform. However, she returns to Verran (2001) to engage with how numbers' inside contribute and shape the practical engagement with the number. With Verran, Holtrop develops a second level of meaning of interface: Also internally, the number is multiple, Holtrop suggests. She identifies an "oscillation between doubt and certainty, towards stability and chaos" (Holtrop, 2018: 79).

Radhika Gorur (2018) turns to Australia's 'Education Revolution'. With this, like Holtrop, she engages in empirically analysing schools, education and their governance trough numbers – extending earlier work in *Science & Technology Studies'* broad focus on higher education (e.g. Tuunainen and Kantasalmi, 2017). Gorur's focus is on a public website that the state administration deployed to achieve transparency about schools' performance. She is interested in how the numbers presented are calculated and how they reconfigure other parties, including parents and schools. She uses the concept of 'informed publics' by Callon et al. (2009) to address how the government provision of simple calculations to the, thus, reconfigured public enabled the latter to not simply heed the numbers but also to question them.

This questioning of numbers is analytically of central interest to Gorur. She employs specifically Kristin Asdal's (2011) work on the production of non-authority to attend to this mode of relating to numbers. Where Asdal points to the role of intimacy in accounting whereby control was not exercised from the distance but inserted intimately within the controlled office, Gorur indicates how intimate accounting was enabled from the distance, allowing both the governmental numbers to reconfigure intimate relations in schools and families. She shows, too, however, that the informed publics were not relating to these numbers in a singular way, but multiply: publics subverted and refused numbers. She conceptualises these ways of relating as a form of

achieving non-qualculability, with Callon and Law (2005).

Intimately engaging with numbers is also a theme in Catelijne Coopmans' (2018) analysis of multiple ways of respecting numbers in a meeting. Whilst often in a meeting, numbers are presented (e.g. on a screen in a control room, Silvast and Virtanen, 2014) and action is taken based on these, in Coopmans' focus is the question of how accountably presenting, and engaging with, numbers is accomplished. She explores a series of meetings in a Singaporean medical centre in which diagnostic results were presented as part of project that sought to innovate a diagnostic infrastructure. In these meetings, she repeatedly encountered various actors who were quite obviously not satisfied with each other's ways of relating to numbers.

Thus, Coopmans explores how numbers are differently brought to life. She approaches numbers' liveliness specifically through Helen Verran's (2012), Dawn Nafus' (2014) and Tjitske Holtrop's (2018: 75-88) work and uses them to posit "numbers' relational agency in knowledge-practices" (Coopmans, 2018: 112). She then deploys her case as a 'comparison engine' (Beaulieu et al., 2007) to learn about her case as and simultaneously contrast Helen Verran's (2001) take on numbers as unity/plurality, John Law's (1994) 'modes of ordering' and Steve Woolgar and Daniel Neyland's (2013) 'accomplished ontology of entities'. She shows how each of these achieves a different symmetrical analyses of the competing commitments to respecting numbers. To think

about this, she suggests the metaphor of the kaleidoscope. Coopmans' analysis concludes, thus, in terms of the kaleidoscope of analytics that organise symmetrical descriptions shaped by different concerns. And these analytics are differently generative of results, revealing different nuances about the analysed material.

Collectively Contributing to Number, Algorithm and Data Studies

The kaleidoscopes employed within this special issue indicate the range of capacities in recent STS analytics of numbers to analyse processes and practices involving numbers. Based on our authors' selection and use of analytical approaches, we identify a core contribution of the SI to STS: Even though many of the approaches share family resemblance, the contributions assembled here, indicate that the approaches effect different analyses. As a retrospective map, we indicate in Figure 1 which contributions to the SI deployed, tested or compared which analytics whilst interrogating numbers.

We suggest, STS has much to gain from papers that simultaneously interrogate a phenomenon, in this case numbers, and analytics. This is a dual interrogation. Whilst STS is well equipped with studies of technoscientific phenomena (first interrogation), being explicit that and how we interpret and reconfigure analytics when producing a narration of the genre 'analysis' (second interrogation) generates three contributions. First, we learn
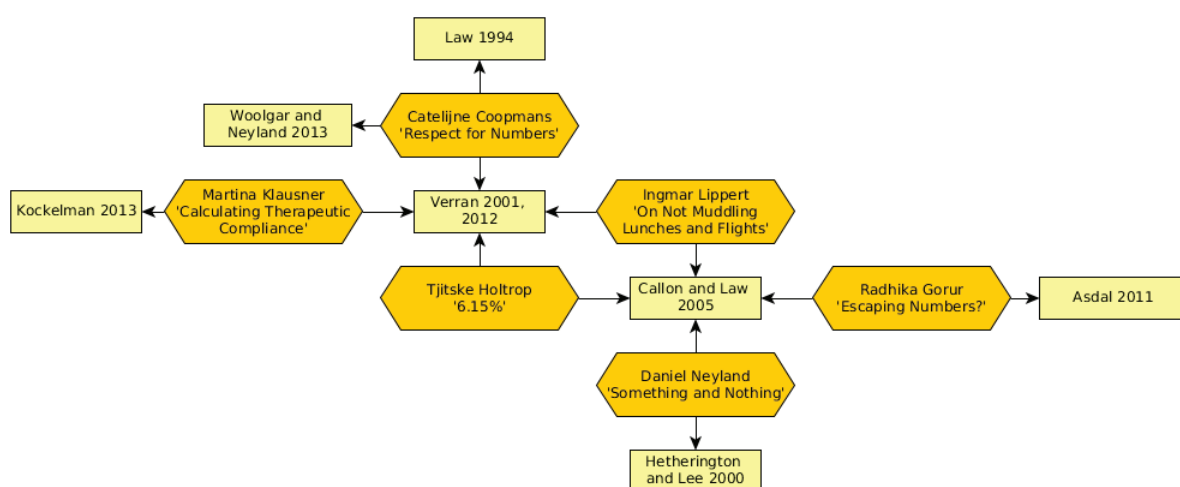
Figure 1. Map of use of core analytical approaches in SI contributions.

about the epistemic configuration of the phenomenon. Second, we learn about the limits and capacities of the analytic. And, third, we render ourselves, our practices of analysing, accountable to the reader, and to ourselves (see Kenney, 2015).

For this special issue we assembled contributions to comparatively interrogate several analytics. By contrasting the capacities and limits of two analytics, a paper can reveal and discuss nuances in STS's own knowledge-making. We assembled papers that show this contrast (Gorur, Holtrop, Neyland) and that discuss the contrast (Coopmans, Klausner, Lippert). The collection of these papers indicates that different modalities within a broad community, like actor-network theorising, produce different results.

Producing accounts that perform not only the dual interrogation – of analysing the phenomena but also the analytics – but also interrogate the differences between several analytics – not as abstract theories or tools but as they are performed in analytic practice – is demanding much of authors as well as of readers. As stories of multiple interrogations, to be generative, the story-telling needs in-built patience that allows for sensing and explicating nuances through which differences, compatibilities or equivalences between specific components and relations built into analytics are accomplished. This multiply interrogative strategy then opens the black boxes of STS's own analytics.

One development, originally surprising us – us being invested in post-ANT analytics of numbers – was that authors used these analytics not only to study numbers, but data and algorithms, too. So we return to the nexus of numbers/algorithms, and extend it to include data.

We recognised early on that it is a common perception among STS scholars that numbers and numbering studies includes algorithm studies as well as data studies. In contemporary technosciences numbers and algorithms and data come tightly knitted nowadays. Each of the projects that have excited the interest of our contributors involved working the relation between these forms. Let us pause and reconsider that seemingly obvious point.

Whilst Helen Verran's (2001) work is concerned with and disconcerted by basic arithmetic practices (e.g. enumerating tomatoes, measuring length), many STS projects engage with with numbers and data within socio-technical contexts that include the processing of a range of data-points or even infrastructures. Consider Paul Edward's (2010: 92–96) presentation of the computers orchestrated to solve an differential equation in 1922: 64,000 human computers were to conduct ordered steps of arithmetics, i.e. perform an algorithm. Whether performed by human or silicon computers, at each step, we are concerned with an algorithm-con-computing entities (multiply by 2), calculating with variables (qualities) and their contents (quantities), step by step.

Two kilogram of tomatoes, when datafied, could be represented as $x = 2$. Where x equals "kilogram of tomatoe". The first step's finding, it's results, the content for the specific variable, is 4. 4 is given as input to the next step, as data. Though, the data storage ideally stores the 4 as the content for the variable x. So, data includes not just the quantitative meaning, but the qualitative, too. Decisive for the semantic load of the variable, Ingmar Lippert (2013, 2018) points out, two qualities are involved, the standardised unit kilogram and the qualitative category of tomatoes. Helen Verran's (2012) chapter 'Number' engages this semantic complex with the term 'number'. Lippert (2013: 93) illustrates the (un)certainty potential of such a number with a triangle, indicating that for mathematical coherence all of the three components and their relations need to be under control. Managing this control is labour (Coopmans, Lippert).

In technoscience, corporate or political contexts, performing data, and big data, comes with a risk; a risk also for STS analyses: ignoring relevant issues within these semantic knots. Inside numbers we might find mathematical non-coherence, or more complex socio-cultural investments.

The contributions to this special issue can be read as showing multiplicity both within the doing of numbers (Klausner, Lippert), outside (Gorur, Neyland) and where the inside and outside collapses (Coopmans, Holtrop). So, numbers can be studied as networks, their inside explored, what is behind them. This implies analysing number as relational practice. And we can study how numbers are used, contested, including the

contestation of how numbers should be engaged with. Therefore we suggest numbers as sites of the political that precedes numbers' social effects – social effects that STS and related fields have proven already to be worth of scrutiny.

This special issue shows, too, that human actors, and potentially artificial actors, too, are partially well aware of tensions and frictions within their numbers, data or algorithms (Lippert, Neyland). To be sure, this implies specific ontologies and analytics, held by members 'in the field' themselves, are employed by members to evaluate their numbers, data or algorithms.[1] We consider it a task for the STS scholar to analyse the actual material and epistemic practices that shape numbers and stories of numbers. This then includes interrogating both members' and scholars' analytics through which numbers' harmonies, tensions and frictions are established. In parallel to insisting of the vitality of carefully interrogating our own analytics, we insist on exploring the politics of real-worldly numbers, including of numbers with in-built incompatibilities. Ignorance is only one form of managing incompatibilities, others are corrections and mislead attempts of correction. We identify in the contributions an amazing variety of how numbers, too, are also employed as a guise. Performing numberliness effects relations and connectibility; numbers appear as ready plug-ins (see Latour, 2005). However, we must not forget that numbers can be practically, even if mathematically invalidly, processed in algorithms; recent big data enthusiasm risks multiplying such risks. These may fail science, engineering, markets and democracy (e.g. Lippert, 2016).

After numbers!

Analysing numbers leads us to considering how we analyse numbers. This is a sideways movement. When analysing numbers we are making the analytics work and pass it along. In passing it along, 'it' changes, it is remodalised. This implies that an analytics, a theory, is never isolated or 'pure'. Instead, the analytics is situated – e.g. in a textbook or in a research paper that performs 'applying' it. So we invite attention to how we can exercise care in using and making analytics work. What does it mean to do 'good work' *with* STS

number analytics, *through* or *on* them? We register a value in simultaneously interrogating numbers and the STS number analytics: this mutual interrogation qualifies the relations between numbers, analytics and, then necessarily, the analyst. Some of the papers in this collection provide situated responses to these concerns, and we read these as particularly generative for understanding the nuances of analytics and how their interpretative flexibility comes to matter in STS analyses of numbers. In short: going after numbers requires thinking through how we go after them.

'After numbers' captures seven points we like to end this editorial with.

First of all, being somewhat humble, we recognise that the quantitative value of numbers may not be at stake, numbers may be ignored (see also Lampland, 2010). But still, the numberly guise of numbers here can be expected to be decisive.

Second, recognising the significant tradition of studying the social effects of numbers, we suggest that after the fact, after a number has been produced, many relevant phenomena can be studied. Phenomena that employ the number: n^{th} order calculations.

Third, once we encounter a number, we can turn to what happened behind, before, it. Thus, after identifying a number, we turn to its emergence, its becoming-number. Within this process of becoming, significant commitments to the expected number may be invested.

Fourth, from a temporal perspective, engaging with the two prior points gets us onto the track for a study of the life-cycle of the number or a narrative diary of what happens on its multiple and lively ways.

Fifth, numbers are often invoked in discourses of accountability and rational, calculable, action or evidence. Addressing these matters, politically.

Sixth, we can employ STS number analytics in studies of data and algorithms, too. And more conversation, specifically mutual interrogation, between number studies, data studies and algorithm studies may prove valuable.

After Numbers! This is a call to employ, further develop, interrogate STS number analytics and study numbers.

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Notes

1   Mathematics establishes the extreme case, in itself deserving STS attention (Rotman 1999; Heintz, 2000; Barany and MacKenzie, 2014).