Special Issue: Number ecologies: numbers and numbering practices
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Numbering: ecologies and composition
Sophie Day (Goldsmiths), Celia Lury (University of Warwick) and Nina Wakeford (Goldsmiths)

Introduction
In putting together this Special Issue we seek to contribute to the social study of number[1], a field which has acquired renewed significance in recent years with a revival in forms of self- and collective-experimentation, the rise of the digital and big data-sets, and changing boundaries between 'public' and 'private' forms of knowledge production. As Guyer *et al* noted in a previous collection of *Anthropological Theory* on this topic, "The 'modern' world sometimes describes itself in seemingly magical numbers that hang in mid-air, unconnected either to a grammar or a grounding" (2010: 37). These developments make the question of how to understand our relationships with numbers and numbering practices particularly pressing. The field of the social study of number is interdisciplinary and includes cognitive studies of the situated use of numbering (Lave 1988), histories of statistics, large numbers and probability (Porter 1986, 1996; Hacking 1990: Desrosières 2002; Galison, 2004), the study of statactivism and the politics of indicators (Didier, 2005, 2010; Espeland and Sauder 2007; Power 1999), the ethnographic and comparative investigation of numeracy (Crump 1992; Mimica 1988; Stafford 2009, Zaloom 2003, 2006), the study of numbers in art, money, technology and science (Simmel 1990; Hart 2000; Zelizer 1994), the philosophy and history of mathematics (Whitehead 1986; Badiou 2008) and the exploration of numbers as signs (Rotman 2000) or enumerated entities (Verran 2001). All these studies – whether from the disciplines of psychology, philosophy, history, sociology, anthropology, art, digital, software and media studies - consider numbers in terms of what numbering *does*, rather than what numbering *is*. Following in this tradition, we wish to adopt a felicitous analogy from Helen Verran and think of numbers in the same way as anthropologists do kin: numbers both are and have relations just as people are and have relatives in ordinary English (Verran 2010: 171). Accordingly, it makes sense to ask how we live *with* or *in* rather than *by* numbers.

The groundbreaking 2010 special issue of *Anthropological Theory*, "Number as inventive frontier", (cited above) identified a contemporary 'profligacy' of numbers that provoked the contributors to explore challenges associated with 'thinking in numbers' (2010: 37). They adopted a variety of perspectives to address numbering in different knowledge practices, as operations and markers of social situations; private and public numbers, formal and informal, dodgy and provisional as well as precise and persuasive; numbers as symbols, indices and icons. To build on these understandings, we add, in the first part of this introduction, the notions of *number ecologies* (Leigh Star 1995) and, in the second part, that of *number compositions*. In doing so, we describe an approach to the study of number practices that we believe allows us to consider the ways in which numbering is fundamental to social life but not always visible. In our own studies – on biobanks, Weightwatchers, the NHS, the

Nike Fuel band, measuring radiation, the CPI and Klout[2] – we found that the activity of numbering kept 'disappearing' into bodies, practices, rituals, scores and, simply 'data'. Rather than seeing this disappearing act as evidence of a missing or inadequate numeracy in the everyday world, we began to look at forms of *participation in number*. We looked at processes such as texturing, knotting, zooming, or the suturing together of tracking and counting as a way of expanding our understanding of the significance of numeracy as a practiced or cultural activity.

In the paper that begins this Special Issue, Jane Guyer describes herself as offering the 'view from below', analysing specific allusions to numbers in relation to their wider social matrix, so allowing her to explore operations of power. Her contribution is concerned with the whole/part relationships generated through numbering practices, in particular percentages, and their role in what she calls the 'aspirational mode' of number, examples of which she finds in everything from virtual worlds to her local newspaper in Baltimore. The percentage is an easily understood form: 'It is one mathematical formulation whose mechanics anyone with a basic education could understand, and it carries the potential of conveying transparency in the public domain, persuasive ethical and philosophical allusions, and also moving in only partial form, from one context, and perhaps one mode, to another'. The history of percentage expressions, she shows, is integral to the public significance of processes as various as income tax, scientific standardisation, mathematical probability, the weather forecast (a working with percentage also deployed by Olafur Eliasson's Weather Project)[3], nutrition, and government debt.

Drawing on a wide range of examples, she suggests that while many uses of percentage have been tied to notions of fairness and proportion (rather than justice) from their beginning, the "vague whole"[4] that is conjured up by contemporary uses in which the denominator is rendered invisible contributes to a specific cultural orientation to the future. Thus while it may be a common assumption that numbering is always about the pursuit of precision, she shows that the creation of vagueness is an important outcome of numbering practices. The declaration of a percentage – for example, 'We are the 99%' or 'There was a marked increase in the proportion of adults that were obese from 13% in 1993 to 24% in 2011 for men and from 16% to 26% for women' – is also an incitement to participate in a vague whole. You don't simply read or register a number but respond to it, perhaps lobbying for the redistribution of wealth, or the creation of a sugar tax. What does this disappearance do to wholes, Guyer asks? What happens when you 'price' nature or carbon emissions? Attempting to do the sums via a recent newspaper report in her local city, she describes the 'percentage improvements' in Baltimore, simultaneous with its supposed elevation within the ranks of US cities. Percentage expressions, she states, seem to be proliferating but, in this process, denominators become either absent or so vague as to fall apart when they are inspected closely. Instead, the numbers, supported by the new conditions of communication and info-graphic visualization techniques participate – and incite participation - in the making of more-than-one or multi-modal worlds.

Elsewhere, the rise of social media has been accompanied by the development of data-aggregating services that process and present records of Twitter, Facebook, Google+ as numerical scores for social

[2] These were part of our project on contemporary numbering (2011-2014), supported by Intel Research as part of a wider University funding programme on biosensors.
[3] A publicity poster for the 2003 installation at Tate Modern proclaimed, '47% of people believe the idea of weather in our society is based on culture, 53% believe it is based on nature'.
[4] Whitehead writes, 'What is original is the vague totality. … The discrimination of detail is definitely a secondary process, which may or may not assume importance' (1968: 109-110).

abstractions such as reputation. In their contribution, Carolin Gerlitz and Celia Lury consider one such service, Klout, a self-evaluation tool which brings together and aggregates users' data across social media over a rolling 90-day period and offers back a number between one and one hundred as a score of the ability 'to drive action'. This calculation of influence is a kind of tracking device, but, Gerlitz and Lury argue, it should also be examined for its productive capacity. The Klout score is a relation and has relations, and the authors highlight the participative rather than merely performative capacity of this number in order to emphasize the relations of inclusion and belonging that accompany the number as score. The service functions through dynamic comparison: users are observers and influencers of each other, and always aim to increase their influence. However, the entity of a whole number score, as produced by Klout, has further significance for the authors because of the forms of ordering and value achieved by embedding this number in further media-semiotic operations. The value of the Klout score can be translated into a relation with the consumer market, and indeed the Scores are sold to commercial organisations: high scores can mean prizes – a high-scoring influencer might be asked to try a new model of mobile phone, or be offered a free weekend by a city visitor's bureau. And this connection between an individual's Score and 'third parties' is continually reconfigured: as the authors observe, Klout is constantly changing the algorithms by which each individual user's score is connected to "the achievements of the referent population of all Klout users, whose size, composition and activity is itself constantly changing".

The question of the precise social forms or 'group unities' that number might take through multiplication preoccupies Adrian Mackenzie who describes an epidemiological model to show how multiplication fuses social groups in the process of composing numerical forms. He deploys a vocabulary of participation and performance. Numbers 'fuse' together, 'multiply differently'; they predict in a general (a looming pandemic) or a particular (likely cases) way. For Mackenzie, the issue of precisely what is multiplied is crucial to the ways in which different kinds of group unities are brought into existence in mathematical models. His study of the building of a model of the A/H1N1 virus begins with the careful analysis of an equation to show that flows of numbers through events have shapes and patterns. Unlike other numbering practices in which numbers are assigned (in more or less 'good faith', Verran 2012) to referents alone, Mackenzie's case involves a model in which the numbers used are sometimes complexly referential and sometimes produced by the application of functions: the latter coming not from counting, but from mathematically-driven computation. Statistical populations of diverse entities are mingled, along with numbers from very different origins, and different probability distributions. As a result, the model effectively 'slows down' the mixing of different dimensions of the pandemic event. It becomes an endless (Mackenzie comments, either a 'distressing' or 'metaphysically marvelous' exercise in) multiplication of synthetic variables, which we can see in the very lines of code that Mackenzie includes in his article.

Dawn Nafus approaches number through a discussion of two projects in which sensors were used to generate numerical information from data. In collaboration with an interaction designer, Nafus engages in the anthropologically-informed practice of 'critical making' - building physical sensor-related software and hardware to show that sensor data may take different numerical forms. The first design Nafus describes was an attempt to intervene in the operation of the national Consumer Price Index (CPI) by allowing individuals to scan product barcodes to produce their own individual index. The hope of generating a personalised CPI, through which people could critically reflect on their individual relationship to collective spending, was soon thwarted. Although a scanning technology was made available to enable individuals to record prices, their personal purchasing realities could not be understood directly in relationship to the aggregations involved in making the index at a national level. Nafus concludes that the composite CPI index is just too resistant – too knotted or felted, perhaps - to be untangled by this design-led critical making approach.

By contrast, Nafus' second case, the creation of numbers about environmental sensing yielded more productive results. This interaction-design task aimed to develop a measure, including a number scale, which could be read in parallel to the sensor data that the users of one website, Pachube, were already uploading. The data on home energy sensors, largely generated by what Nafus describes as the 'data enthusiasts' or 'activists' of Pachube, is described as 'dead' or 'trapped' prior to the design intervention which offered sensor users a visualization of their own collected data on indoor temperature to be set alongside the outdoor temperature, bringing it 'to life'. Nafus is interested not only in the 'un-stopping' of data, but also in the kinds of labour that are involved in making numbers lively. Her claim is that the ability of numbers to 'point towards' a referent derives from the specific mobility of data, which may be supported, or not, within the wider ecology. As she observes, data (and by implication, the numbers they lead to) may generate new realities or they may be stalled and stopped in their tracks. Numbers do not always readily circulate, enable further actions or be stored for the future in existing repositories; they do not automatically take shape or persist. In order to navigate our number-saturated worlds, she concludes, we need to think about numbers that are provisional, dodgy or simply 'failed' (in Verran's terms at the workshop) – unsuccessful speech acts or poorly constructed composites – as well as those that endure.

The claim that underlies Orit Halpern's contribution is that contemporary understandings of numbering practices may usefully be situated in relation to the history of cybernetics. Halpern draws attention, in particular, to the concerns of some of the key historical pioneers of cybernetics for whom the algorithmic rationality of the network rationality had both aesthetic and numerical dimensions. With a historian's gaze on the moments at which such ideas enter public life, including the lecture given by the cybernetician Warren McCulloch in 1948 on circuits and brains, Halpern documents and analyses occasions when reasoning becomes both equated with, and represented by, algorithms. Although some of the technologies in which this cybernetic view are realized do not emerge until the 1970s, Halpern suggests that the ambitions of many subsequent engineering projects, and indeed our current equation of mental processes with the processing of data, begin with the understanding of the model of brains as circuits. As she shows, a temporal politics – or more precisely an erasure of temporalities – becomes bound up with this framing of cognition. She concludes by suggesting that numbers need not necessarily circulate as they do, even though her analysis suggests that the bundle into which data, algorithms, numbers and calculation are now tied is very tight.

Perhaps, then, alternative practices of numbering can be found in forms where numbers as such are invisible? Contemporary artists sense and participate in number as they simultaneously engage with the emphasis in 'post-conceptual' art on distribution and dispersal. John Chilver, in his contribution, provides some examples of how this is so by focusing on artists who work with practices of listing or inventory-making. Chilver's argument suggests is to suggest that the inventory or list is "the dominant mode by which contemporary art figures number". Yet the article begins with an artist, Robert Mangold, who does number via ""proportion and ratio and very little else". Robert Mangold's long-standing concern with geometry can be understood, Chilver argues, as a way of doing number as proportion, and as such it provides a foil to the more recent works of Florian Slotawa and Walid Raad/The Atlas Group that he also discusses.

Committed to minimalism, Mangold is offered to the reader as an artist who works with distortions and decentre-ing as a way of approaching number via "hollowed out diagrammatic misreadings" of Da Vinci's *Vitruvian Man*. His paintings are presented as "visual condensations of number", with an emphasis on the potential of the contingency that emerges in processes of deformation, resulting in

forms that do not quite 'fit'. In contrast, the works of Slotawa and Raad involve numbering as extension and connection, rather than proportion. Slotawa's documentation of hotel-room interiors, which were disassembled and reassembled during his stay as a guest, rely on the device of the inventory in order to present themselves as contemporary art. Wrapped up in the titles of the resulting photographs are "compositions" which Chilver pinpoints as "explicitly nominated as numberings" of place (the name of the hotel) and time (the day, month and year of the event). The numerically-itemized list is a form deployed by Raad also, although in the work that Chilver discusses we are led to focus on how colour functions as inventory making and therefore can itself be understood as a numbering practice (see also Bochner, 2012). For Chilver, both these post-conceptual artistic endeavours suggest that there can be an excess that escapes the inventory, and perhaps thus indicates alternative ways of participating in numbering.

All the papers collected here thus address, more or less explicitly, the ways in which numbers both involve participation and themselves participate in the composition of forms of social life, that is, how numbers participate in *ecologies*. Thus they variously describe what might be involved in living in and with numbers by considering number practices in relation to changes in technical supports, media and infrastructures, variously comprising banks, archives, experimental systems, measuring devices, scales, screens, hotel rooms, sites and exhibitions. More than this, they show that it is *as* relations that numbers are able to perform: that is, to travel, to make possible comparison, conversion, and exchange, to be stored, to inform and to make sameness and difference. Thus we use the term ecology to draw attention to the liveliness, multiplicity and heterogeneity of the relations our contributors describe: how they may motivate inferences, responses, interpretations and translations.

Ecology is a term that can encompass numbers as legends (for example, the 99% of the occupy movement), big numbers and little numbers, numbers as shifters and as tokens of exchange, numbers that can support comparisons and those that cannot, numbers that are able to mark and make value. In relation to an understanding of number ecologies we can ask further: are numbers invariably precise and specific in their workings or can numbers be vague? In what configurations do numbers appear? How are numbers produced as *measure* in sampling and *statistics*, as *figures* in finance, as *digits* in digital technology, as a *grade* or *scale* in testing procedures, as a *ranking* in marketing, as an *index* in the stock market, or as a *point* in games and sporting practices? And so on. Recognizing that numbering practices are not confined to calculation, we may consider the relations between enumeration and denomination, between numbers and names. In the workshop that prompted this Special Issue, Helen Verran focused on the performativity of numbers as 'speech acts', names of a kind, which make relations, and incite participation and action. Taking inspiration from Austin's (1962) consideration of how to do things with words, we consider that we can look at numbers in the way he looked at words. We ask: can we think of numbering as a practice that operates beyond what is conventionally considered numerical, just as it possible to look at language beyond what is considered linguistic. Can we, for example, ask about what counts as a 'big' or 'small' in relation to speech act theory more variously than through enumeration? When is twelve a dozen and when is it three times four?

The term ecology further allows a consideration of continuities and discontinuities in numbering practices, to ask: what might we learn from past formulations of numbering in information science, in art and in everyday life? Thus, just as Timothy Choy understands 'ecologies of comparison' (2012), so we see ecologies of numbering as themselves in motion, characterised by a whole range of emergent, dominant and residual logics, narrative forms, technical and conceptual practices in which numbers move, have and are relations. One of the most obvious changes to note here is the increasing

pervasiveness of computational media, which has allowed for an expansion and transformation of numerical activities. With this expansion, numbers make new entities and ways of naming, new materialities and property, including practices of securitisation across a variety of borders (Amoore 2013; Kurgan 2013; and see below). They can fold inwards (as with concepts of saturation, when a model produces no new answers) or outwards as when a social media platform recombines various indices to yield new ratings. As numbers attach new meanings and embed new materials they simultaneously detach – a count (Badiou 2008) flies free of its denominator or an index becomes dis-embedded from its national milieu. Our interest in ecologies, then, leads us to explore where numbers come from and where they go, the ways in which they can be detached and reattached, their variability and their constancy.

And to address this question, we turn to the notion of *composition*, a process that we take to describe how numbering is a re-presentation that always holds more-than-one presentation. As Brian Massumi describes a white chalk line drawn on a blackboard, so we suggest more generally of number compositions:

> As been, the whole presents itself twice. Once: in the concrete surface continuity of black and of white. Again: in the pure abstractness of the invisible line separating and connecting the surfaces. (2011: 90)

In developing this approach to number compositions in part two of the introduction, we make a second line through the papers collected here, one in which they are present differently, though no less significantly.

Composing numbers: a glossary

The approach that we develop here is to see numbers not simply as composites (Verran 2001) but as *compositions*. In common with other approaches to the social study of numbers, this approach is concerned with the performative capacities of numbers (Lampland, 2010). We address this performativity in terms of composition[5], and in doing so look at practices in which numbers themselves are not immediately visible as such. Thus, we consider numbering not in terms of those formulae, accounts or practices in which numbers feature as (always already situated) integers or semiotic entities, but by addressing the ways in which numbering is composed or accomplished as a form of practice. And here we draw on the notion of form elaborated by Kant when he describes as 'the agreement of the manifold with a unity, leaving undetermined what this is supposed to be' (Kant, 2000: 112, quoted in Weber, 2008: 57).[6] More specifically, we draw on Rabinow's (2008) use of the notion of the work of *Bildung*, the work of forming or shaping. This is a term which he says involves a kind of doubling, both the work of self-forming and also the work of making the self into an object upon which work can be per-formed. For us, this description of *Bildung* resonates with the claim made by Whitehead that there is no such thing as a number that is merely a static entity, that is, a number is never simply closed or already formed.[7] Where a number comes from and where it goes matters for what that number is and does.

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[5] Whitehead writes, 'Power is the compulsion of composition' (1968: 119).

[6] As Guyer observes, 'while all number systems relate unity to plurality, the emphasis varies from the one/many form to the whole/part form' (this Issue)

[7] As discussed by Mackenzie (this Issue), Whitehead writes, 'The very notion of number refers to the process from the individual units to the compound group. The final number belongs to no one of the units; it characterizes the way in which the group unity has been attained. Thus even the statement

Such an approach allows an exploration of numbering in terms of ordering, comparing and sequencing, and their combination in practices, some of which we describe below. Of course, in mathematics, numbers are often involved in the geometrical operations of reflecting, rotating, translating, projecting and so on. But rather than looking at the 'essential' characteristics of numbers (if any such exist), our aim is to understand numbering in terms of the apparently endless ways of being and having relations, making relations between the one and the many, the part and the whole. Our ambition is to see how numbering produces not only discrete and continuous but also partible ecologies, within or adjacent – in the neighborhood - of the other. We thus end by bringing together the notion of composition with that of ecology as a way of understanding what it means to live with or in, not by, numbers; for us, numbering is not external to or outside social life but participates in its happening or liveliness as well as an in its reduction or extinction.

Such a way of thinking about numbering has a long history. Consider, for example, the drawing analogies. For the historian Barbara Stafford, in the practice of analogy, something that is like something else or participates in what it is not:

> Analogy correlates originality with continuity, what comes after with what went before … This transport of predicates involves a mutual sharing in, or partaking of, certain determinable quantitative and qualitative attributes through a mediating image. (2001: 9)

For Stafford, analogy is an associative method, a demonstrative and evidentiary practice. She says, 'All of analogy's simile-generating figures are thus incarnational. They materialize, display, and disseminate an enigma that escapes words' (2001: 24). She identifies two varieties of analogy, in both of which numbering practices have been involved. The first goes back to Greek mathematics, where it referred to proportion or due ratio among numbers, as is acknowledged in Guyer's discussion of percentage and Chilver's discussion of the artist Mangold. As both Stafford and Guyer observe, this meaning was extended by Aristotle, among others, to embrace non-mathematical relations in areas like justice, virtue and poetics. By means of a disciplined inferential logic, it was held that it was possible to establish measurable connections between incongruent phenomena through a stepped system of predication. The other variety of analogy - the qualitative theory of participation – Stafford traces back to Plato. While the method based on establishing quantitative proportions drew on a geometrical language of equality and inequality, the second, grounded in the rhetoric of participation, employed the mimetic vocabulary of similarity and dissimilarity. Both, we suggest, are present in today's practices of numbering.

Stafford argues, however, that the hallmark of contemporary experience is an absence of analogy, and points in evidence to what she sees as an exaggerated awareness of difference. For this reason, she thinks it necessary to recuperate analogy; indeed this is the primary motivation of her study. Yet she also seems to see some possible support for the resurgence of analogy in, for example, the operations of hypermedia that she describes as 'based on a non-linear structure that operates by encouraging the swift interlacing of interdependent ideas' (2001: 83). Stafford argues that analogy is the making visible or imaging of ordered relationships articulated as similarity-in-difference. In the terms of the argument being developed here, analogy so understood is central to the (numerical) practices of composition, to *making and unmaking* continuity, ones and manys, parts and wholes,

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'six equals six' need not be construed as mere tautology. It can be taken to mean that six as dominating a special form of combination issues in six as a character of a datum for further process. There is no such entity as mere static number' (1968: 93).

stops and starts, beginnings and endings. It does not produce either *only* similitude or *only* difference (the latter seems to be what Stafford believes to be the case), but both similitude and dissimilitude at the same time.

The glossary that now follows adopts a similar mode of analysis to include: zooming, folding, scoring, pausing, accreting, knotting, and diffracting. It is a preliminary list, and we would have liked to include gridding, scanning and cutting amongst many other practices. Nevertheless, we hope that this initial attempt will serve as a provocation to understand everyday numeracy as it is practiced with and without numbers and expand our understanding of what numbering can do. Indeed we see the open-endedness of the glossary as an invitation to others to extend its terms of reference. In each case here, however, our discussion proceeds, perhaps somewhat unusually, by way of a consideration of images. So, before we start, we would like to explain that we do not intend the images to be used as illustrations of the numbering practices we describe. Rather, our use of these images is more a way of making visible the dynamic formal or compositional dimensions – the figures, shapes or forms - that numbering involves. The images are simultaneously analytic and synthetic demonstrations of numbering as the figuring out of singular topoi, the deformations of patterns, and the making of atmosphere, enchantment and alienation by way of provoking participation. They show numbering practices as compositions in process: coming from and connecting to rather than completed, static or self-referential entities while nevertheless presenting a unity that is undetermined.

Although many of the images are art works, it is not our intention to privilege art as the pre-eminent site in which numbers are composed – indeed we include an ethnographic image as part of our thinking and could equally well include a mathematical equation as Mackenzie does in his contribution to this issue. Our aim in using them is to illuminate the *doing* of number – number-ING; indeed, we understand all numbering practices or operations in terms not only of knowing, but also of sensing and participating. So we also want to recognize that there is something about the specificity of artistic practice – and the criticism that addresses that specificity - that has been immensely helpful. Finally then, just as we share with the artist Mel Bochner a concern, in Shen Chaves' words, 'to expand the use of empirical methodology beyond problems of physical environment and into the murky territory of conceptual space' (Shen Chaves 2013), so we seek to continue the use of the term ecology in this second part of the introduction by agreeing that "No Thought Exists Without a Sustaining Support" (Bochner 2008). In this regard, we adopt and adapt what Bochner says of his use of series for our own purposes in understanding the composing of number ecologies 'The 'art' is the demonstration of a network of supports that forms the system (the knowledge of it, in it)' (2008: 100).

1. Zooming

Zooming is today a familiar term that characterizes specific interactions within screen-based data visualizations. For example, Google Earth builds on conventions of incremental movements towards a particular object to make its 'zoom' in. In this and many other cases, 'zooming in' (significantly enough represented by way of the symbol for addition or to indicate an integer is positive: +) may be reversed in a process of 'zooming out' (or -) so that a larger vista is brought into view. We want to ask how zooming might be a way of encountering number. Or, asked in a different way, what kind of numbering appears when zooming is performed?

Zooming has, of course, a long history within cinematography and the popular imaginary, within which it functions as a performative gesture that operates the dynamism of moving from bigness to smallness, distance to nearness,. The cinema company Paramount, for example, first used a zoomar lens in the 1920s, and by the 1950s, the 'zoom' had been integrated into cinematography techniques,

via a variable focal lens, following major investment in aerial photography in the Second World War. NBC TV in New York demonstrated a camera equipped with a zoomar lens in 1947 (Willemen 2003), and zooming was widely used in cheaper film productions of the 1960's and 1970's. It became a popular formula for television advertising spots as an "emphatically overt sign of the narrator's performance of the narrative" (Willemen 2003). In 1977, The Eames office, founded by Ray and Charles Eames, made a film called *Powers of Ten*, which reflected on zooming. The Eames brothers aimed to explain 'the relative size of things in the universe' by way of a sequence of images, zooming out in a series of frames from the aerial view of an unremarkable event, a couple having a picnic on a lawn, to the Milky Way and then back to a microscopic view of DNA. Citing the architect Eliel Saarinen, the Eames argued for 'the importance of always looking for the next larger things – and the next smaller' and sub-titled the film *About the Relative Size of Things in the Universe*. 'With a constant time unit for each power of ten, Ray Eames writes, 'an unchanging center point, and a steady photographic move, we could show 'the effect of adding another zero' to any number" (quoted in Kurgan, 2013: 19). Laura Kurgan observes that this 'steady' move was what filmmakers Philip and Phyllis Morrison called "a disciplined smooth flow", "a long and uninterrupted straight line', and notes that,

> The zoom is simulated in the Eames movie, using more than a hundred separate images, many obtained from scientists and from NASA, others made in the studio, some even drawn and painted by hand. … Every scale is relativized by its proximity to and distance from the next, and there is no base or ground for the process of zooming itself. (Kurgan 2013: 19)

Today zooming is widely used as a technique of encountering large quantities of information, and appears as a default mode for navigating a variety of mappings of 'big data', allowing for movement within the interface through the use of the + and - options. The conceit frames zooming primarily as an activity that allows the user to move into and up close to a map so as be able to pinpoint themselves ('my house'; 'the restaurant where I said I would meet my friends') at the same time as producing a surface for exploration and revelation ('my house is actually quite near the restaurant'). Zooming in these uses does not enact a change in scale, but rather generates a reformatting. For Latour (http://homecookedtheory.com/archives/2013/05/14/on-the-fallacy-of-the-zoom/), the maxim 'big because collective, small because individual' is not inevitable: if a global view is not 'larger' than the local, increasing or decreasing 'distance from' (in the photograph in Google Earth view) should not be confused with scalar (or any other) relations between the one and the many. This, he suggests, must be found elsewhere, perhaps by making partial connections (Strathern 1991).

The work of American photographer Chris Jordan also engages the operation of zooming as movement towards or away from a surface while, at the same time being concerned with what is revealed as the viewer moves from a frequently abstract large-scale photograph to the specificity of the repeated units which make up the image. His images thus provide a way to sense the properties of a singular entity, but they also suggest how repetition and accumulation become a way in which we can experience the many as a plurality. In his work, zooming is an operation by which relationships between the one and the many may be interrogated. Importantly, this is zooming not as a click (+ or -) or a swipe of the fingers, but an encounter with numbering via a body in motion through a non-screen based space and time.

Depicts two million plastic beverage bottles, the number used in the United States every five minutes
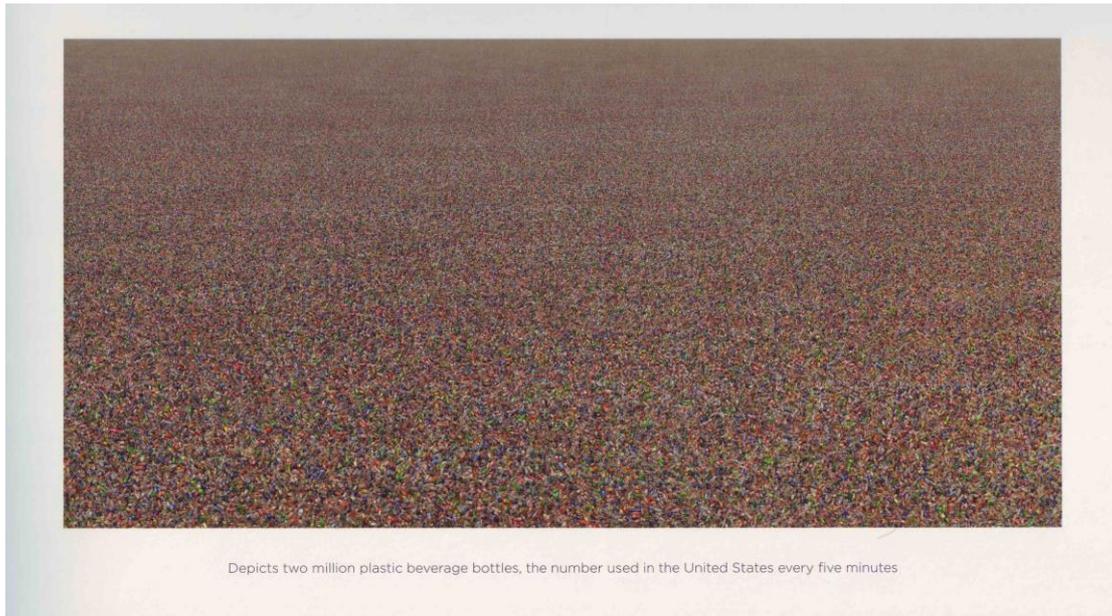
Chris Jordan Plastic Bottles, 2007   60x120" (credit: Chris Jordan)
Depicts two million plastic beverage bottles, the number used in the US every five minutes.

In the series of images titled *Running the Numbers: an American self-portrait*, Jordan creates vast composite landscapes (Jordan, 2009). Although generated using photo-editing software, and adopting similar assumptions about the affordances of zooming as applications such as Google Earth, Jordan's attempt to put 'big numbers' into an aesthetic register departs from those associated with the interface of the computer screen. The optical revelation happens as we physically approach or distance ourselves from the large-scale 2D artworks hung on the gallery wall. From a distance, an image – not clearly abstract or representational - appears to the viewer. As the viewer moves closer the repeated constituent element becomes clear: the plastic bottle, the Barbie doll, the SUV, etc. In the encounter with number as one-dimensional quantity (1+1+1), Jordan encourages our body to operate the zoom – to move closer - to experience a qualitative relationship of the one in the many; to move away again to perceive a surface which resolves into another image – another 'one' that is simultaneously a many, a (vague) whole.

Chris Jordan Plastic Bottles, 2007 (detail) (credit: Chris Jordan)

Each singular part or unit, such as the plastic bottle, functions as a pixel in a larger image, but is also chosen by Jordan for its part in a social and political narrative. Thus the plastic bottle is chosen for its resonance with environmental damage, the cigarette with toxicity, and the Barbie doll signals a particular kind of normative femininity. As well as being an attempt to stage an encounter with bigness, Jordan's work makes use of specific statistical facts that are leveraged as part of the aesthetic encounter. Repetition constitutes the formal artistic strategy – enacted through repeated photographing and digital editing. The artist observes that his work aims to show "the actual quantities of things, rather than just big piles of them" (2009:5). This concern with quantity in terms of what Jordan sees as American culture's endemic problems of waste and excess makes the experience of number something that is intimately linked to the question of what action will be taken by the viewer after viewing the image (http://www.ted.com/talks/chris_jordan_pictures_some_shocking_stats). In relation to Jordan's work, the artist Lucy Lippard reflects, 'The time it takes to move from expansive visual intricacy to close-up specificity is momentous' (2009:16). Clearly the literal time of approaching the 2D image from any point in the gallery need be no more than a few seconds; what Lippard is pointing out is how zooming provides a way of adding duration to the 'time' of participating in the relation between one and many. This imagery provides a challenge to the assumption that information related to numbers, counting and measuring must be quickly apprehended – in 'real time' through data visualization - to be acted upon.

2. Folding

In a fraction, the number above the line is known as the numerator, the number below as a denominator; the fraction is a figure representing a total population or whole in terms of enumerated units or parts. Rather than seeing this as an already completed act, we can consider fractions in terms of an activity or process of folding: the folding of a denominator into a numerator, an activity in which a whole is folded into, across or within itself to make parts. This folding can produce parts that are proportionally 'equivalent' versions of the whole. For example, if you fold a square piece of paper

along its lines of symmetry, the edges of the paper come to coincide with each other, but the surface area of the paper is reduced proportionally.[8] In this process of folding and unfolding, it becomes clear that while the denominator of a fraction is a 1 (a whole), that 1 may itself be a part or numerator (a 1) of another whole or denominator (1), and so on. So the activity of folding can be seen in terms of a potentially unlimited series of part/whole/part/whole/part/whole relations that are simultaneously number/name relations.
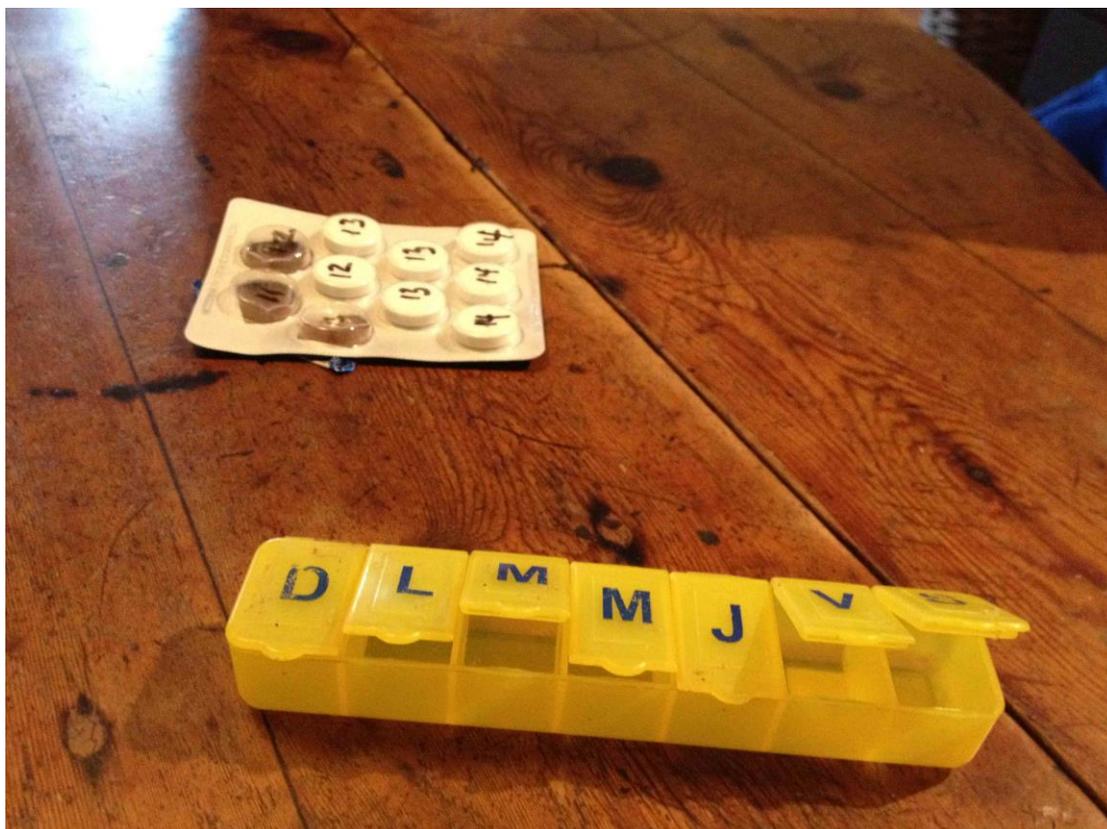

Sophie Day, Names and Numbers, 2013

Of course, 1 whole/part can be folded into 1 part/whole in many different ways. Think about what happens if you fold a square piece of paper without respecting its lines of symmetry; you will find that the edges of the folded paper do not coincide with each other. The parts produced by this folding are still proportional as determined by the angle and position of the folding – including those described as the golden ratio, or the golden mean. This fraction is a ratio of considerable interest to artists as well as mathematicians as in the image below, a work by Dorothea Rockburne. But, in folding, the parts may either not reach to or they may extend beyond the previous edges of the paper. The activity of folding has moved the paper into and through another dimension in such a way as to reveal a new, perhaps 'smaller', perhaps 'bigger', whole that was always implicit in the paper, a whole or wholes that the activity of folding makes visible.

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[8] As Guyer notes, uniform proportionality of denominations has been built into systems of weights and measures for almost a thousand years in Britain, linked to concepts such as fairness that 'give uniformity an ethical cast that continues to this day' (this Issue).
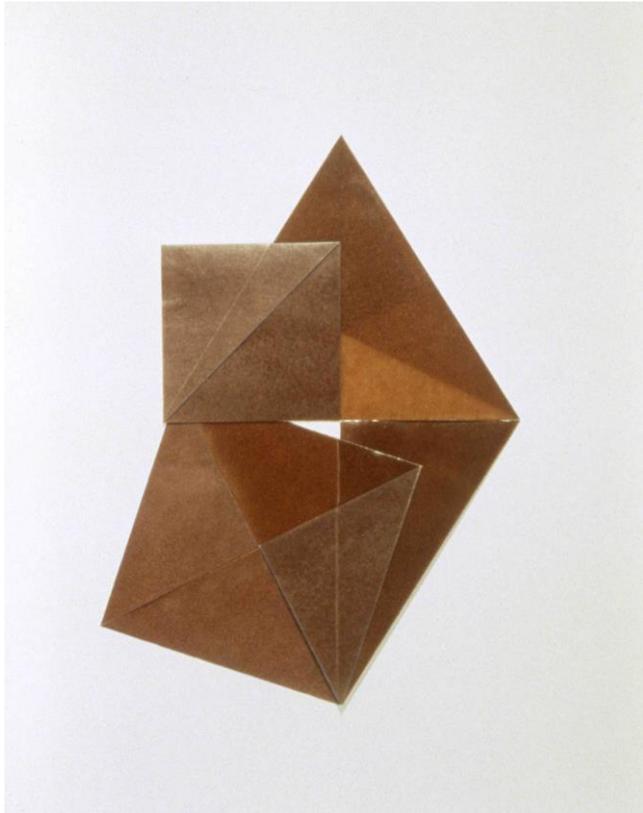
Dorothea Rockburne, Copal 15, 1977
Kraft paper, varnish, pencil, tape on ragboard (39 x 29")

In describing a work by Rockburne that employs carbon paper, folding and a wall or floor, (*Neighborhood*, from the series *Drawing Which Makes Itself*), the art critic Rosalind Krauss says that it is an act of recording a set of limits (edges?) that are in fact external to the space of a piece of paper or figure: 'It is a work that defines with striking economy and exactitude the way in which boundaries adhere, yet do not belong to the figures that generate them and that we assume they delimit' (2010: 221). Rockburne's drawing that makes itself is a demonstration that folding a whole into parts can make new wholes. The space of the paper or mathematical form (which we can also think of as a set, category or class of members of a population of, for example, bacteria, genes or people) has possible boundaries or edges beyond those that are evident in its initial (re-)presentation.
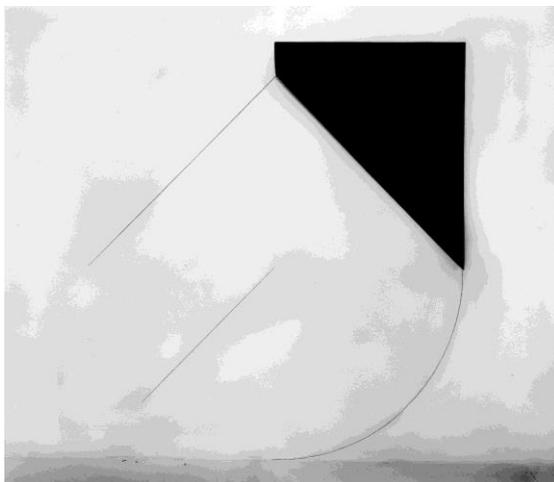
Dorothea Rockburne, "Installation Piece: Arc." Carbon Paper, Graphite on Wall, 70 × 60" (Dimensions Variable)

Thinking about fractions in terms of folding thus allows us to understand how a class, set or group may be considered as what Verran (2007) calls 'vague wholes'[9], and indeed to begin to address how it is that numbers such as fractions and percentages may be deployed to produce what Guyer calls 'a kind of permissive vagueness' (this issue). As Guyer observes, the assumption of a vague wholeness produced by the use of 100 as the fixed numeric denominator for a percentage (which may be represented as a fraction) can impel or im-part a quest for completeness as the use of percentage moves from being a descriptor of proportion to demography, to policy matters on value for fiscal purposes, to probability and risk in ever more varied contexts. The quest for completion may be conducted in many different kinds of way:

> … as in 99%, the public's own sense of how to create "completion" for themselves; or perhaps there are implicit criteria for completeness, such as logical internal coherence or exhaustion of the envisageable organic or systemic feedback cycles. In economics, one can ask whether equilibrium has become ever more indexed to a long-term coherence that can be mathematically modeled and to a short term efficiency of immediate variable-calculation, both of which differ from the awkwardly organic and indeterminate interactionism – confusion? - of the mid-term (the "near future"). (Guyer, this Issue).

3. Scoring

Folding may also be performed as scoring, the activity in which the line, divide or fold (of the fraction) is transferred into the medium of the surrounding or surround (multi-dimensional context), leaving a mark that maps some of the possible edges of the vague (as yet unspecified) wholes that are present within a figure. Indeed, in Rockburne's *Neighborhood,* the 'definition' of the limits of the whole is not metaphorical but is, rather, established by the scoring of lines (Ingold 2007) that function as a material element of proof. Krauss says:

> There, as the [double-faced] carbon paper is moved into interlocking stations on the wall (or floor), the positions of its internal folds are transferred onto the wall plane by scoring the paper along the creases. The act of scoring simultaneously deposits carbon onto the wall surface and underlines the fold of the paper itself. The resultant lines or marks are read with a striking ambivalence, for they are both on the wall and yet are retained within the carbon paper that had been flipped into a new position. (2010: 221)

She continues,

> The act of drawing is thereby conceived as different from the traditional procedure in which a set of objects (lines) is superimposed on another, foreign object (paper). Instead, one

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[9] Vince Miller says, 'Vagueness has been a part of the philosophical landscape since the time of the ancient Greeks, where the Sorites paradox queried the notion of precise identity ... The Sorites paradox posed the question that if we agree that one, or two, or three proximate grains of sand cannot be rightly called a "pile" or "heap" of sand, at what point will one additional grain of sand create a pile? Thus, a pile or heap of sand can be seen as possessing vague or indefinite properties. This "problem of the many" extends to a wide manner of objects and categorizations we take for granted' (2006: 255).

confronts works in which the lines arise from information that is 'in' the paper. And the logic of the works states the self-evidence of the fact that this information, although it could be transferred to different situations (on the wall), could not be dislodged from the mediating body of the paper that is the source of the information. … The lines on the wall, by repeatedly marking the changing edges or limits of the paper field as it moves through its various rotations or reflections, are declarations of the boundaries or approaching limit of a changing set. For, in terms of a topological space, … those points that are within the actual field of the sheet have limits that also belong to the sheet. [But] the limits (or neighbourhoods) of the edges of the paper lie outside it. (2010: 221)

Folding or fractioning is the recursive, logical (ratio-making or proportion-ing) activity carried out by many ranking devices including the example, Klout, discussed by Gerlitz and Lury. This is the name of both a company and its proprietary measure of influence in social media, which it has developed to provide a personalised Klout Score for users - a number marking a position along the drawn, traced or scored line of the fold or fraction:

> Klout takes as data records of activities pre-structured by a number of social media platforms, including tweets, retweets and replies on Twitter, comments, wall-posts and likes on Facebook, and comments, re-shares and +1s on Google+ (Klout 2012), and puts these continuously updated data points in various kinds of recursive relations with each other to calculate a Klout Score for each Klout user or participating individual. The score is a (whole) number between 1 and 100. (Gerlitz and Lury, this Issue)

We can see how the making of measures such as Klout preserves and extends the activity of folding by scoring the lines of the fold or fraction, setting the terms of the proportions between parts and wholes, wholes and parts by presenting parts as units, and providing a calibration according to which the folding of one part/whole relation may be compared with that of another part/whole relation. Scoring thus involves measuring here, even if both the denominator and the ranking structure (or series of foldings) often become invisible in the provision of the single number as score, as in this case.

A studio piece by Mel Bochner turns the work of measurement into a puzzle, problematising the measure as a stabilization of the scoring of a part/whole relation. This piece consists in a line on the wall, identified as a measure by the inscription '25"'. Bochner writes,

> The first measurement 'piece' I did was because I was unable to put anything on the paper. Nothing at that moment seemed meaningful enough to note. I had two sheets of paper on the wall which I was just looking at. Suddenly I saw the space between them. I saw that it was as much the subject as the paper. I measured that distance and drew it on the wall… When I took down the sheets of paper I had the measurement alone. It puzzled me. It still puzzles me. What does it mean to have 25 inches drawn on the wall? (In Richardson, 1976:12)

The critic Brenda Richardson writes of this piece,

> The radicalness of this particular studio piece was not in marking on the wall the 25-inch measurement between the sheets of paper, but in the act of then removing the paper. It was the recognition that the 25" notation was somehow no longer a part of a larger whole (that is, a three-part construction of two sheets of paper and a measurement) but comprised the

whole of the work itself that seemed so puzzling and now seems so remarkable. (1976:12-15)

As she continues, the puzzles are many:

> … measurement of what? 25 inches from what point to what point? where were the edges of the "piece"? what comprises a boundary? what is inside and what outside a given measure of length or width or height? what can or cannot be measured? by what criterion is any unit of measurement determined? how verifiable is a measurement? does a measurement's verifiability depend on the action and/or perception of the measurer? or the viewer? (1976: 15)

What these questions introduce is the issue of value: the piece shows how measures not only provide a means of calibration; they also introduce a way of sizing or, rather, of shaping, of giving form, to measure as value, even if it is only the value of one-dimensional or linear quantity that is produced in the folding (and scoring) of ratio-nality that produces proportional equivalence.[10] As Whitehead says, '… beyond all questions of quantity lie questions of pattern, which are essential for the understanding of nature. Apart from a presupposed pattern, quantity determines nothing. Indeed, quantity itself is nothing other than analogy of functions within analogous patterns' (1968: 143).
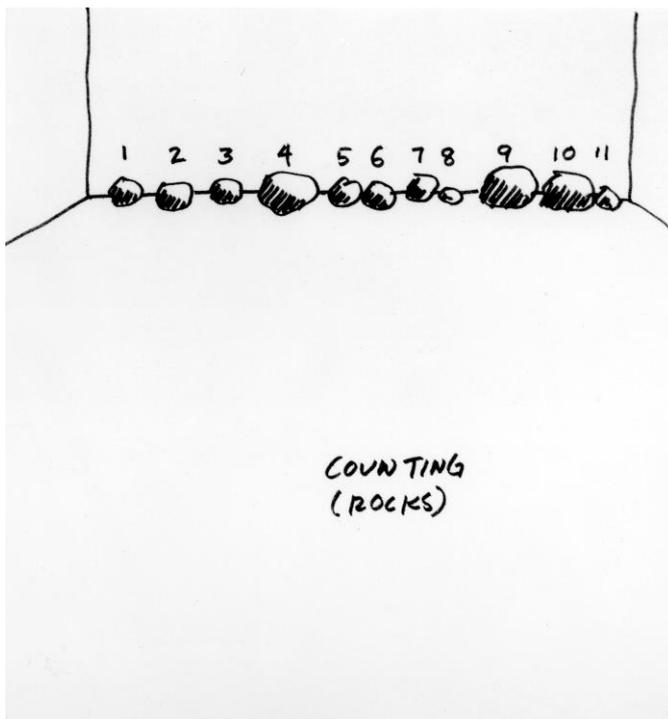
Mel Bochner, Counting (Rocks), 1969

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[10] Jane Guyer (this Issue) gives the following definition of percentage from *The International System of Units*:

> In mathematical expressions, the internationally recognized symbol % (percent) may be used with the SI to represent the number 0.01. Thus, it can be used to express the values of dimensionless quantities. When it is used, a space separates the number and the symbol %. In expressing the values of dimensionless quantities in this way, the symbol % should be used rather than the name "percent". In written text, however, the symbol % generally takes the meaning of "parts per hundred". In such definitions, the potential for vagueness is removed.

Black ink on paper 8$^{3/4}$ x 8$^{5/8}$″

In *Counting (Rock*s), (1969) Bochner draws a line of rocks, positioned on the floor against a wall (a line-up), each rock being numbered from 1 through to 9, but each being of a different size and shape. This simple variation in the size and shape of the representation of numbers undermines the assumption that a given numeral has a fixed and constant denotation, that is, that it is a measure that has a fixed unit, what Badiou (2008) calls the count for one. The image puts the ordinal (or ordering) capacity of numbers into visual tension with the cardinal (the numbering capacity that says how many of something there is. Together they are the numerical capacity not only to enumerate size – how many? - but also to give shape or form.[11] Similarly, when Adrian Mackenzie quotes Nigel Thrift's remark that `number tends to cast the world reciprocally in its image as entities are increasingly made in forms that are countable. Number performs number,' (2005: 589), it is to suggest that the forms of life are not simply enumerated in ways that make them countable but also through convolutions, in which qualified quantities are multiplied together in complex chains. As Mackenzie says, 'The intuition for convolution is more like plotting the shadow cast by an object as it moves in front of a light source. The shadow changes depending on where the object stands in relation to the light. The convolution integral, then, is an anamorphic shadow'. Such convolutions 'are one place where we see how numbers can generate space-times that re-configure existing planes and surfaces of life' (Mackenzie, this Issue).

The tension between the ordinal and the cardinal is what animates ranking systems such as Klout in which the activity of valuation precedes the sizing or shaping of value – in such cases it is the opportunities of the space-times of multi-valence rather than equi-valence that are explored (Marres and Lury, forthcoming). How so? The activity of ranking in Klout is one in which the relation between order and value is produced by a proprietary algorithm that sequences a series of folds in sets of data-points across various dimensions (or variables) to produce a scoring scale or measure without presuming the shape (or relation between ordinal and cardinal) that is to be produced. In this case, while the end-points of 1 and 100 appear to contain or limit the unit of measure, the size and qualities of the whole that comprises the denominator – the data points produced by the changing activities of a changing population of social media users – is itself not fixed, but is, rather, in a constant state of flux. The Klout score is a measure of a sequence of folds (folding and unfolding) in a whole that is itself constantly changing as it is folded; it is a participative measure of dynamic participation. As Gerlitz and Lury observe, this is not to say that Klout is not supported by a system of distributed and well-ordered value, only that valuation precedes the fixing of values in measurement; value is emergent in what Mackenzie calls convolution or shapeshifting.

Bochner's *Study for a Theory of Boundaries (At/In)* (1969) is a powerful depiction of this process. In one of the works that comprise this piece, an instance of what Bochner calls 'language fractions', the brown pigment that makes a square situated in relation to three perpendicular axes (most often given the algebraic nomenclature x, y, z) is not fixed by these dimensions, but is in movement: the colouring of the brown pigment representing the activity that is captured by the sequenced fraction or algorithm described as 'at/in' is a demonstration of the shape-shifting capacities of participative measures in permissive wholes (see image below). Bochner suggests that language-fractions are ways to test the boundaries of pre-positions such as *at* and *in*, or *in* and *over*. In these works, the prepositions are not defined by the words, but by the use of colour (as Chilver, this issue, argues is

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[11] Think here of the composition of what are commonly known as 'square' or 'triangular' numbers.

also true of Mangold). Guyer suggests that contemporary uses of percentage, in which both denominator and ranking structure are invisible, involving the combination of familiar categories with their own implicit mechanisms of completion and permissive vagueness, are contributing to the rise of the logic of possible worlds. As she observes, in such a world of multi-modal logic, which shades into what she says anthropology would recognize as "the dreamtime", that is, "things as they are" (Jackson 1996) for people living in other cultural, historical and existential contexts, the practices of producing relevance (out of equi- or multi-valence) are what becomes important.

> At the outer limit both the vagueness and the whole may even fade from consciousness, in the sense that most participants in some communications may have no precise idea of the denominator in a percentage statement and yet are not too worried about that. We become accustomed to the 30% chance of rain: the 10% decline in the growth rate of the GDP; the 25% rise in obesity. (Guyer, this issue)

Both the examples that Dawn Nafus and Gerlitz and Lury discuss suggest that it is possible to use participation as a way of cultivating relevance, a way of tending the process of shape-shifting from one (numerical) form to another. In the case of Klout, what matters is whether and how the Scores the company provides can act as tropic points, a term that Guyer uses to describe the attachment between numerically expressed scales for the purposes of transactability. These tropic points are hugely significant in making links; as Guyer observes, they provide the coordinates for shaping existing complexity that is currently being technically and rhetorically deployed in a variety of socio-technical assemblages as the platform for simplified – or purified – virtual projections into the future.

4. Pausing

As Dawn Nafus shows in her contribution to this issue, number compositions include pauses or intervals that incite participation and enable reflection. If this pause can be compared with practices of zooming to/from the most granular level or finest pixellation (as we have noted above), it also suggests a process of stopping and starting that repetitively gathers a collectivity. As Guyer (2010) emphasizes,

> Between moments when the process stops for the ratings to move in, all participants relate to one another continuously and competitively. The results seem very close to what Bateson (1958[1936]) called 'schismogenesis': the continual reproduction, confirmation and intensification of difference, which is then ritually marked when the process itself is momentarily suspended, as if for collective contemplation and affirmation. (Guyer 2010: 4)

We ask: what happens in the moment of the pause?[12] This moment is illustrated in Cathy Wilkes' installation, *I give you all my money*, which was originally shown at the Turner Prize, 2008 and recently part of a group show at Kunsthaus Bregenz (2013) called 'Love is Colder than Capital: An Exhibition about the Value of Feelings'. Six images from the show are available at http://www.themoderninstitute.com/exhibitions/4849/images; they show details of a scene featuring two mannequins waiting at a deserted and cavernous supermarket checkout. The piece gives us cause to ask: have an individual's goods reached the end of the line, stopping the conveyor belt for a bit? Is the check-out person pausing while the next customer assembles her things? Or is it a longer interval that allows a counting and accounting: do the numbers add up correctly in the day's tally of what came in and what went out; what is the profit margin?

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[12] This is a significant question in the history of mathematics as it raises the problem of continuity and change (Buckley 2012).

When we inhabit the moment of the pause, we can catalogue the stilled objects: contemplate the collection and perhaps the scene. Do the objects share some family resemblance (Wittgenstein 1953); has the repetitive bringing together of people and things in prefigured ways allowed us to see how their shadows merge - mannequin, prosthesis, comestible - or enabled an entirely new scene as we focus or zoom in, little by little, onto the checkout itself (see website, 6th image)? Pausing or freezing numbers, as scores, prices or positions, gives us the opportunity to order, re-order and value forms of measurement differently. Do we compare one dessert or one drink with another on this conveyor belt? Do we respond to the distribution of objects on the belt, and the gaps between? Does the arrangement lead us to focus on individual forms: are those all handles attached to their objects or are some of them spoons or perhaps pens? Can one type of item be considered equivalent to another or is each distinct and incommensurable?

Although we tend to emphasise movement, stopping is no mere epiphenomenon. These pauses are not inessential nor do they simply disrupt production and normal life; to the contrary, they belong to our expanding worlds of rating, ranking and tracking and to everyday processes of calculation. They are, for example, fundamental to the use of 'compartments' in the epidemiological models discussed by Mackenzie, this issue, contributes to the slowing down of the progress of influenza that the model affords the epidemiologist. Mackenzie writes,

> Members of a population are treated as if they are in one of several states or compartments, and the model describes how they move from one compartment to another. The number of compartments and the possible moves between them vary from model to model. Infection occurs at different rates, so at any given time, the affected population will be made up of individuals in different states or compartments.

In this image, the pause is *part of* an endless movement where items and people are tracked and reconfigured. But such pauses can also freeze numbers in other ways. For example, through pausing, numbers can be detached from their referents in the way Guyer discusses percentages in this issue. They can also be assessed and considered more or less provisional, dodgy or persuasive, in the way of speech acts. Intervals are temporal as well as spatial. One of the (here to be consumed) items will be checked out before another; they are listed in what will become a linear printout enumerating the items and their costs.

The pause enables reflection, as Guyer emphasizes, assembling observers and observed, enabling an individual and a collective valuation that may be stepped, allowing for both observation and the observation of the observing, in such a way as to support further folding. For – in and of - a moment, entities are held together as well as apart. Bourdieu (1977) argued that the gaps between giving, receiving and returning open the strategic spaces of world-making and politics, as in the marginal gains Guyer considers in her studies of West African economies (Guyer 2004). Pacing and spacing will make some forms of comparison or valuation more visible than others and make these shapes into the quotidian forms of social and cultural life, such as the list, the queue, the inventory or the genre.

5. Knotting

Knots may also make intervals, but they also can be thought of as a way of fastening a number in place. Knots do not necessarily provide a stop but may rather involve some kind of *looping* by which fastening is achieved within movement (as in blanket stitching in which an edge is secured), and this combined operation offers another way of thinking through number's encounter with time, space and material visual forms. By repeated looping and fastening, knots may accrete or accumulate in a

variety of ways. Think of the consequences for the resulting surface and form, for example, of knots in embroidery, tatting, knitting and crocheting (http://crochetcoralreef.org/contributors/margaret_wertheim.php). One way to think through numbering as knotted form is to look at the difference between knots used as static, singular entities and those deployed to invoke proliferating chains or nets. Thinking about how knots fix or gather (compose) numbers also involves considering more specifically the materials of knotting, and their affordances to make ecologies. Donna Haraway argues forcefully for this concern with the precise form the knot takes:

> … it matters what matters we use to think other matters with; it matters what stories we tell other stories with; it matters what knots knot knots, what thoughts think thoughts, what ties tie ties. It matters what stories make worlds, what worlds make stories. (2011:4).

Textile artists have long used knots as fixings, and some textile art of the 1960s and 1970s abandoned the loom in favour of three-dimensional structures (Smith, 2011). Other artists not working primarily in textiles have also experimented with forms made purely as a result of the knotting process. Mira Schendel's *Droguinhos* are knotted objects that were the result of twisting Japanese paper into ropes that were then knotted and re-knotted to make three-dimensional forms. Luis Perez-Oramas has pointed out that these forms were intended to create bounded entities, which reflected Schendel's concern with the boundaries of sense-making and the limitations of language: "For Schendel … the knot is literal, static, solid: it is the word as a tie, and it is also, in the *Droguinhos*, simply a knot formation, a knot knotted only with itself, connecting to nothing" (Perez-Oramas 2009: 32).

When numbers knot together they may also create the impressions of a form that is entirely closed, numbers performing numbers, perhaps numbers that are the consequence of the operations of functions that Mackenzie describes in his discussion of an equation to model influenza. Alternatively numbers too may use a uniform material to fold, twist and knot themselves into other phenomena, as Guyer suggests for the percentage. Even for Schendel, the knots do not really achieve a connection to nothing. The *Droguinhos* are never far from being supported or carried or more simply being touched or stretched, as in the photograph that accompanies Perez-Oramas' essay, where one knot is being carefully eased apart by two hands cut off by the frame just above the wrist (2009:33). This attempt to inspect the inner workings of the knot creates not an untangling, but a new kind of knotted surface. Schendel's knotted forms are resolutely handled and touched; the knots are given relations to each other that are determined by the physical properties of the twisted paper and the size of the hands that make them. Participation in other number compositions will likely be similarly embodied.

Knotting can also be undertaken as an activity that explicitly reaches onwards or outwards, such as in the use of netting by Gego (Gertrude Goldschmidt). For this artist, knotting is a way of creating links that point to the impossibility of a limit or boundary. Perez-Oramas writes of Gego's knotting, "it is conjugated in terms of deferral – of the center, of completion, of the border or edge" (2009:32). Gego's nets sit somewhere between line drawings and three-dimensional structures, occupying what one commentator calls the "in-between dimension" (Ramirez, 2006: 24), holding open other dimensions in which folding makes parts from wholes and wholes from parts. For Gego, making connections through knotting involves exploring the architectural space of, for example, an art gallery, through organic and proliferating twists and knots of wire that hang from ceilings. These knots have more generous intervals along the lengths of the knotted materials, and yet also still hold together a structure in space. The body here moves through and around the knots – it is not a zooming in and out, but rather a circulation through, a being with.

Knots may also be another way of adding time to counting. One knotting system – the 'khipu' or 'Inca accounting' system - is a form through which we can investigate not only the measuring and storing of numbers, but the slippages between counting and writing. Unlike data visualizations that permit zooming in and out, khipu accumulate and accrete forms along a string, cord or similar line. The 'primary cord' is hung with secondary 'pendant cords' to which further subsidiaries may be attached. The result may be displayed as a curtain (with the primary cord held taut) or as a form in which pendants radiate out from their points of attachment (with the primary cord as a curve). Made from natural fibre, usually cotton, khipu are rolled up into spirals for transportation or storage. This rolling up recalls the movement of the knots in Schendel's work; a reminder that knots move not just along a rope or string but also may involve other kinds of gatherings. Referencing the writings of Bruno Latour, Katie King asks us to consider knotting as things or assemblies that convene stories (http://affectdesign.blogspot.co.uk/p/slides.html).

By handling and manipulating the properties of khipu knots and their constituent fibres, the 'accounting' which these cords are able to enact are intricate, and provide a way to think beyond the knot as a condensed and undifferentiated 'one'. Indeed the word for this knot itself carries the meaning of both singular and plural. The ethno-mathematician Gary Urton, who imagines khipu as if they could be understood through computer machine language, has elaborated the seven types of information which are 'coded' in the knots: (1) the precise material a string is made from (2) the colour class of each string (3) its spin/ply relationship (4) how it is attached to other cords (5) what spin or ply direction the knot is tied in (6) which of two number classes it belongs to (7) which of two types of khipu string it might be: one for recording numbers or (8) for recording histories (Urton, 2003). What is significant is not only the sheer complexity that these knots are able to engage in relation to number, but also the speculation that khipu knots provide an example of forms which could hold together all kinds of reciprocal relationships and stories, including, as Urton states "poetry or other ritual, canonical narrative forms" (2003: 48). They are a "data-sense medium whose clarity did not depend on expansion into words" (Salomon 2001: 26).

5. Accreting

Michael Landy (2001) made an inventory over a considerable amount of time as he compiled a list of a lifetime's gatherings, comprising 7,227 items. Listing, as Chilver (this Issue) shows, is an aid by which we include and exclude, add and subtract, remember and forget; in Landy's work Break Down (2001) and in an accompanying drawing it takes the form of an assembly (or disassembly) line.
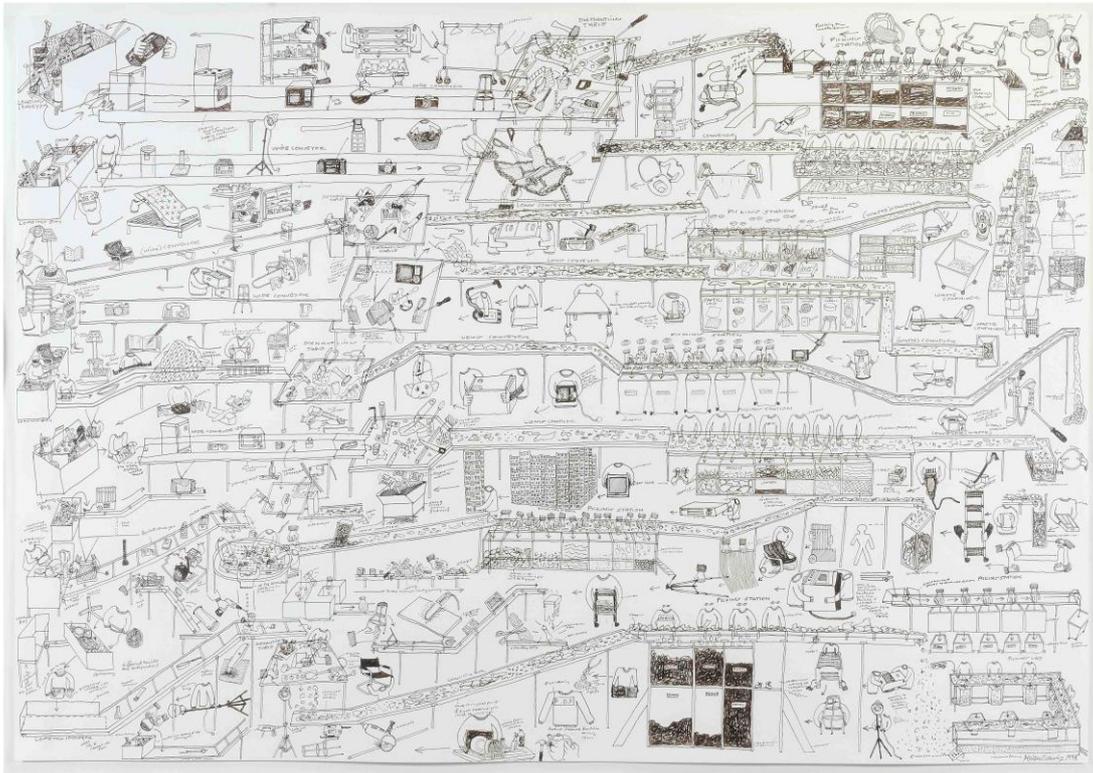
Michael Landy, P.D.F. (Product, Disposal Facility), 1998
(image courtesy Thomas Dane Gallery, London)

In a reverse move from the checkout stop/pause discussed above, we see Landy and his belongings in motion at a former department store in a major London shopping street (Oxford Street) where, according to Artangel, 'Landy's consumer nightmare was displayed during a fourteen day period of systematic de-construction', a version of the process through which valuable goods are recycled and reclaimed (turned again to waste and buried in a landfill). [13]

The large infrastructure for disassembling or reassembling a lifetime's gatherings took a circular form with two figures of eight looping around four bays in which operatives worked. An accompanying video has the title, 'The factory line'; this line can be considered continuous, taking the form of a circle powered by a continuous loop; "circulating on a roller conveyer". We are told that, "the stuff of Landy's life was classified into ten different categories – Artworks, Clothing, Equipment, Furniture, Kitchen, Leisure, Motor Vehicle, Perishables, Reading Material and Studio Material." These categories then mobilize operators who occupy just a section of the line, possibly addressing a category of the life or, more likely, a stage in its disassembly, "It was then systematically smashed, pulped, granulated – whatever it took to destroy it entirely" (Artangel, *Break Down*, 2001; Landy *Break Down Inventory,* 2002).

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[13] Images of this work can be viewed at Artangel's website:
http://www.artangel.org.uk/projects/2001/break_down

Michael Landy, BREAKDOWN, 1998
(image courtesy Thomas Dane Gallery, London)

Insofar as this dis/assembly images accretion, we can take the perspective of the video maker whose camera takes in or 'tracks' the whole process, accreting each stage of the assembly to the picture. Nina Wakeford proposes the image of a snowball, gathering up snow, amassing weight as it moves along. This moving along suggests a spatialised motion that is a complex product of combining, collaborating or weaving together different views of and from the line. In both video and the extensive still imagery that have documented the assembly line, this process of tracking often looks as though it follows behind the process of production although in fact it traces a unique view that does not correspond with any other. It does not exactly follow the product or the operatives and nor does its 'bird's eye' position, looking down and along, capture that of manager or designer.[14]

Although it is beyond the scope of this glossary to explore the role of photography and film in composing assembly lines, Simmel's social theory shows, in Kemple's view, "how the logic of the assembly-line takes on the aesthetics of the cinematic spectacle with its techniques of editing, framing, attention and montage" (Kemple 2007: 15). We can only observe how camera angles and techniques compose practices of accreting in different ways. Single long-shot tracking techniques, for example, tell a story through accretion in *Russian Ark* (dir. Alexander Sokurov 2002) while the collaboration between Pierre Bismuth and Michel Gondry, *All Seeing Eye* at <http://www.youtube.com/watch?v=LNQH-UknEnE> shows subtraction as also in Gondry's film, *Eternal Sunshine of the Spotless Mind.* In this case, a camera/editing process following product, operatives and/or managers composes a single line. From the camera lens, the line might be imagined as it carries on behind closed doors and outsourced across the world, anticipating perhaps the desired outcome of efficient production.

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[14] See also our reference above to the Eames' line (page X).

In the work by Landy, the camera pulls in what from the perspective of 'the product' will be more discontinuous. From a determinate beginning of the line, the rollers move yellow boxes full of Landy's belongings towards completion, adding a bit at each pause or stage, in the way of a sum, $1+1+1^n$. This process of accretion normally folds into the product for we less often think of the stage at which a car is painted than of the car that arrives, complete with paint. From the car's perspective, however, this movement is not continuous and the end is not prefigured in the beginning; it is simply a series of stops and starts. So too does the camera pull in worker or operative, the most common sociological image of capitalist production, who is also moving, sometimes with and sometimes across the line not with it.[15] In the latter case, he or she sees a small part of the line, a single section perhaps. S/he may be a 'cog' in a team or work as an individual, joined or added on to others in the way of the parts added on to the product.[16] From her or his perspective the line is largely invisible. And so accretion, from the operative's perspective, is a very different matter of adding up minutes to the sum of a working day or anticipating units accumulating in the weekly pay packet. Accretion here refers to repetition across a segment of the moving line orchestrated by or in relation to an imagined community that integrates all of the moving parts.

On this assembly line, we suggest, integration is 'imagined' and anticipated in the desired efficiency that results from collaboration and complexity. A stop calls to mind various forms of break down. Machines halt. Workflows within your environment, either side of you on the line, are interrupted. Is it the supervisor who refuses to give you tasks to do so that you lose the bonus anticipated from exceeding your benchmarked quota/rate? Are the porters having a cigarette break or has a dispute broken out somewhere along the line? Is management failing again to queue and align processes and people in the right order? Who or what waits when and where along the line points to the incommensurability of different perspectives and towards the points where accretion or accumulation matter most in this choreography. Who or what stops the line? What happens in the event of a stoppage? What makes the line start again? Stoppages have become famous in stories of evolving production techniques, largely around securing compliant or committed labour. Whereas it is said that workers were prohibited from stopping the line in Ford for any reason, Toyota is credited with advancing quality control through the now mythic story of progress in which workers were encouraged to halt production whenever a problem arose, calling all to their aid until the issue was resolved and apparently giving Toyota its historic market edge. More commonly, stoppages indicate struggles over surplus value and the distribution of shares. The consumer too belongs to the line in these various forms of accretion, and is credited with forcing the shifting temporal values of 'just in time' production as opposed to 'storage' for the future, associated with distinct labour and space costs.

This composition of accretion directs counting and number toward and along the line and simultaneously obscures or sidesteps questions about the ecology. What about the environment around the line, and how to conceive of one activity in relation to another; what is their relative

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[15] In some Ford factories, the organization of the assembly line had four 'sides', some of which moved with the work-- some operatives would ride on the cars doing their work, while others worked beneath the cars in pits, or on trolleys that were attached to, and pulled along with the cars.

[16] See, for example, Sally Westwood's workers who did not appear to be 'on the line' because they were organized into units with a supervisor (Westwood 1984). These women "were at the end of the production process and the co-ordination of the other processes was not always as streamlined as it might have been. A blouse, for example, would come into the department ready-cut for only half the sizes required by the customer, in the wrong colour and with parts missing. Delays and frustrations seemed to be an ever-present part of the production process." Work in this case was not delivered by a conveyor belt but by a supervisor, responsible for the workflow.

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importance, what proportion of the line do they occupy; what procedures might permit a fair distribution of shares in relation to the enterprise overall? Since the line you know and see is only part of what you imagine stretching across many hubs of activity, you cannot deduce the context in which activities of commensuration would yield any reliable measure or sense of equity.[17]

6. Diffracting

We may also talk about numbering in and of repetition – of similarity and difference, of zooming, folding, knotting, pausing and accreting - in terms of the activity of dif-fracting, with its etymological roots in Latin: from the past participle of diffringere: 'dis-, *apart*; see **dis-** + frangere, *to break*; see bhreg- in Indo-European roots' and of the notion of genre. In contemporary scientific uses, diffraction refers to:

> … the phenomenon exhibited by wave fronts that, passing the edge of an opaque body, are modulated, thereby causing a redistribution of energy within the front: it is detectable in light waves by the presence of a pattern of closely spaced dark and light bands (diffraction pattern) at the edge of a shadow. (http://dictionary.reference.com/browse/diffraction-pattern)

In the emphasis on the constitutive role of the boundary or edge in making patterns, Bochner's work is once again illuminating. He says of the series of works that comprise *Monoprints*, in which words taken from a Thesaurus are printed on paper, that their inclusion is dependent on the boundary conditions of the paper:

> I start with a list of words copied out of a thesaurus and arranged and rearranged to fit a certain format. I don't consider these things to be poetry as such, but I am interested in a certain kind of rhythm or meter that develops through the words. There's a very strong boundary situation created by the proportions of the rectangle to the width of the line. There are only so many characters I can get on a line. At a certain proportion, I can get, let's say ten characters on a line. So I have to work within that set of constraints. Think of it as something like the visual equivalent of the sonnet form. (Bochner and Schwabsky 2012: 64)

The process Bochner describes produces a rhythm or meter. It is a measure that decides the terms of participation, of inclusion and exclusion and relative positioning within a belonging. Whether and how inclusion is made co-incident with – or equivalent to – belonging is critical to social and economic conventions and measures of value as fractions or fractals, in stepped systems of proportion and predication and the associational ripples of mimesis, of participation and similitude. In the case of Klout, for instance, the Score that is produced is a demarcation or mark that measures along a fold to create an edge or verge, across which data is made to move, producing diffractive patterns, middles of inclusion and belonging that are never quite closed. So an edge or limit does not simply mark a discontinuity; it generates the relations between inclusion, exclusion and belonging.

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[17] Thanks to Jane Guyer for drawing our attention to differences among 'information societies', not all of which are premised upon principles of accreting, hierarchy and control. In Equatorial Africa, she and Belinga argue, 'wealth in people' cannot be understood in terms of control, domination or accumulation. 'Wealth' is not additive in a numerical sense but rather a composition of different elements (Guyer and Belinga 1995). They suggest that wealth in knowledge provides a more helpful perspective on the region since it points to singular and specific compositions that simultaneously involved a specialization in the division of labour 'carried to absurd lengths' (1995:116).

The significance of this understanding of diffraction or patterning can thus also be framed in terms of the role of edges, limits or boundaries in processes of making classes, kinds or genres, that is, in terms of the setting of limits, drawing lines and making circles, sets or groups. In the image below, a line on the floor composes a circle, presenting the circumference as an edge of inclusion and exclusion, but the words of this language fraction remind us that the agreement of a manifold with a unity is (at least) double, indeterminate: the circle is not static, but a loop, a knot or an algorithm that may become undone or be repeated, or may become undone in being repeated.
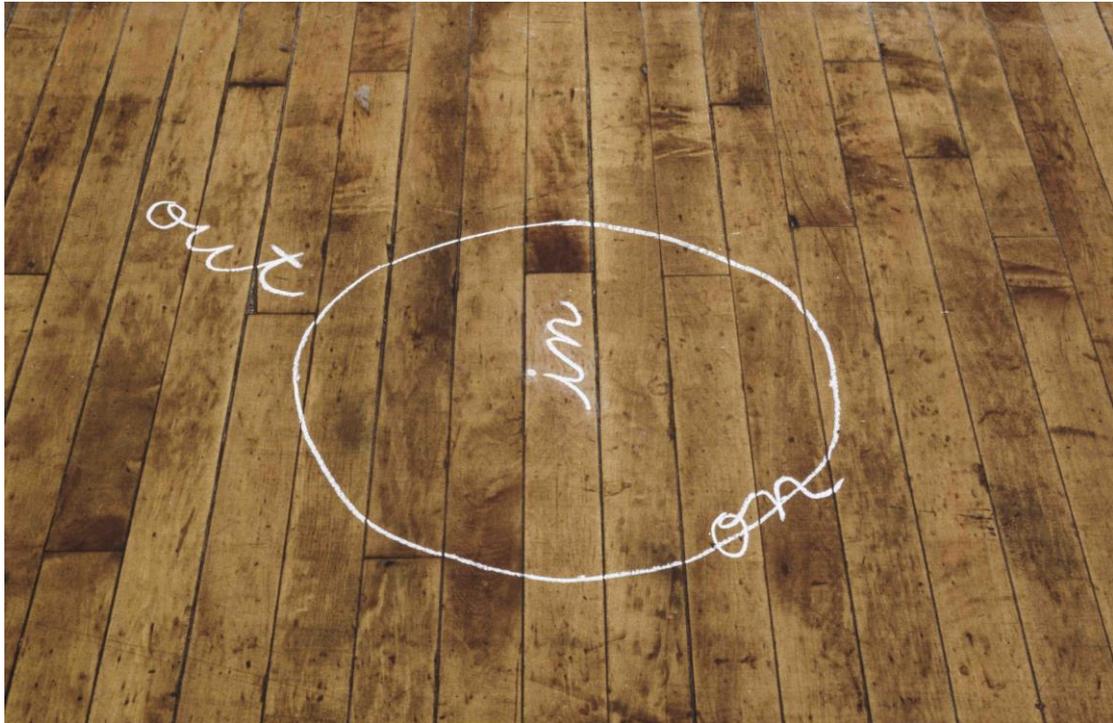
Mel Bochner, In/On/Out, 1970
Chalk on floor, dimension determined by installation

In such practices of repetition, the making of an edge or a boundary (the limit of a part/whole, which itself can be part of a continuing series as a serialisation of whole/part/whole and so on) sometimes introduces a patterning – a texture of interference (Gell 1998) – of similarity and difference.[18] Patterning is a process of in-(and out-)forming, of composition, in which proportion and participation combine. For Derrida, 'the law of the law of genre' is 'a principle of contamination, a law of impurity, a parasitical economy' that is organised in terms of 'a sort of participation without belonging, a taking part without being part of, without having membership in a set'. He writes,

> A text cannot belong to no genre, it cannot be without or less a genre. Every text participates in one or several genres, there is no genreless text; there is always a genre and genres, yet such participation never amounts to belonging… Making genre its mark, a text demarcates itself. (1980: 212)

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[18] Alfred Gell notes, 'The interminableness of large numbers and complicated patterns work in the same way; but patterns are more interesting and certainly more artistic' (Gell 1988:84).

This process of demarcation is a process that Massumi describes as, 'The *singularity* of an edging into existence 'yielding' to the appearance of a particular instance of a *general* type' (2011: 92).[19]

7. Edging

We end with a final example of our approach to numbering by looking at edging, which we approach by way of a discussion of compositing. But to do so we first we need to return to number ecologies for, as we highlighted earlier in this introduction, the ubiquity of computing, the growth in digitisation, and the prevalence if not predominance of the screen as interface provide a profoundly transformed space for numbering practices. Orit Halpern (forthcoming) has described how post-war neuroscience, informed by theories of communication and control, refused to treat vision as a series of discrete mechanisms (for example, a causal chain of stimulus -response behavior), imagining it instead as the patterning of the relationship between the being seen and the seer. Just as communication channels in telephones and computer systems could be manipulated and constructed in different ways to increase capacities, thresholds, and action potentials, the same, it was argued, could be done with vision. And, in her contribution to this Issue, Halpern suggests that cybernetics can be situated in relation to – and extends a history of - visualization in which 'the serialization of time [takes place] through the systematic subtraction of duration from event' (Bochner, 2008: 42). It is in relation to these developments, we suggest, that knowing, sensing and participating in number increasingly take place. Screens in this number ecology are not simply material artefacts in-between the seer and the seen, but the edges or surfaces across which a patterning of relationships is produced.

What we find to be significant about such surfaces is their capacity to *render* images or compositions, by which we mean not only a capacity for accuracy or precision but also the capacity to transform and transmit images. They emerge not only in the relations established between GPS, the military, governments and everyday users of location-based devices and applications, but also, for example, across the rapidly changing organization of the three sites of the televisual: the place of recording, the place of reception, and the place of transmission (Weber 1996). Then again, they also emerge in the auto-matisms of the car, such as, for example, practices of urban planning (Busbea 2012) or the 'car system' (Urry 2004). As Rosalind Krauss says in relation to the art work of Ed Ruscha: '… the technical support is not an idea, it is a rule. It runs on the track of Cavell's automatism the way, in traveling the road, the car demands refills of gasoline or places to park, each space alike just as the cars twin one another. The car doubles as the Hollywood dolly, allowing the traveling camera to shoot *Every Building on the Sunset Strip* from a moving van, if that's what it wants' (2011: 20). Indeed, we suggest that the surface of composing numbers is increasingly a function of algorithmic rules, complex functions of digital computation that operate to transform processes of composition in and as a capacity of vision.[20] The capacity to render – or visualize - is, we suggest, the dominant technical support for many contemporary number practices today.

A reflection on the logistics and aesthetics of this capacity is afforded by the video work of the artist Hito Steyeri, 'How Not to be Seen: A Fucking Didactic Educational.MOV File'. The video takes as one of its sites the photo calibration targets constructed in the 1950s and 60s in the California desert to test the resolution of airborne cameras and drones. According to the Centre for Land Use

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[19] While recognizing its long history, Olga Goriunova (2013) has described the grid as a paradigmatic contemporary methodology for producing the singularizing generic, with not only its own internal (unit) measures, but also its own dynamic of inclusion, exclusion and belonging.

[20] This is perhaps a continuation of the privileging of vision described by Martin Jay (1993). However it is an organization that operates, as Laura Kurgan explains, 'close up at a distance' (2013).

Interpretation (http://www.clui.org) most of them follow the same general lay-out: a rectangular concrete or asphalt pad constructed flat on the ground, coated in heavy black and white paint. The pattern painted on the targets comprises sets of parallel and perpendicular bars, and, sometimes, a large white square. As such, it is similar to the test patterns used to determine the resolving power of microscopes, telescopes, cameras, and scanners. Described by Michael Connor as 'a kind of optometrist's chart for the ancestors of drones' (http://rhizome.org/editorial/2013/may/31/hito-steyerl-how-not-to-be-seen/) they are also reminiscent of the test card that was a familiar sight for children in the UK in an era when programming was not a continuous 24-hour-a day experience.[21] Alternatively, the photo calibration targets can be seen to function like an eye chart at the optometrist, where the smallest group of bars that can be resolved marks the limit of the resolution for the optical instrument that is being tested - the eye.

Partly shot on location at one of these now disused targets, *How Not to be Seen* presents itself as an instructional video, educating viewers about how to remain invisible in an age of image proliferation. Various possible strategies are presented, including camouflaging oneself (to demonstrate, Steyerl smears green paint on her face), hiding in plain sight, cloaking and camouflage. Paranoia (the affect that Halpern suggests is paradigmatic for contemporary rationality) mounts as the announcer runs through the possibilities. You can also become invisible by being poor or undocumented, living in a gated community or in a military zone, being a woman over 50, owning an "anti-paparazzi handbag", being disappeared by the authorities, eradicated or annihilated, or "being a dead pixel". To demonstrate this last strategy, several people appear, wearing pixel-like black boxes on their heads, only to disappear. Digitally rendered ghosts dance in the desert landscape as The Three Degrees' *When Will I See You Again* plays on the soundtrack.

The test beds that are the setting for this video are no longer much in use – the example used in the video has large cracks and the sharp lines of the pattern are distorted by the growth of plants. During the course of the twentieth century, the organisation of vision as a surface for intervention or action has been further transformed as clocks and maps are tied ever closer together (Galison, 2003). One contemporary manifestation is found in what Galison calls the orbital machine of the Global Positioning System or GPS, the network of twenty-four military satellites that today helps everything from missiles to mobile phones to know more or less exactly where they are on the face of the earth[22]: 'The late twentieth GPS satellites provided precision timing (and therefore positioning) for both civilian and military users. Built into this orbiting machine were the software and hardware adjustments required by Einstein's theories of relativity. The result is a planet-encompassing, $10 billion theory machine' (Galison, 2003: 285, quoted in Kurgan 2013:15).

Laura Kurgan provides one example of the imagery that such surfaces afford in a discussion of a sequence of views of planet earth that began with *The Blue Marble*, a photographic view of the earth as seen by the Apollo 17 crew travelling towards the moon in 1972, and ends in the analogous digital 2012 versions of this image. She describes them as being,

> … assembled from data collected by the Visible/Infrared Imager Radiometer Suite (VIIRS) on the Suomi NPP satellite in six orbits over eight hours. These versions are not simply photographs taken by a person traveling in space with a camera. They are *composites* of

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[21] The television test card or test pattern was originally a physical card at which a television camera was pointed, and was used for calibration, alignment, and matching of cameras.
[22] But not, as we write (17th March 2014), the location of the Boeing 777 that went 'missing' as it crossed the edge of Malayasian/Vietnamese airspace.

massive quantities of remotely sensed data collected by satellite-borne sensors. … This is not the integrating vision of a person of a particular person standing in a particular place or even floating in space. It's an image of something no human could see with his or her own eye, not only because it's cloudless, but because it's a full 360 composite, made of data collected and assembled over time, wrapped around a wireframe sphere to produce a view of the Earth at a resolution of at least half a kilometer per pixel – and any continent can be chosen to be at the center of the image. As the story of the versions suggest, it can always be updated with new data. (2013: 11-12; our emphasis)

We suggest that the numbering practices in which we now participate, knowingly or not, are more often than not screen composites.

Lev Manovich (2001) describes digital *compositing* as the process of combining a number of moving image sequences and possibly also stills into a single sequence with the help of special compositing software. He observes that it is now a norm in the creation of digital imagery and routinely used to put together TV commercials and music videos, computer games scenes, and shots in feature films. He offers *Stars Wars: Episode 1* (1999) as a paradigmatic example: according to its director, George Lucas, 95% of the film was assembled on a computer. Manovich observes that while compositing as a technique to create moving images goes back to video keying and optical printing in cinema, digital compositing has greatly expanded its range, allowing for greater control of the transparency of individual layers and the combination of potentially unlimited numbers of layers. He notes that a typical special-effects shot from a Hollywood film will consist of anything from a few hundred to thousands of layers. Our suggestion, however, is that compositing is not confined to the realm of the digital moving image or computing but is to be found in the way in which zooming, folding, pausing, accreting and diffracting are combined in layers in number ecologies; significantly, compositing as a technique is able to produce images in which a manifold can be made to agree with *multiple* unities simultaneously. The vagueness of such more-than-one wholes today is not the result of a lack of precision but rather is its consequence.

A striking example of the creation of such vagueness is that of *Haverhill 2000*, the work of the photographer Chris Dorley-Brown who collaborated with the people of the town of Haverhill in the UK to produce a composite image of the community. Over a 3-month period Dorley-Brown took a mini-studio around various locations in the town including shops, community centres and the local arts centre. The 2000 digital portraits that he produced were then digitally manipulated using morphing software. The merged portraits were then arranged into groups on the basis of gender and age:

[Figure omitted]
© Chris Dorley-Brown & Haverhill Town Council 2001

The intention of the project was said to be both to establish an image archive of a town's population at a certain moment in time and to create a new "virtual population" made up of different combinations of faces within gender-specific age groupings (see Lury 1997 for a discussion of analogous photographic practices in the twentieth century).

Compositing – however it is achieved technically - aims to produce an image in which the alignment of parts in a more-than-one unity is rendered both exact and invisible. That is, compositing is a technique that aims to produce a unity or vague whole in which there are no visible fixed edges. The consequence of the invisibility of edges is that we cannot know whether we are inside or outside, or

indeed whether or when a line will be drawn to make an inside and outside. The result is the creation of genres or types from which we may suffer exclusion (as for example, in the practices of credit-rating agencies or security consultancies), or may instead be subjected to the goal of 'continuous improvement'[23], as not simply targets but also measures and the scores that they produce, the lines along which the vague whole is folded, are continually modulated. Writing in 2001, Manovich noted that only a few layers could be combined automatically in 'real time' (with the use of virtual sets technology); that is, digital compositing was still a time-consuming and difficult operation. We suggest however that while the technical limit of compositing, though no doubt significantly improved, may still be the capacity to process information, there are other ways for singularities to edge into existence in composite forms. We explore one example here.

One of the most familiar surfaces or edges of visualization that can be approached, navigated and explored by an individual user is Google Earth. As we noted earlier, this 'earth' has been brought into existence, in part at least, by 'drone' navigation enacted by automated movement. In artist Hannah Sawtell's video *RE PETITIONER IN ZERO TIME*, the viewer is also given a drone's eye view of a landscape. The gallery installation of this video, which deploys the 'first person shooter' perspective of video and massive online gaming environments, offers not only a projected HD video animation, but places this projection in what Sawtell calls a "bespoke psychoacoustic apparatus" of dense digital sound that she calls the "Global Grey Viral". This audio-visual surface, which has no apparent edges, is interrupted only by a Vine video loop[24], inserted into the screen. This short loop is a contrast to the longer sequence of the film, which it annotates or interrupts, acting as a layer above or orthogonal to the primary surface of the work. It is very 'light' in processing requirements, and is a form that can be produced easily, circulating in different rhythms to the continuous sound of the drone space-time in which it is inserted. It thus has the effect of making perceptible the making of edges: even though the loop is only six seconds long, it offers the possibility of a slowing down, a de-globalising, de-greying, a colouring in, an interference of speeds, a de-laying rather than a de-layering[25] of the processes of compositing to draw attention to the volume that always exists in an ecology of composition. It affords a localization of sight, that is, a pointing in Krauss's terms or a "look here!", but as a tangent not a target; it is the making of an edge, an 'across' rather than an 'at' in the terms of the language fractions described by Bochner.

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[23] There is, for example, an Institute for Continuous Improvement in the Public Sector (ICiPS) in the UK: http://www.icips.org.

[24] Vine is a mobile app owned by Twitter that enables its users to create and post short video clips. The service was introduced with a maximum clip length of six seconds and can be shared or embedded on social networking services such as Twitter and Facebook.

[25] In the terms of Human Resources, 'Delayering is the process of removing layers of hierarchy between the highest and lowest levels in order to boost operational efficiency, decrease the wage bill and remove red tape. Delayering typically removes middle managers, providing senior managers easier reach over the organisation as a whole' (http://www.hrzone.com/hr-glossary/delayering-definition, accessed 9 April 2014).

Hannah Sawtell, *RE PETITIONER IN ZERO TIME*, 2014
Installation image courtesy of Vilma Gold

Conclusion: Numbers

While, as we have noted, our glossary is incomplete (and invites participation), we hope that these examples illustrate the value of our approach to numbering as a practice and performance, and perhaps most importantly as a process of composition. We also hope to have demonstrated that what might be included in the social study of number is far wider than an immediate focus on numbers as such might suggest: numbering practices – making parts and wholes, adding and subtracting, zooming in and out, multiplying and dividing, stopping and starting, diffracting, making and marking continuity and discontinuity – saturate the social world even when numbers themselves are not visible. In short, there is no fixed line to be drawn between numbers and non-numbers: insofar as numbers are and have relations, they can and should be understood in terms of a kinship with other ways of making relations (Strathern 2014). Numbering practices do not just have social effects but are themselves social: we live in and with numbers, not just by them.

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