Something and Nothing: On Algorithmic Deletion, Accountability and Value

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Abstract

This paper draws on a three year ethnographic study of the development of an algorithmic surveillance system. It explores ways of understanding the doing and undoing, something and nothing of algorithmic video analytics. The paper pursues a means for engaging with something and nothing by initially drawing on treatments of calculation and qualculation to explore doing. It then seeks to broaden out qualculation by drawing in distinct provocations – blank figures and motility – to engage with forms of undoing. The paper uses the ethnographic study of the algorithmic surveillance system as a means to reflect on the analytic utility of this approach. The conclusion considers three points on something and nothing that this project generated and that could be developed further in future research.

Keywords: algorithms, deletion, value, accountability

Introduction

This paper suggests that qualities and quantities can be enacted, bringing realities into being – in conversation with the pivotal issues provoked by the special issue on numbering and numbers (Lippert and Verran, 2018). At the same time, it suggests qualities and quantities can be undone. The paper focuses on the development of an algorithmic surveillance system designed to delete a large percentage of the data on which such systems would normally depend. As we will see, deletion was proposed as a means to ensure privacy. What the paper will explore is the notion that efforts to delete involved both doing – algorithmically selecting data for deletion to bring a new reality of privacy into being – and undoing – the production of a stream of system outputs that continually demonstrated the system's ineffectiveness.

In this way, something (data) ought to become nothing (through deletion). But as the system only ever proved partially effective, the new reality of privacy was never more than hesitant and uncertain. The developers of the system also looked to sell the technology to the security market. Hence nothing (deletion) would need to become something (sales). The paper uses the deletion system as a basis for exploring possible ways to engage with this doing and undoing, something and nothing.

Drawing on a three year ethnographic study of the development of the algorithmic surveillance system provides an opportunity to develop and test the analytic utility of drawing together distinct ideas from Science and Technology Studies (STS) on quantification as an initial basis for under-

standing doing and undoing, something and nothing. The paper will pursue an analytic means for engaging something and nothing by initially drawing on treatments of calculation and qualculation to engage with forms of doing. It then seeks to broaden out qualculation by drawing in distinct provocations – blank figures and motility – to engage with forms of undoing. The paper uses the ethnographic study of the algorithmic surveillance system as a means to reflect on the analytic utility of this approach. The conclusion considers three points on something and nothing that this project generated and that could be developed further in future research.

Qualculation and deletion

In order to make sense of doing quantities, one starting point is provided by studies of calculation. STS work on calculation raises a number of challenging questions. These include how accuracy is constructed (MacKenzie, 1993), the accomplishment of numeric objectivity (Porter, 1995), trading, exchange and notions of equivalence (Espeland and Sauder, 2007; MacKenzie, 2009), among many other areas. The kinds of concern articulated in these works is not focused on numbers as an isolated output of calculation. Instead, numbers are considered as part of a series of practical actions involved in, for example, solving a problem (Livingston, 2006), distributing resources, accountabilities or responsibilities for action (Strathern, 2002), governing a country (Mitchell, 2002), and ascertaining a value for some matter (Espeland and Sauder, 2007; MacKenzie, 2009). Verran (2012: 112) suggests that the constitution of a numerical value involves a complex kind of politics that emerges through "a seamless elision of the dual moments of articulating an order so as to create value, and valuing the categories created in the order to stabilize the order". The switch between using numbers as a basis for ordering and as a basis for valuing becomes hidden and hence switching becomes one basis for numbering activities to embody judgements (such as how and when to switch). We might say then that the seamless elision is one of doing both qualities and quantities. This is the starting point for the neolo-

gism of qualculation (Cochoy, 2002; Thrift, 2004). For Callon and Law:

> Qualculation implies qualification. Things have to qualify before they can enter a process of qualculation… this can be … done in an endless number of ways. With an endless range of mechanisms and devices. (Callon and Law, 2005: 715)

The work of qualculation, they suggest, operates in three parts:

> First, the relevant entities are sorted out, detached, and displayed within a single space. Note that the space may come in a wide variety of forms or shapes: a sheet of paper, a spreadsheet, a supermarket shelf, or a court of law – all of these and many more are possibilities. Second, those entities are manipulated and transformed. Relations are created between them, again in a range of forms and shapes: movements up and down lines; from one place to another; scrolling; pushing a trolley; summing up the evidence. And, third, a result is extracted. A new entity is produced. A ranking, a sum, a decision. A judgment. … And this new entity corresponds precisely to – is nothing other than – the relations and manipulations that have been performed along the way. (Callon and Law, 2005: 719)

Detachment, forging of new relations and the production of a judged result provides an initial analytic focus for studying the doing of quantification and qualification. These forms of qualculation can be seen at work in recent discussions of algorithms. Defined in relatively benign terms as a basic set of instructions to be put into action through computer code (Goffey, 2008), the algorithm has been subject to research in diverse circumstance, from Google search engines (Gillespie, 2013) to academic plagiarism software (Introna, 2013). Taking the latter as an example, plagiarism software would produce an algorithmic qualculation by detaching strings of characters (words, sentences and so on), forging new relations between those characters and other entities (by searching for similar or identical strings of characters in the world of published texts beyond the string) and producing a qualculative result; a basis for judging the similarity and distinctiveness

of, for example, a student essay and already published texts. The algorithmic qualculation studied by Introna is a commercial product sold to Universities, which uses detachment, forging of new relations and the production of a result to generate a judgement of the students most likely to have plagiarised their essays.

Using algorithms to make judgements (such as who has cheated in an essay) has led to multiple and quite dramatic claims being made regarding algorithms and their likely contemporary consequence. For example, power has been presented as an indisputable feature of the algorithm (Lash, 2007), generating consequences beyond the understanding or control of those subject to such consequences (Beer, 2009; Spring, 2011). The algorithm has been presented as having an inaccessible politics of programming logic (Gillespie, 2013), a kind of politics that might run wild (Slavin, 2011). In this approach, algorithms are attributed power and agency to scrape our data together, detaching it from its conventional moorings, create new associations of classification, and make judgements of our relevance and value. This has led to calls for resistance[1] – we could say that one concern has become how to prevent the algorithm from running wild.[2]

Within the European Union, limiting or resisting data sifting algorithms has taken the form of a twin policy response to pursue the possibility of a right to be forgotten combined with a right to accountability. In other words, a future is imagined in which the algorithm might not only be stopped from running wild, but the expectation is that these stops will be made accountably, demonstrably, even transparently[3] available. First has been the move to articulate and institute a 'right to be forgotten' or 'right to erasure'[4] as a feature of the revision of the EU Data Protection Directive (Directive 95/46/EC).[5] As Bernal (2011: n.p.) highlights the right has become defined as "the right of individuals to have their data no longer processed, and deleted when they are no longer needed for legitimate purposes.". In this sense, the algorithm would be limited in that it could no longer detach data, form new relations or results from data. Second has been a move to establish a basis for accountability. The EU Article 29 Working Party on Data Protection has issued an Accountability

Principle which sets out a provision: "to ensure that the principles and obligations set out in the [Data Protection] Directive are complied with and to demonstrate so to supervisory authorities upon request" (Accountability Principle, 2010: 2; also see EDPS, 2010). In this way, the principle of accountability is designed to ensure a transition from Data Protection in theory to practice and to provide the means to assess that this shift has adequately taken place.

Within the development of the new European General Data Protection Regulation (no longer a Directive), these two moves have become entangled such that to delete and thus cut the action through which 'our' data might run algorithmically wild and beyond our control, must also become an accountable feature of activities; organisations must be able to demonstrably prove they have taken on responsibility for deletion and cut 'our' data. It is thus assumed that Data Protection will carry out resistance on behalf of EU citizens.[6] Although the Article 29 Working Party Accountability Principle and the proposed and critiqued revisions of the EU Data Protection Act have been mostly focused on on-line data, these policy moves have also spurred broader discussions of data repositories and data analysis and the posited need for erasure. For example, erasure, forgetting and accountability have become key reference points in the development of what have become termed Privacy Enhancing Technologies (PETs)[7] and Privacy by Design projects.[8] Here the remit for data storage and analysis is not restricted to on-line data but also incorporates concerns with, for example, video-based data, organisational records and forms of policing, among other areas. The premise of these arguments for PETs is that all algorithmic technologies risk running wild with data and might be resisted by technologies which take privacy concerns into account. In these discussions, privacy is often understood in more or less straightforward binary terms. For example, it is proposed that if one's data no longer exists, there is no risk to one's privacy.[9] One type of emerging PET within this field is auto-deletion technologies (also see Mayer Schonberger, 2009). If we accept that these policy discussions and developments are to carry out resistance on our behalf, then to delete and to accountably demon-

strate that deletion has taken place might become the benchmark required for preventing algorithms from running wild (Slavin, 2011) with our data. Deletion might become the means to turn something into nothing (by deleting data) and nothing into something (by rendering deletion accountable).[10]

Deletion and the blank figure

Doing deletion might be open to analytic consideration as a form of qualculation. A conventional approach to deletion involves simply changing the connections through which a user might access data[11]. In this way, data might be selected, new relations formed and a qualculative result – deletion – produced. However, this approach to deleting is unlikely to fulfil the proposed terms of policy mechanisms such as the revised EU Data Protection Regulation or the concerns articulated in the literature on PETs and Privacy by Design. The concern articulated as prompting the right to be forgotten/right to erasure is couched in terms of a need to expunge data from a repository, making it impossible to link, scrape, share or make further user of that data[12]; it is argued that to simply change the route via which information is retrieved can be overcome with little effort and re-opens the data to all future uses[13]. And the Article 29 Working Party accountability principle will require that compliance with such expunging is made clearly and demonstrably available. It involves making absences (deletion) notably and demonstrably present (by making deletion accountable). This kind of something and nothing is not easily addressed through qualculation alone. In place of a seamless elision of quantity and quality are on-going debates as to the feasibility and desirability of this approach. The certainties of doing qualculation appear to be challenged by questions of much undoing.

One starting point for augmenting the notion of qualculation by opening the seamless elision of quality and quantity, doing and undoing, something and nothing is provided by the work of Hetherington and Lee (2000) on zero. They suggest that zero was introduced into western European mathematics and economics in approximately the fourteenth century.[14] Zero provided

the basis for a numeric logic of order at the same time as disrupting conventions for ordering, disrupting by connecting otherwise unconnected entities (nothing and the progressive accumulation of something from the number one upwards; as well as at a later date, providing the basis for counting downwards with the introduction of negative numbers to Europe from around the 17th century) and came to be seen as generating a new order. This despite zero itself being an underdetermined figure, both a sign on its own (signifying something of no value) and a meta-sign of order (providing for the significance of subsequent numbers or indicating rank in the decimal system). Hetherington and Lee (2000: 177) suggest that: "What [zero] reveals... is that very basic mathematical ordering practices are themselves dependent on a figure that refuses to adopt a singular position in their semiotic order". Following on from this, we might think of an algorithmic system for deletion not just as a focus for qualculation (doing something), but as a system that refuses to occupy a singular position (both something and nothing, doing and undoing).

However, Hetherington and Lee (2000: 175) go further and suggest that zero, as something and nothing, can also be considered a blank figure, something that: "hybridises presence and absence rather than two forms of different presence". Following from this, an intervention in an order – such as the introduction of zero – can be considered a blank figure when its nature is underdetermined, uncertain, unclear, troubling, provokes tension and generates not just a connection between pre-existing entities, but provides a basis for further investigation of those entities now connected. In this way, an algorithmic system might introduce an accountable nothing (the deletion of data) that would not just create (or remove) connections between entities, but also create new troubling questions (for example, regarding the extent or adequacy or consequences of deletion). Hetherington and Lee (2000) suggest that such disruptive questions can introduce forms of motility, a disruption of the world of relations on which an order might be based. For algorithmic data systems, a motile switching might be provoked in moving from an order based on comprehensive data storage to an

order based on deletion. Whereas studies of qualculation appear to depend on the emergence of a result from a singular order ("a result is extracted"), motility and the blank figure suggest a more persistent instability or multiplicity of order.

In this way, the work of Hetherington and Lee (2000) sensitizes us to the possibility of disruptions to conventions of order through simultaneous somethings and nothings; zero which provides a basis for reordering something (the rules and conventions for order such as negative numbers) and for considering nothing (a more literal zero). Their work also opens up the opportunity to consider motile switching in the world of relations that make up an order. A switch in order might be transformative of both the nature of entities and the world of relations through which those natures have been held steady. The interjection of a new entity (such as zero) might be the basis for such a fundamental switch. Following this argument, to introduce accountable deletion might be to generate a motile switching in the world of relations in focus. The nature of data, of algorithms and their associations might be called into question, and so might the relations that generated the call for accountability in the first place. Instead of algorithms running wild with our data, we might have nothing (deletion), but we might also have a generative something (new accountability relations through which the deletion is demonstrated alongside difficult questions regarding what constitutes adequate deletion). The generative dissonance or profound change in ordering provoked by the blank figure – the something and nothing – as we shall see, attains a brutish presence: the seamless elision of quality and quantity is opened and (at least for a time) held open.

The suggestion that the algorithm can be limited (even through another algorithm), that a new qualculative form can be constituted and inserted into sociomaterial relations, constituting a something and nothing, and that this nothing can be accountably accomplished requires detailed investigation. The empirical analysis will now begin that investigation particularly attuned to the possibility that new algorithms might generate blank figures and motility, disorder as well as order. First, the analysis will explore the creation of an algorithmic system, exploring the ways in which deletion involves active, qualculative work. Second, attempts to accountably demonstrate that nothing has been created from something will be pursued, wherein the certainties of qualculation become overwhelmed by the disruptive figure of what might constitute deletion. Third, the world of relations and motile switches constituted in order to prepare for the accomplishment of value to be generated from the algorithmic deleting machine, will be assessed.

The algorithm at work

The project from which this paper draws was initially conceived as an experimental location for testing out the possibility of creating an algorithmic video-based surveillance system that could take into account aforementioned concerns regarding the prospects of guaranteeing deletion and accountability through a Privacy Enhancing Technology (PET). The suggestion from the co-ordinators at the start of the project was that algorithms could be put to work to create a 'privacy sensitive' surveillance system, but that this could also become a valued commodity. The idea was to monopolise the market space opened up through discussions of PETs and Privacy by Design, the right to erasure and the principle of accountability, by creating and demonstrating a video-based surveillance system that could take on these concerns on behalf of putative end users. Computer scientists from academia and industry, potential end users (including a European train and airport operator) and social scientists (including the author of this paper) were drawn together by the project co-ordinators to work in this experimental space.

In the early months of the project, three principles were constituted as the basis for exploring the development of a 'privacy sensitive' surveillance system. First, that algorithms could be used to detect and select relevant and 'suspicious' behaviour in locations like airports and train stations, and that relevancy could then become the basis for restricting what surveillance operatives got to see, reducing the amount of data made visible in a video-based surveillance system

by around 95-99%. Second, that relevancy selections could then be used to delete the 95-99% of data not required. Third, that new algorithms would not be required for selecting relevance and doing deletion. A 'privacy sensitive' system was thus founded on principles of reduction and deletion, a system which could simultaneously be algorithmic and limit the algorithm. The following analysis will explore the building of the system, attendant attempts at deletion and their consequences.

Building an algorithmic surveillance system

In order for the video-based surveillance system to work, multiple algorithms were drawn together including event detection algorithms for selecting 'suspicious' behaviour and auto-deletion algorithms. These were designed to work in an order; video would be streamed from an existing airport and train station video surveillance system, via a media proxy, which would make available to event detection algorithms, digital video streams to be sifted through to detect such things as abandoned luggage. This was an initial step for restricting the video-based surveillance system: the amount of video-based data made visible to operatives would be reduced by 95 to 99%, using algorithms to make selections of 'suspicious' activities; the bank of monitors common to video-surveillance control rooms would be replaced by a single monitor on which text-based alerts would appear (including text such as 'abandoned luggage alert'); operatives' choices would be constrained to click (or not) on these alerts and a short video clip selected by the algorithm would be played, showing operatives what had set off the alert. In place of the algorithm running wild (Lash, 2007; Beer, 2008; Spring, 2011), there was to be the algorithm constrained; a neat and orderly managed process of generating minimal visibility and clear, bracketed text alerts. Counter to any threat of disorder or motility, the proposed world of algorithmically reduced surveillance appears certain and singular. Yet to produce this orderly world required new forms of qualculation.

Qualculations would work as follows. Event detection algorithms involved a relatively straightforward seeming series of 'IF….THEN' rules. However, prior to IF…THEN rules being implemented, background models of particular spaces such as train stations or airports had to be developed to ascertain the stationary/fixed features of the setting such that any video stream could then be compared to the background to figure out if, and what, was moving. Following Callon and Law (2005), this is the first step toward qualculation – separating out and disentangling entities such that they might be recombined in a single space (within the algorithmic system). The separating out was referred to by computer scientists in the project as a background-subtraction method. Background-subtraction created a 'mask' of pixels covering any entities that were not a feature of the background model already created. Computer scientists used Gaussian mixture models to identify and then 'subtract' from the fixed background these new entities. Further qualification ensued to tidy up the initial 'masks' (which provided approximate shapes of the entities subtracted), with any single, isolated pixels erased and any holes between pixels filled. An extra algorithm and associated code would then remove shadow from the mask, designed just to leave the newly subtracted entity. However, qualculation was more complex than identifying fixed and stable features of a setting and subtracting new entities. It required figuring out a means to classify subtracted things in order to work out just what entities were. Object-classification would attempt an initial definition of what kinds of objects were in view. To figure out, for example, if an item of luggage had been abandoned, required this background-subtraction method for the system to know the fixed and non-fixed attributes of a setting, but also object-classification to know what was a person and what was luggage.

Object classification fulfilled the second feature of qualculation, drawing entities together into new relations such that they might be qualified for judging. Classifying something as a human-shaped object in object-classification involved algorithmic analysis of video streams in order to draw boundaries around 3D models of the likely parameters (size and shape) of human-shaped objects. The same was done for luggage and other items (such as cleaners' trolleys and temporary signposts). And this would provide an initial basis for judgement: some objects (temporary
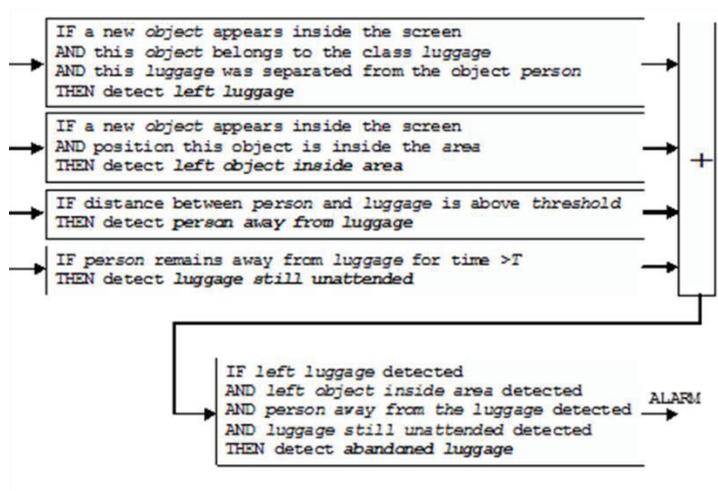
signposts for example) were designated as things that were not permanent attributes of the setting, but were also not a person or abandoned luggage, and so needed to be classified as non-fixed and non-relevant objects (in this sense, a temporary signpost or cleaner's trolley was classified as a benign object and thus to be ignored). The parameterisation process was designed to cut down on the amount of data the event detection system needed to consider. However, each object was identified through a vector of around 200 features, so each object in itself was complicated.

Calculation (using 200 features to assess an object) became a basis for initial automated qualification. One object (possibly a human) and another object (possibly luggage), combined with a known background (such as an airport check-in zone), provided a basis for algorithmically identifying a suspicious scene in potential. However, this was only an initial, approximate judgement. Following object detection via background-subtraction and object-classification through vector analysis, object tracking would take place. The object was given a bounding box based on its dimensions and the speed and direction of the box was noted in its movement across the screen. The bounding box could then be tracked across a camera's visible range and between cameras where the system searched for other bounding boxes of the same dimensions, relative to camera position, angle and zoom. These were termed Tsai calibrations by computer scientists in the project – they did not operate using pixels alone, but rather by working out the position of an object relative to a camera, its position, angle and zoom, and then counting the number of pixels to figure out the dimensions of that object in centimetres relative to its distance and angle from a camera. To calculate the size of an object in centimetres (rather than just its size on a screen), the world of the video stream had to be connected to the world of measurement in the space where the camera was located (such as an airport) and the world of the objects within the video stream had to be connected to the world out there of people, luggage, etc. This was accomplished by measuring the space seen by a camera and then incorporating those measurements into a topological database drawn on by the event detection system. Eleven conversion coefficients including angle and zoom of the camera in relation to the world-out-there measurements[15] were involved in producing an object's size.

This work to produce a more precise calculation also framed the basis for further qualification. Starting from this decision that an object was in a certain position, was of a certain size and so could be classed as a type (for example, a human-shaped object), algorithmic IF…THEN rules could be implemented. These would form the basis for judging initial, probabilistic and hesitant qualifications of who or what was worthy of being seen by operatives (who could then make further judgements – is this a suspicious event, who should be called in response and so on). Qualification through IF…THEN rules could work as follows. For abandoned luggage, IF an object being tracked splits, THEN this could be used to initiate an abandoned luggage alert (on the basis that a single human was statistically unlikely to split in two whilst walking in an airport). However, the IF…THEN rules could also provide the basis for disqualifying an initial, hesitant qualification. For example, IF an object splits and both objects keep moving, it would be less likely to be abandoned luggage or if an object splits and both resultant objects were of the same size, this might be unlikely to be abandoned luggage (in these cases it would be more likely to be a system error whereby two people have for a time walked in synch and then gone their separate ways). The IF…THEN rules needed to accommodate the approximate size of a human-shaped object, IF that split, the approximate size of a luggage-shaped object, IF a luggage-shaped object was not moving, remained at least a specified distance from its human-shaped object and for a specified time, THEN an alert could be sent to human operatives.[16]

Here are the IF…THEN rules for abandoned luggage:


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IF a new object appears inside the screen
AND this object belongs to the class luggage
AND this luggage was separated from the object person
THEN detect left luggage

IF a new object appears inside the screen
AND position this object is inside the area
THEN detect left object inside area

IF distance between person and luggage is above threshold
THEN detect person away from luggage

IF person remains away from luggage for time >T
THEN detect luggage still unattended

IF left luggage detected
AND left object inside area detected
AND person away from the luggage detected          ALARM
AND luggage still unattended detected
THEN detect abandoned luggage
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Note here the additions required for an alarm to be sent to operatives. The IF…THEN rules were developed into the following algorithm:
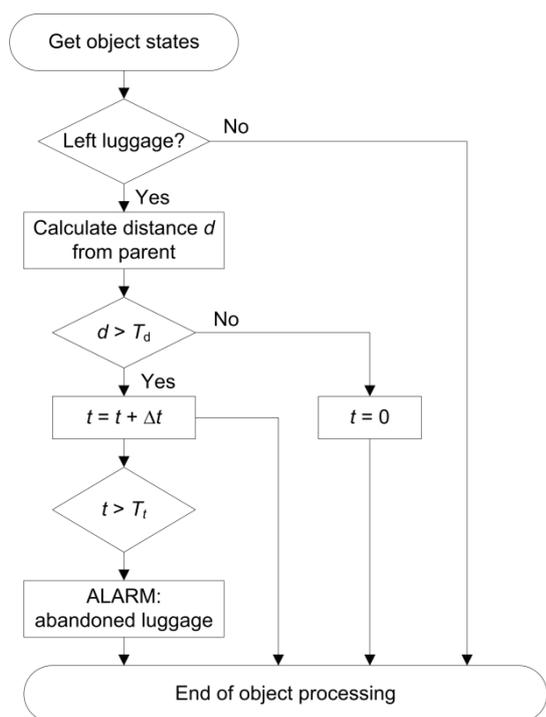
This qualifying work, separating things out, drawing them together into classifications, working through IF…THEN rules to further qualify whether an image needed to be seen by operatives, was directed toward reducing the amount of video-based data made visible. Qualculative work was complex in that it involved detailed efforts to know the space in which the surveillance system operated, build that space into the algorithmic system, and come up with a means to identify and qualify relevant objects. However, this was merely a first step in the move toward limiting the algorithm – identifying relevant scenes, people, objects, and actions. Limiting the algorithm involved using 'relevance' detection as a basis for deletion.

The algorithmic deleting machine

Limiting the algorithm[17] required creating an accountable nothing. In part this involved gathering all the data not seen by operatives along with those clips deemed irrelevant by operatives, and deleting that data. However, it also involved retaining the orderly integrity of the accountability process imagined in relation to the initial qualculation process. Deletion needed to follow a similar logic to that of background-subtraction and object-classification which were expected to be appropriately qualified and made available for accountable judgement. Emphasising the point made by Lippert (2018, this issue), certainty does not precede calculation – instead, calculative practices helped to bring certainty into being. In this project, to generate accountable certainty and avoid motile and disruptive disorderings, the system was designed to work in the following ways. A Secure Erase Module (SEM) would be built of three sub-modules: a secure erasure scheduler (SES); a secure erase agent (SEEA); and a log generator (SELG). The SES would work with the other system components to retrieve data to be deleted

(this would operate using a FIFO queuing system). The SES would send a series of requests for data to the other system components. These requests would include: the full path to the file to be deleted; the start point of deletion (this was based on temporal parameters); and the end point of deletion (using temporal parameters to calculate the final block of video data to be erased in each session).

The SEEA would then work on the data to ensure it was over-written and completely irretrievable from within the system. The basis for doing this over-writing was to try and ensure that data could not be retrieved from within the system and provide accountable certainty for its non-status. In place of conventional deletion whereby data access routes would be cut, over-writing became the basis for expunging data from the system (although in practice this turned into something closer to corrupting than expunging the data as expunging proved technically difficult to automate). The SEEA would then check that deletion was successful by matching the content deleted with that selected by the SES. After deletion, the SELG would then produce a log of data deleted. The log would include the file names of deleted objects, the time taken to delete and the form of overwriting that had been applied. The SELG would act as the key component for producing accountable certainty of absence.

An external viewer component would then parse the log to make it readable by humans and then a human system administrator could audit the log and check it against expectations of how much data should have been deleted (for example by comparing how much data had been deleted against how much data passed through the system on average every 24 hours) and whether any traces had been left (of either video streams or meta data relating to, for example, object-classification). Events which had been the subject of an alert to operatives would be reviewed manually on a regular basis and then also moved into the SEM for deletion as necessary. The audit log provided a basis for demonstrating within the project that deletion was working. As an internal accountability mechanism it could become a means to see that the algorithm was limited, that further qualculations could not be made on the

corpus of video-based data that would now be unavailable.

In this sense it might seem that accountability could provide the means to transform nothing (the deleted) into something (proof of deletion) and to do so in an orderly and certain manner. However, the results derived from system testing suggested deletion would be anything but straightforward. In tests carried out 'live' in the airport, designed to act as a demonstration of system capabilities for potential users (airport security operatives), video frames and meta-data were not gathered in their entirety, orphan frames were left behind on the system, and the reporting tool merely produced a continual accountable output of partial failure. Problems particularly appeared during secure auto-deletion; it was in the moment that data should be corrupted and made irretrievable that some data evaded the system's grasp. The computer scientists involved in the project could get the system to auto-delete the system files in their entirety by using an insecure deletion protocol (which effectively shifted deletion back to changing the routes via which data could be accessed) or by dropping auto-deletion and carrying out a manual corruption process (which might prove more complete but also require more work).

Work to build the algorithmic deleting machine and constitute an ordered and certain accountable nothing, a notable absence, instead became the basis for establishing a precarious kind of uncertain presence. Orphan frames and the audit log continually generated a disorderly account of something instead of nothing, a blank figure (Lee and Hetherington, 2000) that paid recognition to the terms of its own order (that it should find and prove the existence of nothing), but also questioned that order (by finding orphan frames that then required explanation). The system threatened to overwhelm the qualculations that had tried to establish a demarcation between data to be kept and data to be deleted.

Hence we could say that as a putative blank figure, the audit log generated a notable question: could the technology still be sold primarily on the basis of its technical efficacy in deleting? The clear and negative answer to this question for the co-ordinators required a motile switching

in the world of relations being built into the system, switching the conditions under which parties might be invited to engage with the system. Initially the project co-ordinators had sought to take the internal accountability mechanisms of deletion out into the world as a basis for bringing the world to the deleting machine. They sought to develop from nothing, a market-valued something. The project co-ordinators sought to leave aside the technical difficulties through which nothing (the deleted) failed to be effectively and accountably constituted, at the same time as they continued to embark on concerted market work. As we will see, having one form of qualculation overwhelmed by this blank figure, encouraged the co-ordinators to seek a different basis for ordering their qualculations.

Market values and deletion

To do market work and build a value for nothing (the deleted), the project co-ordinators had to look beyond accountable outputs of technical certainty (given that the machine had trouble deleting). Instead they looked to build a world into the deletion system through other means.[18] Recognising that the audit log would generate an accountable dissonance, the project co-ordinators introduced a motile switching of the basis on which a world of relations might be built into the technology. From trying to sell technological efficacy, the project co-ordinators instead sought to build alternative relations and hence value through mapping out a new market value for the technology. In line with Gorur's assertion (this issue) that division is required (in Gorur's case between science and politics) to ensure evidential credibility, here a division was drawn up between technical efficacy and the market. In place of technical efficacy as a basis for selling the system, willing customers were constituted as a means to attract others to (potentially) invest in the system. Building a world of (potential) customers to attract investors required a different basis for qualculative work. The world out there needed to be qualified and built into the world in here of algorithmic deletion through an order based on investment. Only through this new basis for qualculation could the seamless elision of quality and

quantity be reinstated after it had been opened by the failures of the deletion system.

For the co-ordinators of the project – a European-based consulting firm – the market possibilities of the technology had provided a compelling reason for deletion, algorithmic experimentation and indeed the co-ordination work they carried out over a three-year period. Building a value for the technology following trouble with the deletion system, involved qualculative work to separate out entities such that they might be drawn into new relations (in this case market relations) and become the basis for new outputs (in this case investments). The number of entities involved was broad with market trends, sizes and values separated out and made subject to calculation. For example, the world was segmented by the project co-ordinators into geographical regions to be accorded more value (Central and South America with strong predicted growth rates in video-based surveillance), even more value (Canada and Europe with a growing interest in video-based surveillance and a burgeoning privacy-interested legislature and lobby) or less value (the US with apparently less interest in privacy and a saturated market place for smart video analytics). These segmented geographies were not left as vaguely valued territories, but transformed into specific and precise calculations of Compound Annual Growth Rates (CAGRs) derived from a combination of expensive industry reports the co-ordinators had purchased and on-line sources. In this way, the market for video-based surveillance analysis was calculated to have a CAGR of 15.6% between 2010 and 2016. This was then broken down into the more and less attractive geographical segments previously described.

This provided an initial step in qualculation: geographies were segmented and calculated. However, work to separate and calculate did not end here. Customers were treated in much the same way. Hence governments were identified as a particular type of customer, tied to more or less attractive geographies. The more attractive governments were calculated as accounting for 17.59% of the video surveillance market and as more likely to be compelled into buying a deletion technology in order to promote their own privacy sensitive credentials. Transport was another

customer type segmented and calculated as accounting for a further 11% of the video surveillance market with a predicted CAGR of 13.39% between 2010 and 2016. Major transport-based terror attacks were invoked as a basis for this growth in investment, but transport organisations were also identified as another potentially privacy-concerned customer (this despite the transport companies involved in this project seeming to lose interest in privacy as the project developed). Technologies were also given the same treatment, with pixel numbers, high definition cameras, storage capacity and algorithmic forms of data analysis all separated and calculated as growth areas. Finally video-based surveillance processes such as data storage were also separated out and calculated as a growth area, but with a growing cost – the kind of cost that could be reduced through deletion. Although this separation and calculation work was directed toward qualifying these entities for market relations, the co-ordinators also worked to distinguish entities as outside or external to the world they sought to build into the technology. Hence 44 competitors were also identified, ranked according to size and spend and their particular systems presented in terms of their inferior capabilities in delivering video-based analysis.

Separating out, calculatively preparing and qualifying some entities while disqualifying others (such as competitors) provided the basis for building a key piece of qualculative work for the co-ordinators. Alongside segmented geographies, everything from governments, to pixel numbers[19] became entities of market work. The entities qualified (and disqualified) were drawn together into a world of relations. The world of segmented geographies, customers, technologies, processes and inferior competitors was co-ordinated into a document entitled "The Exploitation Report." Here the qualified (and disqualified) entities made sense as providing a basis for investment. At the centre of the world, however, sat the deleting machine as absence and presence – an investment vehicle whose technical efficacy remained hidden from accounts preventing it from being a somewhat disruptive blank figure (Hetherington and Lee, 2000). Technical capabilities remained notably absent from the Report, rendering the Report's content accountably certain and ordered.

The terms of accountability had been subject to an ordered motile switching by the project co-ordinators from proving the system could do deletion to proving there was a market value for deletion. The preparatory qualifications embedded in the Report and the censure of any uncertainty in the terms of accountable proof, would now provide the basis for taking the world built into the deleting machine to a world of investors. Through convincing investors that the Report was compelling proof of the viability of investment and that the deleting machine qualified as a reasonable investment risk, the co-ordinators hoped to also build investors into the world of the machine.

Inclusions, exclusions and careful qualification provided the means for the co-ordinators to try and build a compelling narrative which worked as follows. In place of uncertainty derived from 44 competitors came the assertion that none of the competitors could deliver as sophisticated a solution as that promised by the project. In place of a concern with governments cutting budgets in times of austerity came the assertion that governments must look to cut costs and therefore should look for the kind of cheap storage solutions that auto-deletion technologies could provide. In place of a concern that a new surveillance system might attract privacy-based criticism came the assertion that this system carried with it and provided a response to that privacy criticism. And in place of any concern from among project members that the technology didn't work came nothing; technological inadequacies remained hidden from the Report and its audience. To build something from nothing required this compelling narrative (Simakova and Neyland, 2008) through which particular somethings and nothings could be presented or absented, managing what was made accountably available.

From the preceding analysis it follows that accounts and accountabilities may not be left to fend for themselves, to be orderly or disorderly; accountable order can be a carefully managed activity. Managing motility requires ordering work and concerted efforts. But understanding these efforts requires detailed study of the preparation work carried out in constituting a world of people, things, processes, resources and relationships through which algorithmic deletion might be

accountably accomplished. Preparing a world for deletion involved attempts to produce a notable nothing (the demonstration of deletion) and also the possibility of accumulating something (a different kind of qualculation, a judgement that nothing is available for detachment, for re-inscribing into new relations or from which new results can be produced). This preparation work, however, continued to stumble over the difficulties of deleting and accountably proving deletion had taken place. The doing of qualculation threatened to be overwhelmed by the undoing of the blank figure (the audit log). At the same time, building a machine has costs and requires investments and, it turns out, the careful consideration of future returns on investments for building a deleting machine. The world prepared for accountably accomplishing nothing, then was re-directed toward creating something by demonstrating the value of deletion as an investment proposition rather than a matter of technical efficacy – that a machine could be invested in and might go on to do the work that might be required of the future imagined policies of erasure. Resistance to data sifting algorithms, delegated to the deleting machine might become a marketable good and attain a value. And so we are back to Cochoy (2002) and Callon and Law's (2005) original proposal[20] for qualculation; that it is a matter of qualifying things for market values. In this paper we have explored the work done to prepare a world through which deletion could, and then could not, be accountably accomplished and we explored the work done to prepare and then absent the deleting machine from market-value work.

Conclusion

Through an analysis of one particular project and the work carried out to create a machine to limit the algorithm through deletion, make that deletion accountable and create a market value, this paper has sought to bring three points to readers' attention that might be further explored in understanding qualculations, their doing and undoing. First, doing deletion can be a form of active qualculative work. The members of the project team featured in this paper dedicated hours and

effort to build a machine to algorithmically delete. The technical work was also market work and accountability work. It involved co-ordination, computer science, social science, the invocation of end user needs, likely competitors, and different ways to understand a developing policy environment. Doing this work was neither singular nor straightforward, but involved somehow making something from this diverse array. And making something required qualculations to separate out and identify objects, then bring those objects together in object-classifications in order to be judged. Using qualculation in this way provides an opportunity to consider the up-close work of algorithm building. In place of any counter assumption that an algorithm is powerful or will run wild with data, qualculation provides an analytic sensibility for considering the work required to make a numeric and qualitative judgement.

Second, limiting an algorithm is not straightforward; for something to be convincingly limited, it might have to be demonstrably and accountably limited. The work to produce an accountable deleting machine was focused on producing a machine that could account for itself and the way it set limits, demonstrating nothing (the product of deletion) as a prior step to something (the account of nothing, building a world of relations of value into the technology). However, accountability work was also uncertain and a little precarious with the world of relations of people and things assembled to do accountability, shifting between certainty and uncertainty. The study of making deleting externally accountable (outside the project) further emphasised this precariousness – to prove that nothing exists as a result of something being deleted, without resurrecting the thing deleted, proved an on-going conceptual and practical challenge. Technical failure opened the seamless elision of quality and quantity, simultaneously undoing what had been done. On these terms, moves to limit algorithms through deletion require a careful consideration of what is required to render such deletion accountable. We cannot simply move from qualculation, to action, to a straightforward rendering of an account of that action: the actions required to make these steps and the on-going challenges that such steps introduce require attention.

Third, making something of nothing by building a market value for deletion, also involves particular kinds of work. This work was directed toward an ordered and motile switch in the world of relations initially oriented around technical efficacy and subsequently oriented around value (with efficacy subtracted). What might have been something (the details of the technology) became nothing and a new something (a world of relations of value) was generated in its place. Following many weeks of labour by the project co-ordinators in producing "The Exploitation Report", the switch between these worlds of order was hidden. Managing order in this way also transformed a less than accountable something into a market value through qualculative work to segment geographies, technologies, competitors and customers. These were each accorded a calculative value (or non-value) and evidence was amassed from third parties to support the values evidenced. However, market value work was about more than segmentation and calculation-valuation, a disentangling of entities and their reformulation into specific kinds of relationships. The segmented and valued entities also had to be drawn into a compelling narrative that supported the future development of the deleting machine. Work was thus done to connect things we all know are happening now (such as

government austerity measures and the need to cut budgets) with features of the technological future (such as deletion), to generate a compelling narrative for investment in the deletion technologies (in this instance that austerity measures and cost-cutting could be achieved through deletion by cutting data storage costs). At the same time, producing a compelling narrative also required that numbers remained hidden that were not to be made accountably available. This continual switching between temporalities – the world as we know it now and the investable future – and accountabilities – things to be made available and things to be concealed – became the means to attempt to compel investors to join the world of relations being built into the deleting machine; that its market value would arrive. This suggests that although qualculation is analytically useful for focusing on how the seamless elision of quality and quantity is produced, the dissonance of the blank figure and motility also provide analytic means to engage with these moments when seamless elision prove elusive. In sum, understanding the doing and undoing of numbers, qualculations, the algorithm and accountabilities, appears to require a developing sensibility for certainty and uncertainty, something and nothing.

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Notes

1   See Gorur in this issue for more on resistance.

2   Except of course to limit an algorithm can require an algorithm

3   Discussion of forgetting, deleting and transparency, involves both positive assertions of the benefits of forgetting the past (for example, an individual who wants old photos removed that they find embarrassing, see: http://www.bbc.co.uk/programmes/b01pnn4m) and cautions of the dangers of forgetting (with, for example, freedom of expression campaigners warning of censorship, see: http://www.bbc.co.uk/news/world-europe-27388289). For more on the challenges of transparency combined with accountability, see Neyland (2007).

4   The discussions have included this change in terminology, although the EU still maintain that a right to erasure incorporates a right to be forgotten: http://www.research-live.com/news/government/eu-civil-liberties-committee-backs-right-to-erasure-of-data/4010672.article

5   This revision partly stems from on-going criticism of the absence of any adequate privacy protection, see for example: Benn and Gauss (1983); Bennett, and Raab (2003); Gallagher (2004); Goold (2009); O'Harrow (2005); Rosen (2001); Rosenberg (1969); Rule (2009); Stalder (2002).

6   Assumed that is by those involved in drafting the Regulation. It is neither clear to what extent the public en mass have called for this resistance nor whether publics would consider this quality of resistance sufficient.

7   On PETS, see for example: Goold (2009); ICO (2006) http://www.ico.gov.uk/upload/documents/pdb_report_html/privacy_by_design_report_v2.pdf;

8   On Privacy by Design, see: https://www.privacyinternational.org/category/free-tags/privacy-design; http://www.microsoft.com/privacy/bydesign.aspx; http://privacybydesign.ca/;

9   See for example: http://uk.reuters.com/article/2013/10/21/uk-eu-data-idUKBRE99K0LF20131021

10   This has some parallels with numbers as interface, see Holtrop this issue.

11   See for example: http://www.howtogeek.com/197436/what-happens-to-data-when-it-gets-deleted-from-your-recycle-bin/

12   However, arguments are on-going regarding who has responsibility to remove data. Is a search engine, for example, a controller of data (responsible) or a host for data (not responsible)? See: http://www.independent.co.uk/news/world/europe/eu-court-rules-in-googles-favour-right-to-be-forgotten-vetoed-8672512.html

13   Although this is an issue of on-going debate among privacy scholars: if an organisation has a back-up system that has stored data about you and then deleted the publicly available store of that data, to whom does this matter, is it a sufficient form of deletion, should expunging also incorporate back-up stores? For more on this, see: http://www.theguardian.com/technology/2013/apr/04/right-erasure-protects-freedom-forget-past Included within these popular discussions of expunging are guides on how to delete oneself which frequently allude to the difficulties involved: http://www.theguardian.com/technology/2013/apr/04/delete-your-digital-life-advice

14   Although zero has a longer history outside Europe, being recorded in a Bakhshali manuscript in the 3rd or 4th century AD: http://www.bbc.co.uk/news/uk-england-oxfordshire-41265057

15   This used a computing technique termed Kalman filter state vectors

16   Human operatives in the surveillance system only played a part at this point, some way down the chain of associations through which a decision might be made.

17   For the most part it was envisaged that the event detection algorithm would be limited through the deletion algorithm. Event detection would thus be prevented from running wild with data by continual deletion of that data.

18   For more on the importance of inverting the conventional metaphor of a product launch from sending an object into the world to building a world into an object, see Simakova and Neyland (2008).

19   On the shift of apparently mundane and mute figures into economic actors, see Cochoy (2009).

20   See also: Callon, Meadel and Rabeharisoa (2002) and Sjögren and Helgesson (2007)