Algorithms, Governance and Governmentality: On governing academic writing[1]

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Abstract

Algorithms, or rather algorithmic actions, are seen as problematic because they are inscrutable, automatic, and subsumed in the flow of daily practices. Yet, they are also seen to be playing an important role in organizing opportunities, enacting certain categories, and doing what David Lyon calls 'social sorting.' Thus, there is a general concern that this increasingly prevalent mode of ordering and organizing should be governed more explicitly. Some have argued for more transparency and openness, others have argued for more democratic or value centered design of such actors. In this paper we argue that governing practices—of, and through algorithmic actors—are best understood in terms of what Foucault calls *governmentality*. Governmentality allows us to consider the performative nature of these governing practices. They allow us to show how practice become problematized, how calculative practices are enacted as technologies of governance, how such calculative practices produce domains of knowledge and expertise, and finally, how such domains of knowledge become internalized in order to enact self-governing subjects. In other words, it allows us to show the mutually constitutive nature of problems, domains of knowledge, and subjectivities enacted through governing practices. In order to demonstrate this we present attempts to govern academic writing with a specific focus on the algorithmic action of *Turnitin*.

Introduction

> *And yet to most of us, this entire [digital] world is opaque, like a series of black boxes into which we entrust our money, our privacy and everything else we might hope to have under lock and key. We have no clear sight into this world, and we have few sound intuitions into what is safe and what is flimsy – let alone what is ethical and what is creepy. We are left operating on blind, ignorant, misplaced trust; meanwhile, all around us, without our even noticing, choices are being made*
> *Ben Goldacre (2014) - Guardian Science Correspondent*

It would be true to say that there has been, for some time now, a general concern with the way computerized (or computationally enacted) systems—often expressed as 'algorithms' or 'code'—seem to be organizing our lives and opportunities without our explicit participation, and seemingly outside of our direct control—as indicated in the quotation above. Indeed, one might say that large swathes of our daily lives have become inhabited by algorithms or code operating mostly implicitly and in the background, doing what David

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[1] Forthcoming in **Science, Technology and Human Values**

Lyon (2003) refers to as 'social sorting.' Others have argued that these algorithms (and technology more generally) more or less enact important value choices, made implicitly or explicitly, by those who build them and implement them, which can have significant implications for those that draw upon them in their daily practices (Winner 1980; Friedman 1996). Across state and private institutions a vast array of algorithmic actors are becoming more or less interconnected (through big data, for example) to operate as technologies of calculation and regulation, deployed to enact and regulate their subjects—be it citizens, migrants, tourists, consumers, suspects, customers, students, friends, colleagues, and many more besides. Together these algorithmic actors form a complex and at various times interpenetrating sociomaterial assemblage that is diffused, distributed, fragmented, and, most importantly, 'liquid' (Bauman and Lyon 2012). Practices of calculation and regulation in which the subjects actively participate in their own algorithmic self-regulation, rarely directly and through a complex stream of mediated practices, are often dispersed and not directly amenable to scrutiny.

Most striking about this liquid and flowing sociomaterial assemblage is that it criss-crosses traditional boundaries such as the public and the private more or less effortlessly. It flows in all directions in many expected and unexpected ways, crossing institutional and social boundaries that have become increasingly malleable. Through government agencies the subjects of security, social media and commerce become interconnected in pursuit of, for example, the 'terrorist.' Employers review the social media profiles of their applicants; marketing and recruiting agencies stalk potential targets through their LinkedIn profiles—and so on. Thus, in this algorithmic assemblage many of the traditional institutional actors, boundaries and categories such as public/private, citizen/customer, innocent/suspect have become malleable and interconnected. This continually evolving liquid assemblage of action raises the question of who and how it should be regulated. Who is responsible and how must such regulation be enacted, specifically? In short, it raises the question of governance. Governance, because the idea of governance implies the presence of a plurality of actors (human and non-human, public and private) who are interdependent but lack the power or authority to decide and enact proposed solutions or policies unilaterally and directly (Chhotray and Stoker 2009).

A small example of this complexity is the issue of *informed consent* in sociomaterial assemblages. This practice has a complex regime of regulatory mechanisms, actors and subjects involved. For example, the EU data protection regulation requires that it be in place, though there are disputes about the geographical interpretation of this regulation. Users say that they are concerned about their privacy (Bachman 2014), yet they do not tend to read the terms and conditions, and privacy policies, of the applications that they install. Technology providers claim they are acting legally because they have the user's consent, which is agreed when they installed the applications. When asked why they do not read the terms and conditions the users often reply that they make no sense, and it is difficult to know exactly what they mean, as they seem to be deliberately vague and obscure (Pollach

2007). Others argue that ensuring informed consent should be designed into the system as such (Friedman, Lin, and Miller 2005). If consent is given, does it cover handing over data to governments (as the Snowden documents revealed)? And so forth. What we see here is that agency is continually being displaced. As such, it requires a significant level of expertise, multiple actors, and significant investment in time to determine who is responsible, who is acting, in what interest, and so on, with any degree of accuracy. Consequently, most of the agency becomes delegated to *defaults*—such as privacy settings, standard T&Cs, and so forth—in the ongoing flow of algorithmic action. In such a heterogeneous sociomaterial assemblage, it is difficult to say how exactly, one would enact informed consent.

The brief example above suggests that governance of complex, distributed, and diffused algorithmic assemblages is a non-trivial question. This paper will address this question—albeit very preliminarily. The paper will argue that the action, or doing, of algorithms must be understood in situated practices—as part of the heterogeneous sociomaterial assemblages within which they are embedded. Moreover, such action is constituted through a temporal flow of action in which the current action/actor inherits from the preceding actors and imparts to the succeeding actors. This temporal flow is what produces the 'doing' of algorithms, but, importantly, it is also performative. By this we mean that the doing of algorithms is not simply the execution of instructions (determined by the programmers); rather, their intra-relational actions (Barad 2007) also enact the objects they are supposed to reflect or express. This performativity, we argue, is what is most important when one considers the question of governance. In this regard, we suggest that Foucault's later work on governmentality is most useful (Burchell 1991). In order to demonstrate this we will consider the algorithmic governance of academic writing practices—focusing on such practices where the actor *Turnitin* has become embedded. We will show how academic writing becomes problematized in terms of plagiarism, how *Turnitin* is deployed as a technology of government to constitute domains of knowledge, and how such knowledge regimes become internalized by subjects (students and tutors) to govern themselves as original composers of their texts, with many unexpected performative outcomes. We will conclude by reflecting on what this instance can tell us about the question of the governing of, or by means of, algorithms—especially in understanding the performativity of such governing practices.

Performativity and the doing of algorithms

Essence is Existence and Existence is Action. Latour (1999, 179)

Becoming an algorithmic actor

Perhaps it might be helpful to start with a concrete and specific example of an algorithm to initiate our discussion about the doing of algorithms. For most computer scientists and programmers an algorithm, at its most basic level, is the set of instructions used to solve a well-defined problem. Generally, they differentiate between the algorithm (the set of instructions) and its implementation in a particular source language (such as Java or C++).

Algorithms usually express the computational solution in terms of logical conditions (knowledge about the problem) and structures of control (strategies for solving the problem), leading to the following definition: algorithms = logic + control (Kowalski 1979). A classic example of an algorithm is the *bubble sort* algorithm.[1] This algorithm is designed to sort a list of unsorted numbers (or other objects, such as characters). Let us consider what this algorithm does, or how it acts.

If we are to ask the question, 'what does this bubble sort algorithm do?'—or similarly 'what does the Google ranking algorithm do?'—then we can of course say, it sorts (or it ranks). However, that is not really a helpful answer as it conceals the implicit operations or assumptions that are necessary for such an answer to make sense—as we hope to show. Likewise, if we look at the source code in Figure 1, we can say that what line eight (8) does is that it 'compares' two values. However, such 'comparing' assumes the prior allocation of values for a[j] and a[j+1] to do exactly what it is assumed to be doing. The act, or action, of comparing happens in relation to the preceding, and subsequent, enactment of the code. It compares in order to decide whether to 'swap' (or not) two values in the list (which is what lines 10 to 13 do). Thus, we can say that line 8 compares in order to swap (10-13); in turn, it swaps in order to sort (1-21); and it sorts in order to 'allocate' (gets the highest score in order to allocate an award, for example); and so forth.

```
0 void bubblesort3( int * a , int n)
1 {
2   int temp,swaps;
3    for( int i = 0 ; i < n - 2 ; i++ )
4    {
5      swaps=0;
6      for ( int j = 0 ; j < n - i - 1 ; j++ )
7       {
8         if ( a[j] < a[j + 1] )
9          {
10             temp = a[j];
11              a[j] = a[j + 1];
12              a[j + 1] = temp;
13              swaps++;
14          }
15      }
16       if( swaps == 0 )
17      {
18          break;
19       }
20    }
21 }
```

Figure 1: Implementation of the bubble sort algorithm in C++

What we see is that the action, or doing, of the code has a *temporal flow.* Every particular 'doing' happening in the present already assumes some *inheritance* from antecedent 'prior-to' actions, and it already anticipates, or *imparts* to, the subsequent 'in-order-to' actions. That is, the 'prior-to' and 'in-order-to' actions that are necessary to understand what that particular code actually does (or is) in the flow of action.

We might refer to this temporal flow of action as a continuous *string or stream of interpenetrating*—prior and subsequent—actions that compare, swap, sort, allocate, administer, and so forth. The doing of the algorithm is constituted by the temporal flow of action and is not 'in' the particular line of code, as such. In the same way that the 'playing' of music is not in the enactment of individual notes but the temporal flow of the notes being played—each note inheriting from the prior, and imparting to, the subsequent note, or figure, motif, cell, phrase, or melody. Certainly, each specific line of code (or note) is important, and needs to be correct in its own terms. However, the relational temporal flow is what enacts the ‘sort’, or plays the melody of music. This temporally unfolding process (the doing of the algorithm) itself inherits from prior actions, and imparts to subsequent actions, in the temporal flow of the doing of everyday sociomaterial practices, at work for example. Indeed, it needs to be embedded in the temporal flow of sociomaterial practices to be the actor we assume it to be—flowing in many expected and unexpected ways. For example, minimally, it had to be initiated by some prior action (human or non-human). We might refer to the flow of these practices as heterogeneous assemblages of action or actors—involving human and non-human actors alike. Such assemblages might be called a sociomaterial site (Suchman 2007), a worknet (Latour 2005), a mangle (Pickering 1995a) or a agencement (Çalışkan and Callon 2009).

The reasons to *cut* this temporally unfolding sociomaterial assemblage or process at any point—that is, to make a particular determination of what specifically is being done (such as, comparing, swapping, sorting, administering, managing, etc.)—might be described as technical (to write the code, for example), it might be described as social (to enact an administrative practice), and so forth. The point is that any such cut in the temporal flow of doing can be made, more or less arbitrarily, to enable us to determine what is ‘being done.’ However, such determination would be relatively reductionist as the flow of action is irreducible to any of the assumed actors (lines of code or notes, in our case)(Latour 1988). Moreover, any cut of, or in, the temporal flow would not just be constitutive of the answer as to what it ‘is’ that is actually being done (comparing, swapping, sorting, administering, etc.); it would also be constitutive of what we take the *actor* to be as such: is the actor the programmer, the code, the administrator, the compiler, the CPU, the manager, etc.? The answer is: it depends on how or where we make the cut. This is what Barad (2007, 147/8) calls the “agential cut.” She suggests that such agential cuts are constitutive of the entities assumed in such cuts. Differently stated, such cuts are performative. Not only are the cuts performative, the flow of action in algorithmic sociomaterial practices is also performative. The algorithm is not an algorithm because it executes (the instructions); it is an algorithm because it is enacted as such by a heterogeneous assemblage of actors, imparting to it the very action we assume it to be doing.

Performativity[2] is rooted in an ontology of becoming, often referred to as process thought (Whitehead 1978; Butler 1990; Barad 2007; Pickering 1995b). For process scholars relations do not connect (causally or otherwise) pre-existing entities (or actors), rather, relations *enact* entities in the flow of becoming. Butler (1990, 25) suggests, of gender, “[t]here is no gender identity behind the expressions of gender; that identity is performatively constituted by the very ‘expressions’ that are said to be its results.” And, it is “real only to the extent that it is performed”(Butler 1988, 527). Relational practices are empirical and ontological *at the same time*—but only whilst they are being performed. The enactment does not produce an actor; it is the actor, whilst it acts. Whitehead (1978, 23) formulates this succinctly:

““[h]ow an actual entity becomes constitutes what that actual entity is... Its ‘being’ is constituted by its ‘becoming’. This is the principle of process.” Hence, Law’s suggestion that the practice worknets (that relate to salmon fish in different ways) are *empirical ontologies:* “A salmon is not general but *specific*. It depends on how ‘it’ is being done in practice… since those practices aren’t the same, different and multiple salmon subsist in different and multiple worlds…There is no ordered ground separate from practices and their relations…There is no ‘salmon’ behind the various practices that do salmon” (Law and Lien 2013, 366). Barad (2007, 139) articulates this performative relational enactment through her notion of intra-action, which are “ontologically primitive relations—relations without pre-existing relata.” In performativity every (en)action, within the flow of sociomaterial assemblages, is constitutive of what that assemblage is becoming. There are many aspects of performativity that one can highlight. However, here we want to focus just on the nature of the temporal flow, specifically, intra-relational *inheritance, or imparting.*

In the relational flow of becoming each action inherits from prior actions and imparts to subsequent actions (as we saw in the bubble sort algorithm above). This intra-relational inheritance is constitutive of the action/actor. In the algorithm line 8 was constituted—exactly as a comparison—by inheriting the previous actions of the enactment of a particular a[j] and a[j+1]. There was also a vast array of other heterogeneous actions/actors (or inheritances) necessary for ‘if (a[j] < a[j + 1])’ to act precisely as that which it was assumed to be doing. Chun (2008) also makes this point when arguing against the supposed ‘executable’ nature of software source code. She says that “source code is never simply the source of any action; rather, source code is only source code after the fact: its effectiveness depends on a whole imagined network of machines and humans” (299). That is to say, it needs to be enacted by the temporal flow of a vast array of actions or others—others who enact, or *impart* to it the conditions of possibility of action in particular ways. The *specifics* of these prior actions matter because they are ontologically significant with regard to the sort of actor the subsequent practice will become (as Law suggested above).

Moreover, inheriting (by subsequent), or imparting (by prior), relations (or actions) are never straightforward. They are never direct, automatic or self-evident, because they are always themselves subject to enactment by mediators (Latour 1993, p.81). In addition, mediators “transform, translate, distort, and modify the meaning or the elements they are supposed to carry” (Latour 2005, p.39). Thus, what we see is that action (or agency) is a complex inheriting/imparting intra-relational whole in which it is “distributed, variegated, multiple, dislocated and remains a puzzle for the analysts as well as for the actors” Latour (2005, p.60). Specifically, agency (or action) is never owned or original to any actor (or line of code) as such. Thus, what we have in the fullness of becoming is not some neatly ordered flow of agency, but rather an ‘agentic swarm’ (Bennett 2010, 32) of flows in which all actors in the ontological choreography (Thompson 2007) participate creatively, but which none of them can determine in any significant way whatsoever. Indeed, to keep the code running ‘as code’ is a significant sociomaterial accomplishment, requiring the circulation of action in a complex sociomaterial heterogeneous assemblage, even if it may be seen as routine. What has been suggested about the performativity of algorithms is true for all sociomaterial assemblages. Why then is there a particular concern with algorithms? Why do they need particular scrutiny?

The supposed power of algorithms, or, why they concern us?

Algorithms (implemented as software) are said to be powerful, and dangerous, for a variety of reasons (Barocas, Hood, and Ziewitz 2013). We will highlight two of these, inscrutability and executability. Algorithms concern us because they seem to operate under the surface, or in the background—that is, they are *inscrutable*. We cannot directly inspect them (as object code or machine-executable code) or, in many cases, understand them as source code. Even if we can read the source code, it seems unlikely that one can fully scrutinise the precise nature of its actions when we have 50 million lines of source code to inspect (apparently Windows Vista consists of 50 million lines of source code). This is even truer for machine learning algorithms—which are becoming very widespread with the explosion of big data. Machine learning and genetic algorithms evolve based on their exposure to an ever-increasing set of ‘big data.’ They become black boxes, even to their designers (Heaven 2013). Thus, decisions become encoded and encapsulated in complex inscrutable algorithms that enact (in millions of lines of source code) our supposed choices based on complex relational conditions, which after many iterations of ‘bug fixing’ and ‘tweaking’ even the programmers often no longer understands. As Ullman (1997a, 116/7) observes:

> “The longer the system has been running, the greater the number of programmers who have worked on it, the less any one person understands it. As years pass and untold numbers of programmers and analysts come and go, the system takes on a life of its own. It runs. That is its claim to existence: it does useful work. However badly, however buggy, however obsolete - it runs. And no one individual completely understands how.”

Once encoded, the design decisions (or rather the outcomes of the initial hacking and tweaking) embedded in these multifarious encoding entanglements withdraw into the background and are hardly ever revisited—not even if they break down, because patching and workarounds would normally suffice. Yet some have argued that these encoded geographies (S. D. N. Graham 2005) seem to configure and circumscribe us and our lives in more or less significant ways. Defining what is relevant and what is not; what needs attending to and what does not. As such a ‘technological unconscious’ is emerging which sustains a “presence which we cannot access but which clearly has effects, a technical substrate of unconscious meaning and activity” (Thrift and French 2002, 312).

Others argue that algorithms are very significant actors because they are *executable*. Being ‘executable’ is a significant claim. If software code is directly executable then it means these algorithmic systems can operate 'automatically' (in the background) without the need of human intervention. Galloway (2004) argues, for example, that software code is very different from ordinary language as "[software] code is the only language that is executable." In a similar manner Ullman (1997b) suggests that "We can use English to invent poetry…. In programming you really can't. ... a computer program has only one meaning: what it does…. Its entire meaning is its function." Hayles (2005, 50) in her essay "Speech, Writing, Code" tends to agree with these claims. She suggests, "code that runs on a machine is performative in a much stronger sense than that attributed to language" since, she argues, "the performative force of language is...tied to the external changes through complex chains of mediation." Whilst one might agree with the general point, one could equally argue that these distinctions, between software code and ordinary language, for example, are distinctions of degree rather than distinctions of kind. It is possible to argue that all forms of code must as such be 'executable'—otherwise it would not translate/transform agency (Latour 1988). Legal code, to translate the agency of the legislative body, also needs to be executable. The difference between these various types of 'executability' is the nature of the *necessary constitutive conditions* for such execution. Indeed Wittgenstein (2001) would suggest to Ullman that the meaning of all language, not just software, "is its function." Nevertheless, there is a sense in which the 'executability' of code is different from everyday language and this makes it amenable to be embedded—and subsumed—in sociomaterial assemblages more successfully. As such, one might argue that they are potentially more dangerous kinds of actors.

If algorithms are inscrutable and thus can operate automatically and in the background, then they are most certainly actors with which we should concerned. However, one can argue that the more fundamental point of why we should concern ourselves with their inscrutability and automaticity is their *performativity*. In their flow of action they enact objects of knowledge and subjects of practice in more or less significant ways. They are, as Law suggests above, *empirical practices with ontological contours*. Their actions are not just in the world, they make worlds. Their simultaneous enactment of the empirical, ontological and normative is the issue of concern. Nonetheless, their operation is always enacted in the flow of a relational sociomaterial whole, which is irreducible to any of the assumed actors. Thus, we should be careful not to imagine them to be powerful or dangerous as such. We always need to understand them in their embeddedness in the sociomaterial assemblages of everyday practices.

Algorithms, governance and governmentality

If one accepts the argument that algorithms are important sociomaterial actors in contemporary society, then the question of governance of their actions, or of these actors, naturally emerges. The relation between algorithms and governance is complex, and performative, as we hope to show. However, first it might be useful to say what we mean by governance. Governance has emerged as an important concept or way of thinking about government in a new and different way (Rhodes 1996; Stoker 1998; Kooiman 1999; Kooiman 2008; Chhotray and Stoker 2009). The argument is made that government in contemporary society—as process not entity—happens in a complex space of public, private and hybrid actors participating in identifying and addressing common problems in some interactive mutually dependent manner (Kooiman 2008). It suggests that the governed in society cannot be directly controlled by the use of command or coercive power— by the state or by other political or administrative elites. Central to the notion of governance is the idea of a plurality of actors in which none of the actors has the power or authority to decide and implement solutions or policies unilaterally and directly (Walters 2004). In that sense, it is unlike management or control that assumes such power and authority, at least theoretically. Rather, it points to some level of social order that is not externally imposed but is the result of a multiplicity of more or less autonomous, but interdependent, actors or institutions influencing each other in pursuit of overlapping and sometimes diverging goals and interests (Chhotray and Stoker 2009).

Foucault expresses the process of governance more succinctly. He suggests that governance is the 'conduct of conduct,' or the power to act on the actions of others (Burchell 1991, 2). He uses the term *governmentality*, which "refers to the conduct of conduct, especially the technologies that govern individuals. It captures the way governments and other actors draw on knowledge to make policies that regulate and create subjectivities" (Bevir 2010, 423). Foucault's shift to the notion of governmentality is important for us because of the way it 'rethinks' the practices and technologies of governance. It is also consistent with the idea of performativity. With the notion of governmentality he moves from the 'what' to the 'how' of governance. For him the specific practices are important since they enact particular forms of subjectivities that *self-govern*. Furthermore, for him the practices of governmentality operate within assumed domains of knowledge (or regimes of truth). Thus, the concept of governmentality focuses our attention on *how* practices, knowledge, and power become interconnected to enact particular *governed* subjects (or rather subjectivities) in a variety of institutional settings (such as the asylum, the clinic and the prison). How can these different conceptions of governance relate to algorithms?

If one considers the relation between governance and algorithms then three possible ways of thinking about the problem of governing seem possible. *First*, one can imagine governing agencies that might want to *govern the algorithms* (or those who create the code) *directly*. In other words, actors who might assume the specific algorithmic actors to be important locations of agency and might want to focus on them as such. For example there are those who suggest that the development of these algorithms should be more open and value centered (Friedman 1997; Nissenbaum 2001; Knobel and Bowker 2011; Flanagan and Nissenbaum 2014). Lessig (2006, 79) suggests that "code writers are increasingly lawmakers. They determine what the defaults of the Internet will be; whether privacy will be protected; the degree to which anonymity will be allowed; the extent to which access will be guaranteed….My claim…is that cyberspace is regulated by its code…" As such, he calls for ‘open code’, which is “code (both software and hardware) whose functionality is transparent at least to one knowledgeable about the technology” (139).

This call to ‘openness’ (or transparency) has also been made by others (Machill, Neuberger, and Schindler 2003; Van Couvering 2007). The lack of openness has meant that users and researchers would often consider the actual behaviour of algorithms in thinking about governance. For example, the ranking algorithms of Google and Tripadvisor are routinely criticised for bias and in need of some form of governance (Goldman 2008; Diaz 2008; Scott and Orlikowski 2012). Google’s autocomplete function has been accused of perpetuating racist and other stereotypes (Baker and Potts 2013). Arguments are frequently made for the technology companies (Google, Facebook, Twitter, etc.), or government, to become actively involved in regulating the actions of these algorithmic actors. For example, Baker and Potts suggests that “that Google should seriously consider removing any statements from auto-complete that are consistently flagged [as problematic] (Baker and Potts 2013, 201). Likewise, many authors are calling for high frequency trading and algorithmic trading to become more regulated. They often argue that the HFT algorithmic actors gain unfair advantage in the market (Brown 2011). Whilst these attempts at regulating code itself are helpful, they tend to overemphasise the agency of the algorithms and do not appreciate sufficiently the embeddedness of these in sociomaterial practices, and more importantly, the performative nature of these practices.

A *second* way of considering the relation between governance and algorithms is to see algorithms as important actors *to enact governance*. There is a very significant body of work in this regard. Sometimes this is described as ‘algorithmic regulation’ (Goldstein, Dyson, and Nemani 2013). Algorithms acting as part of regulatory regimes are very widespread. For example the regulation of traffic in the centre of London through a system of congestion charging enacted through number plate recognition systems; the use of facial recognition systems for identification at airports; the use of algorithmic CCTV to identify suspects; the use of algorithms to detect fraudulent credit card transactions, and so forth (Lyon 2001). Below we will consider the governance of academic writing through plagiarism detection systems as a specific example. Algorithmic governance is often criticised for the ‘automatic’ nature of its operation (Norris 1995), its categorical seduction (Lyon 1994), the complex chains of mediation involved (S. Graham and Wood 2003), and the arbitrary or biased nature of its ‘social sorting’ (Lyon 2003). These emerging forms of algorithmic regulation open a new, and contested, landscape of political action. Thrift and French (2002, 331) argue that they require of us “to understand new forms of technological politics and new practices of political invention, legibility and intervention that we are only just beginning to comprehend as political at all: politics of standards, classifications, metrics, and readings…”

A *third* way of thinking about the relation between governance and algorithms is to see it in relation to the Foucauldian notion of governmentality, as suggested above. This approach will be followed in the next section when we consider the governance of academic writing.

Governmentality has been used by many scholars to account for governing practices in a variety of settings—see for example Drake (2011) and Kitto and Higgins (2010) in this journal. Some of the most influential of these scholars are Miller and Rose (Rose 1999a; Rose and Miller 2008). One dominant feature of their work is the focus on *calculative practices.* They suggest, "it is through technologies that programmes of government are made operable. And calculation… [is]one of the pre-eminent modalities of making programmes operable." More specifically, technologies of governance are the specific practices through which expertise and subjects become constituted through calculative practices. Rose (1998, 91) argues that psychological expertise, produced through calculative practices such as psychometric tests, "makes intersubjectivity calculable, enabling the calculated supervision and administration of collectivities. The social space of the factory, the school, the organization, and indeed the 'public' sphere itself has thereby been opened to calibration and management." Miller (2008, 58) in his studies of the calculative practices of accounting—such as double entry bookkeeping, corporate financial reporting and managerial accounting—show how "the single financial figure is a technology of intervention par excellence… [it] not only accords objectivity and neutrality, it makes comparable activities and processes that may otherwise have little in common. The single financial figure, as produced by the calculative routines of accounting, can link up agents and activities into a functioning calculative and programmatic ensemble. … [it can transform social spaces] into a laboratory in which the 'experiment' is to conduct novel forms of calculation while at the same time seeking to devise novel forms of personhood and identity" (see also: Miller and Rose 1990; Miller and Napier 1993; Miller 2004).

We will suggest that this approach of governmentality will allow us to make visible the performative nature of algorithms (and all other actors) in the flow of action of a sociomaterial assemblage. Moreover, it will show that these technologies of governance are linked to regimes of knowledge, and are constitutive of particular subjectivities. The argument would be that the governance *of* algorithms, *or through* algorithms, must itself be understood as practices of governmentality in order to understand *the doing of governance*.

Algorithms, governmentality and academic writing

> *Government is a problematizing activity: it poses the obligations of rulers in terms of the problems they seek to address. The ideals of government are intrinsically linked to the problems around which it circulates, the failings it seeks to rectify, the ills it seeks to cure. (Rose and Miller 1992, 181)*
>
> *Since 1996, Turnitin has been helping millions of faculty and students in over eighty-five countries improve writing and research skills, encourage collaborative online learning, ensure originality of student work, and save instructors' time (Turnitin documentation)*

The algorithmic actor *Turnitin* is embedded in the educational practices of 3500 higher education (HE) institutions globally. These institutions submit approximately 123,000 texts to be checked by *Turnitin* every day (45 million in 2013). In addition, 33 million texts were submitted by 2,862 secondary schools in the United States in the last eight years. Its sister company iThenticate is embedded in the academic publishing practices of 530 journal publishers to "to detect plagiarism and attribution issues." This is the algorithmic governance of academic writing on an unprecedented scale. Why did academic writing come to be seen as a 'problem' in need of such governance? If governed, what are the technologies of governance that make academic writing practices calculable, and what sort of knowledge and subjects do such calculating practices produce or assume? In the words of Rose and Miller (1992, 179) we want to understand the algorithmic practices of plagiarism detection as "a kind of intellectual machinery or apparatus for rendering reality thinkable in such a way that it is amenable to political deliberations [and intervention]." Before proceeding, we emphasise that the purpose of this discussion is to reveal the performative nature of governing practices. *It is not to take a normative view on the issue of plagiarism as such.*

Plagiarism as a problem to be governed

Why did plagiarism emerge as a 'problem to be addressed?" Some educators will respond by saying that there has been a dramatic increase in plagiarism in recent years (Jones 2011)—although others, such as Simmons (1999), would dispute this. Others would suggest that electronic writing, and the fact that most of the sources are available in electronic form, encourages and enacts new and different practices of writing (Heim 1999). Howard (1995) refers to these practices as 'patch-writing,' a form of writing in which composition is reconstituted as a practice of 'cutting and pasting' fragments of material into larger wholes, which are then more or less edited, in order to produce essays or assignments. Others (the majority) would say that this is a problem because it is a form of cheating—that is, presenting another's work as your own, hence the charge of 'plagiarism'. Why is the problem in, or with, academic writing framed in the language of *ownership, cheating or stealing*?

When plagiarism is discussed the canonical reference deployed would be that of the Roman poet Martial (Terry 2007). In the time of Martial most poetry circulated as performances in a gift economy, supported by patronage (Winsbury 2009). However, as poetry becomes embedded in the manuscript, and the manuscript starts to circulate in the booksellers market (throughout the Roman Empire and beyond), poetry becomes constituted as a commodity (Reichmann 1938). Mira Seo (2009, 583) suggests that "in Martial's poetry, the book as object is never far from the marketplace: its promiscuous distribution is associated with its status as merchandise, with an implied monetary value. And once this monetary value has been established, plagiarism can enter the literary discourse." He concludes, "plagiarism requires commodification to work" (ibid, 590). If this is the case then one might ask why academic writing has become constituted as the production and ownership of commodities. What is the rationality that makes it intelligible as such?

Neo-liberal reforms have progressively moved education from the public sphere to the private sphere, giving rise to what scholars call 'academic capitalism' (Hackett 1990; Slaughter and Leslie 1999; Olssen 2004). Universities are increasingly seen as producer of economic value through mechanisms such as intellectual property, industrial impact, and the delivery of productive and enterprising employees. Students are increasingly expected to pay the majority of the cost of their education by themselves (the new fee regime in the UK being an example). Incurring significant debt—or having significant resources to spend--transforms the manner in which student and university conceive of each other. Thus, universities conceive of students as potential customers for their programmes, in a competitive market (Molesworth, Nixon, and Scullion 2011). Molseworth *et al.* (2009, 278) suggest that "the current market discourse promotes a mode of existence where students seek to 'have a degree' rather than 'be learners'." Students see 'having a degree' as an investment in future career prospects, linked to notions such as employability. In the context of such a neo-liberal market economy rationality—supported by governing technologies such as league tables, student satisfaction surveys, institutional audits, and the like—traditional subjectivities and practices become reconstituted (Shore and Wright 2004; Shore 2008). The student is now increasingly enacted as a customer, the academic as a service provider, and the academic essay (with its associated credits) is enacted as the site of economic exchange—academic writing for credit, credit for degree, degree for employment, and so forth. Within such a rationality, academic writing is an important commodity whose originality (or ownership) needs to be ensured—that is, against the unoriginal copy, presented fraudulently. To govern this problem there is a need for a technology of governance that would enact a domain of knowledge within which legitimate (and illegitimate) practices could be "articulated and made operable" for governing activities and programmes (Miller 2004, 179).

Technologies of governance: the calculating subject as an original writer

Algorithms are of significant interest for governmentality because they are often enacted as calculative practices that constitute 'technologies of government.' Such technologies of government aim to establish "a multitude of connections…between the aspirations of authorities and the activities of individuals and groups" (Rose and Miller 1992, 183). As such, Rose and Miller suggest, "we need to study [these] humble and mundane mechanisms by which authorities seek to instantiate government…" (ibid, 183). In governing the problem of plagiarism, *Turnitin* functions as such a mundane technology of government.

How does *Turnitin* make originality of ownership calculable? *Turnitin* is a text-matching algorithm. It compares a reference text (an essay for example) with source texts in its database in order to identify text fragments in the reference text that are similar to text fragments in the source database—similarity is exact correspondence in the string of consecutive characters.[3] This implies that the matched text fragments in the reference text were copied from the source texts in the database. They claim that their database contains 45 billion web pages, 337 million student papers, and 130 million academic articles (papers, books, etc.). Thus, original texts are enacted as texts where there are no matches, and texts matched to the database are enacted as unoriginal. Unoriginal text fragments might be citations, quotations, or commonly used standard phrases; or, it might be 'stolen' 'plagiaristic' copies. The algorithm provides an 'originality report' that provides an overall 'similarity index,' which is the percentage of text in the reference document that was matched with sources in the database. The similarity index is categorised into four categories: *blue* - no matching text, *green* - one word to 24% matching text, *yellow* - 25-49%, *orange* - 50-74%, *red* - 75-100% matching text. The similarity index, like the calculative practices of accountancy, "have one defining feature that sets them apart from other forms of quantification: their ability to translate diverse and complex processes into a single financial figure" (Miller 2004, 180) Interpreting what the similarity index percentage actually means is a matter of professional judgement. For example a professor of political science comments on his interpretation of the similarity index (Jacob 2008):

> *I have found that the scores I prefer range between 20 and 35 percent. Rather than plagiarism, these scores usually confirm that this is a robust research paper with substantial use of quotations, footnotes, and bibliography. It is these two things—footnotes and bibliography—which most inflate Turnitin's score. A very low score indicates a paper with few footnotes and references. A very high score indicates a "cut and paste" job which, even if footnoted, is unacceptable to me. The highest score I have ever seen is 85 percent in a paper in which Turnitin flagged the entire first two pages in red, indicating they came from other sources. Yet, the student had footnoted those pages faithfully and persistently throughout. For me, this was less a case of deliberate plagiarism than one of a student who had no idea how to write a research paper and use sources properly.*

This comment shows how *Turnitin*, through a single figure, makes a multitude of connections between the aspirations of professor and the writing practices of the students. Through the similarity index score he can discern 'a robust research paper,' a not-so robust paper, and a 'cut and paste job.' He can also discern bad writing practices and perhaps intentionality: "this was less a case of deliberate plagiarism than one of a student who had no idea how to write a research paper and use sources properly." He further suggests that he does not use *Turnitin* as a 'sheriff' but rather allows students to see their originality reports in order to take corrective action. In this way, he suggests, he has made his students "partners in policing their own work." Indeed students have become very aware of this governing technology, as calculating subjects. As such, they participate in their own self-formation as such subjects, as the following comments suggest:

> *I just submitted in my draft for Modern History on the Civil Rights Movement and got an originality report of 57%. Am I going to get in trouble for this?*
> *http://forums.whirlpool.net.au/archive/1698663*

> *I feel like mine [similarity score] is quite high but my reference list and course work front page are the culprits that are making it high…probably panicking over nothing…* [*http://www.studentmidwife.net/fob/turn-it-in-percentage.77941/*](http://www.studentmidwife.net/fob/turn-it-in-percentage.77941/)

For the students the meaning of the single figure of the similarity index was much more opaque—a number that was subject to intense discussions on various student forums.

Performatively, the originality report also functions as a technology of correction and remediation. When the tutor engages with the originality report, it recontextualizes the student's text—as dissected and codified according to colour categories and links—as a text constituted through a variety of potentially illegitimate writing practices in need of remediation. As if, "the unoriginal or illegitimately copied student paper inherently means a kind of unhealthy or diseased alterity" (Marsh 2004, 429). Confronted with the knowledge of this 'unhealthy of diseased alterity' the tutor becomes constituted as one that needs to implement programmes of change to get rid of this disease, amongst other things. As such, tutors are encouraged to design assessments more 'holistically' so that they do not encourage these illegitimate practices (Macdonald and Carroll 2006). Faced with these originality reports, the tutors also become implicated as in need of remediation. They need to change the way they teach and assess to prevent these illegitimate practices. Thus, they are constituted as also being a source of such practices, in need of some remediation.

Enacting the self-governed original writer

If this technology of government is becoming an immutable mobile (Latour 1986) in enacting knowledge about the legitimate versus the illegitimate—with reference to academic writing practice—then it matters exactly how this is enacted and what its performative effects are. *Turnitin* detects similarity *when a sufficiently long string of consecutive characters from the 'original' is retained* in the submitted text. For detection to happen the location of the consecutive string of characters within the copied fragment is important due to the 'sampling window.' In some cases a small amount of change in the right way (or place) will make a copied fragment undetectable and in other cases a large amount of editing will still make it possible to detect (Gillam, Marinuzzi, and Ioannou 2010). Students who are linguistically competent (native speakers) can often take copied text fragments and 'write over' them in order to render them undetectable; others with less competency (often non-native speakers) struggle to do this as they often lack the vocabulary and grammar skills to achieve it. In addition, novices at academic writing, or those facing new and complex disciplinary language, also tend to retain larger fragments, and are more likely to be detected (Roig 2001; Sommers and Saltz 2004). Thus, what the algorithms often detect is *the difference between skilful copiers and unskilful copiers*. What this algorithmic governance enacts is a particular understanding of originality and plagiarism, as well as subjects who conceive of 'good' writing practice as the composition of undetectable texts.

The subjects produced in the sociomaterial assemblage of plagiarism detection enact themselves in terms of these governing practices. They internalize these calculating practices, and the knowledge they legitimate, to become self-governed subjects. Some student writers become obsessively self-reflective, continually checking themselves to see that they are 'clean,' just in case. Some institutions allow students to submit their work prior to submission so that they can correct it before formally submitting. If they do not, *Turnitin* offers a paid service called 'WriteCheck' at $7.95 per paper, for students to check themselves. A student's testimonial on their website reads: "I am concerned about catching any plagiarism or missed citations in my papers. WriteCheck allows me the opportunity to make sure that I do not [plagiarize] and correct any citations needed." With such a check, students can be confident of their originality, or be certified as the legitimate owners of their writing objects. Students also become active in the governance of their peers. For example, "At UC Davis…students give their peers free cards stamped, 'Honesty is the only policy,' and free No. 2 pencils with the inscription: 'Fill in your own bubble or be in trouble'" (Weiss 2000). Others reconstitute the writing practice as a place where the governing technologies need to be challenged. Thus, the writing practice becomes constituted as enacting different ways to 'beat the system'(Attwood 2008).

When academic writing practice is constituted as a relatively neo-liberal site for economic exchange one would expect an economic rationality to prevail. In this rationality, reuse of text—taken from a variety of sources—makes sense. It seems to be a more efficient practice of composition. However, one needs the skills to integrate it into a coherent whole, difficult to achieve for non-native authors. Even more efficient, and original, is to outsource this practice to a site where the activity can be done for less cost, such as using ghost-writing services. The multitude of essay writing sites offering such services (or paper mills as they are sometimes called), suggests that this is not an unusual practice.[4] Ghost-writing is not just a practice associated with student academic writing practices, it is also present in the writing practices of academic researchers, especially in the medical field (Ngai et al. 2005; Sismondo 2009)—and more generally in society (Brandt 2007). The point is that the prevailing rationality, and the governing technology, have produced a very particular regime of practice when it comes to academic writing. The inheritance from these governing practices are complex and multiple—for example, they have enacted a particular understanding of what academic writing is, what plagiarism is, what students are, and what teachers are. Zwagerman (2008, 692), a professor of English at Simon Fraser University, reflects on the outcome of these governing practices: "[p]lagiarism detection treats writing as a product, grounds the student-teacher relationship in mistrust, and requires students to actively comply with a system that marks them as untrustworthy." Indeed, it seems that the governing practices might be re-producing the subjectivities and practices that were initially problematized, and that it was supposed to govern in the first place.

More could be said in terms of the academic writing practices of academic staff, but we will not pursue it further here. Rather, we want to consider the implications of thinking about algorithms and governance in terms of governmentality.

Algorithms, governance and governmentality: some concluding thoughts

> *These assemblages are heterogeneous, made up of a diversity of objects and relations linked up through connections and relays of different types. They have no essence. And they are never simply a realization of a programme, strategy or intention: whilst the will to govern traverses them, they are not simply realizations of any simple will (Rose 1999b, 52).*

Algorithmic action has become a significant form of action (actor) in contemporary society. There is a general unease with the way these actors are becoming embedded in a vast array of daily practices. They are seen as troublesome because they seem to be inscrutable yet acting automatically in more or less significant ways. They also seem to be ordering social practices in both the private and the public sphere—whether it be social spaces, cities, financial markets, or government itself. As such, there is a strong sense that they need to be governed more explicitly. Governance by its very nature is never straightforward. However, one could argue that in the case of algorithmic action this is even more so.

As was indicated above, some authors have suggested the need for more open transparent algorithms—obviously, problematic when proprietary algorithms are at stake, as is often the case. Nonetheless, opening up algorithms, or algorithmic behaviour, is important. For example, Introna and Nissenbaum (2000) showed how the logic of the Google indexing and ranking algorithm can produce a particular visible web, making some sites prominent and others more or less invisible. Governance through openness and transparency is certainly important. However, such an approach risks locating, or placing too much agency 'in' the algorithmic actor, rather than in the temporal flow of action in the assemblage as a whole. For example, understanding the logic of the *Turnitin* algorithm meant that one could deduce that those with linguistic skills could 'write over' copied fragments to make them undetectable. One potential outcome could be that non-native speakers are detected disproportionately. This is an important issue to highlight. However, we have argued that the *doing* of the algorithm should also be understood in the temporal flow of the becoming of the sociomaterial assemblage of academic writing. Specifically, the embedding of *Turnitin* in the academic writing practices of students enacted (or imparted) a particular knowledge regime of what legitimate and illegitimate writing practices were. Thus, one might say that the writing practices unwittingly inherited from the preceding actor notions of legitimacy or illegitimacy with regard to writing practices. The students also inherited a particular understanding of themselves as 'original' writers or 'owners' of their texts—that is, as subjects producing original (undetected) texts rather than subjects developing themselves as learners of a discipline. As such, an important governance question is what algorithmic actors impart to the practices in which they become embedded. However, we would suggest that such questions could only really be understood within a broader discourse that articulated the problem (of plagiarism) for which the algorithmic actor is taken to be the governing technology. In other words the actions (or doing) of governing practices, and especially technologies of governance, should be seen within the Foucauldian framework of governmentality.

Governmentality allows us to see the performative outcomes of governing practices. For example, it helps us to consider some of the conditions under which the problem of plagiarism has become articulated as such—or, one might say, the conditions under which the need to rectify the problem of plagiarism has become taken as necessary, inevitable, and the natural thing to do. As Rose and Miller (1992, 181) suggests, "government is a problematizing activity…the ideals of government are intrinsically linked to the problems around which it circulates, the failings it seeks to rectify, the ills it seeks to cure." We would suggest that some historical understanding of the problematizing practices, and their inheritances, are important to understand the doing of algorithms. However, that is not enough. Of particular import are the technologies of government. Here algorithms and the calculative practices that they enact are significant.

Calculative practices are constitutive of domains of knowledge and expertise. They have a certain moral authority because they are taken to impose *objectivity and neutrality* in a complex domain that is already loaded with moral significance (plagiarism in our case). The similarity index and the links to copied fragments of the originality report impose an objective and neutral determination on the matter at hand. As such, many tutors argue that they must submit all their students' work to *Turnitin*, in the pursuit of fairness, because they will not normally detect skilful copiers. In other words, they do not trust their own expertise and judgement but rather accept the authority of the algorithm to be objective. The knowledge regime of the originality report is also taken as definitive determination when a student is subject to disciplinary procedures, for example. Once a particular set of calculative practices are established as legitimate (or true) they tend to become internalized by the subjects they are supposed to govern, thus producing the self-governing subject. As such, students are prepared to pay *Turnitin* to check them in order to certify themselves the owners of their texts, 'just in case.' Thus, understanding governing practices in the idiom of governmentality allows us to see how problems, technologies of governance, regimes of knowledge, and subjectivities, become mutually constitutive of each other to create a regime of government that has no specific essence (location or unified action). All the performative outcomes are "never simply a realization of a programme, strategy or intention: whilst the will to govern traverses them, they are not simply realizations of any simple will" (Rose 1999b, 52).

Finally, what seems clear is that the practices of governance will themselves become embedded in the flow of becoming of a sociomaterial assemblage with more or less performative outcomes. In other words, they cannot locate themselves *outside* of the performative flow. It might be that such governing practices become deployed to problematize further the assumed problems. If they are algorithmic actors they might enact new domains of knowledge, which, if internalized, would enact new and perhaps unexpected subjectivities. In short, the practices of governance themselves may need to be governed, for they are never secure as such. The task of governance is always fraught with new possibilities for problematization, triggering new governing practices, creating new opportunities for problematization, and so forth. The task of governing is itself an open-ended becoming. This is the dilemma of governing and algorithms, as technologies of government, which render practices more or less calculable, will have many expected and unexpected performative outcomes.

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NOTES

1 The algorithm for a bubble sort consists of the following set of instructions: Starting from the beginning of the list, compare every adjacent pair, swap their position if they are not in the right order. After each iteration, one less element (the last one) needs to be compared. Do it until there are no more elements left to be compared. It is possible for a human to follow these instructions but because of the repetitive nature of the task, we are likely to give it to a machine to do. If so, the algorithm must be specified in a source language such as Java or C++. A skilled programme can take an algorithm (as the one above) and express it in a computing source language such as, for example C++ or Java. This C++ source code needs to be translated into a machine executable form in order to be 'executable' on a computing device. This is done in a variety of ways, such as through object code or real-time interpreters. The exact nature of the final machine executable code depends on the specific hardware configuration—such as the type of CPU (central processing unit) of the computing device. Machine code is usually not directly readable by humans.

2 Performativity is a relatively well-established tradition in Science and Technology Studies (STS) and is associated with the 'practice turn' in STS (Jensen 2004). The practice turn is exemplified by the work of Latour and Woolgar (1986), Knorr-Cetina (2000; 2002), and Law (1991), amongst many. Not all practice-oriented scholars have foregrounded performativity explicitly. In Economic Sociology Callon (2007) has done so, likewise with MacKenzie (2008) in the Sociology of Finance. Nonetheless, only a relatively few scholars in STS that have made it an explicit part of their vocabulary such as Pickering (1995a), Mol (2003) and Barad (2007), for example. Even so, it seems true to say that performativity has become implicitly or explicitly accepted, and vital to, a significant body of work in STS. One might even suggest that it has led to what is described as the 'ontological turn' in STS ((Woolgar and Lezaun 2013; Heur, Leydesdorff, and Wyatt 2013).

3 How does the Tunitin algorithm do its work? A simple approach would be to compare a document character by character. However, this approach has a number of problems: (a) it is very time-consuming and re-source intensive; (b) it is not sensitive to white spaces, formatting and sequencing changes; and (c) it cannot detect part copies from multiple sources. To deal with these problems Turnitin has developed a proprietary algorithm, which is inaccessible as such. However, we have studied the logic of certain published algorithms, such as winnowing (Schleimer, Wilkerson, and Aiken 2003), as well as doing some preliminary experimental research on the way the Turnitin algorithm seems to behave. From these we are able to discern some of it behaviours. The detection algorithm operates on the basis of creating a digital 'fingerprint' of a document, which it then uses to compare documents against each other. The fingerprint is a small and compact representation (based on statistical sampling) of the content of the document that can serve as a basis for determining correspondence between two documents (or parts of it). In simple terms, the algorithm first removes all white spaces as well as formatting details from the document to create one long string of characters. This often results in a 70 percent reduction of the size of the document. Further processing is done to make sure that *sequences of consecutive groups of characters* are retained and converted through a hash function to produce unique

numerical representations for each sequential group of characters. The algorithm then takes a statistical sample from this set of unique numerical strings (or hashes) in such a way as to ensure that it always covers a certain amount of consecutive characters (or words) within a sampling window and stores this as the document's fingerprint. A fingerprint can be as small as 0.54 percent of the size of the original document.

4 Here is an example http://essaypedia.com/ (one of many). An undergraduate essay of 10 pages within three days will cost you $300. A recent article in the Sydney Morning Herald revealed that: "Thousands of students have enlisted a Sydney company to write essays and assignments for them as well as sit online tests, paying up to $1000 for the service" (McNeilage and Visentin 2014). Nevertheless, 40 years ago (in 1973) a professor of political science Stavisky (1973) wrote in the *Political Science Quarterly* about the already prevalent practice of using ghost-writers (or paper mills) by students – and some of the regulatory issues involved.

References

Attwood, Rebecca. 2008. "Institutions Limit Access to Anti-Cheat Software." *Times Higher Education*. June 26. http://www.timeshighereducation.co.uk/news/institutions-limit-access-to-anti-cheat-software/402540.article.

Bachman, Katy. 2014. "Consumer Confidence in Online Privacy Hits 3-Year Low." *AdWeek*. Accessed November 28. http://www.adweek.com/news/technology/consumer-confidence-online-privacy-hits-3-year-low-155255.

Baker, Paul, and Amanda Potts. 2013. "'Why Do White People Have Thin Lips?' Google and the Perpetuation of Stereotypes via Auto-Complete Search Forms." *Critical Discourse Studies* 10 (2): 187–204. doi:10.1080/17405904.2012.744320.

Barad, Karen. 2007. *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Durham and London: Duke University Press.

Barocas, Solon, Sophie Hood, and Malte Ziewitz. 2013. *Governing Algorithms: A Provocation Piece*. SSRN Scholarly Paper ID 2245322. Rochester, NY: Social Science Research Network. http://papers.ssrn.com/abstract=2245322.

Bauman, Zygmunt, and David Lyon. 2012. *Liquid Surveillance: A Conversation*. 1 edition. Cambridge, UK; Malden, MA: Polity Press.

Bennett, Jane. 2010. *Vibrant Matter a Political Ecology of Things*. Durham: Duke University Press. http://site.ebrary.com/id/10393339.

Bevir, Mark. 2010. "Rethinking Governmentality: Towards Genealogies of Governance." *European Journal of Social Theory* 13 (4): 423–41. doi:10.1177/1368431010382758.

Brandt, Deborah. 2007. "'Who's the President?': Ghostwriting and Shifting Values in Literacy." *College English* 69 (6): 549–71. doi:10.2307/25472239.

Brown, Nathan D. 2011. "Rise of High Frequency Trading: The Role Algorithms, and the Lack of Regulations, Play in Today's Stock Market, The." *Appalachian Journal of Law* 11: 209.

Burchell. 1991. *The Foucault Effect: Studies in Governmentality*. 1st Edition. Chicago: University of Chicago Press.

Butler, Judith. 1988. “Performative Acts and Gender Constitution: An Essay in Phenomenology and Feminist Theory.” *Theatre Journal* 40 (4): 519–31. doi:10.2307/3207893.
———. 1990. *Gender Trouble: Feminism and the Subversion of Identity*. New York: Routledge.
Çalışkan, Koray, and Michel Callon. 2009. “Economization, Part 1: Shifting Attention from the Economy towards Processes of Economization.” *Economy and Society* 38 (3): 369–98. doi:10.1080/03085140903020580.
Callon, M. 2007. “What Does It Mean to Say That Economics Is Performative?” In *Do Economists Make Markets?: On the Performativity of Economics*, edited by Donald A. MacKenzie, Fabian Muniesa, and Lucia Siu, 316–49. Princeton, NJ: Princeton University Press.
Chhotray, Vasudha, and Gerry. Stoker. 2009. *Governance Theory and Practice: A Cross-Disciplinary Approach*. Basingstoke [England]; New York: Palgrave Macmillan.
Diaz, Alejandro. 2008. “Through the Google Goggles: Sociopolitical Bias in Search Engine Design.” In *Web Search*, edited by Amanda Spink and Michael Zimmer, 11–34. Berlin & Heidelberg: Springer.
Drake, Frances. 2011. “Protesting Mobile Phone Masts: Risk, Neoliberalism, and Governmentality.” *Science, Technology & Human Values* 36 (4): 522–48. doi:10.1177/0162243910366149.
Flanagan, Mary, and Helen Nissenbaum. 2014. *Values at Play in Digital Games*. 1 edition. MIT Press.
Friedman, Batya. 1996. “Value-Sensitive Design.” *Interactions* 3 (6): 16–23. doi:10.1145/242485.242493.
———. 1997. *Human Values and the Design of Computer Technology*. Cambridge & New York: Cambridge University Press.
Friedman, Batya, Peyina Lin, and Jessica Miller. 2005. “Informed Consent by Design.” In *Security and Usability: Designing Secure Systems That People Can Use*, edited by L. Faith Cranor and Simson Garfinkel, First edition, 495–522. Beijing; Farnham; Sebastopol, CA: O’Reilly Media.
Galloway, Alexander R. 2004. *Protocol: How Control Exists after Decentralization*. London: MIT Press.
Gillam, L., J. Marinuzzi, and P. Ioannou. 2010. “TurnItOff – Defeating Plagiarism Detection Systems.” In *11th Higher Education Academy-ICS Annual Conference, University of Durham, UK*. http://www.cs.surrey.ac.uk/BIMA/People/L.Gillam/downloads/publications/HEA-ICS_turnitoff.pdf.
Goldacre, Ben. 2014. “When Data Gets Creepy: The Secrets We Don’t Realise We’re Giving Away.” *The Guardian*. December 5. http://www.theguardian.com/technology/2014/dec/05/when-data-gets-creepy-secrets-were-giving-away.
Goldman, Eric. 2008. “Search Engine Bias and the Demise of Search Engine Utopianism.” In *Web Search*, edited by Amanda Spink and Michael Zimmer, 121–33. Berlin & Heidelberg: Springer.
Goldstein, Brett., Lauren. Dyson, and Abhi. Nemani. 2013. *Beyond Transparency: Open Data and the Future of Civic Innovation*. San Francisco, Calif.: Code for America Press.

Graham, Stephen D.N. 2005. “Software-Sorted Geographies.” *Progress in Human Geography* 29 (5): 562–80. doi:10.1191/0309132505ph568oa.
Graham, Stephen, and David Wood. 2003. “Digitizing Surveillance: Categorization, Space, Inequality.” *Critical Social Policy* 23 (2): 227–48. doi:10.1177/0261018303023002006.
Hackett, Edward J. 1990. “Science as a Vocation in the 1990s: The Changing Organizational Culture of Academic Science.” *The Journal of Higher Education* 61 (3): 241–79. doi:10.2307/1982130.
Hayles, N. Katherine. 2005. *My Mother Was a Computer: Digital Subjects and Literary Texts*. Chicago: University of Chicago Press.
Heaven, Douglas. 2013. “Not like Us: Artificial Minds We Can’t Understand.” *New Scientist* 219 (2929): 32–35. doi:10.1016/S0262-4079(13)61996-X.
Heim, Michael. 1999. *Electric Language: A Philosophical Study of Word Processing*. New Haven: Yale University Press.
Heur, Bas van, Loet Leydesdorff, and Sally Wyatt. 2013. “Turning to Ontology in STS? Turning to STS through ‘ontology.’” *Social Studies of Science* 43 (3): 341–62. doi:10.1177/0306312712458144.
Howard, Rebecca Moore. 1995. “Plagiarisms, Authorships, and the Academic Death Penalty.” *College English* 57 (7): 788–806. doi:10.2307/378403.
Introna, Lucas, and Helen Nissenbaum. 2000. “Shaping the Web: Why the Politics of Search Engines Matters.” *The Information Society* 16 (3): 169–85.
Jacob, Jim. 2008. “Using *Turnitin* as a Tool for Student Learning.” *Inside*. http://www.csuchico.edu/pub/inside/08_02_14/turnitin.shtml.
Jensen, Casper Bruun. 2004. “A Nonhumanist Disposition: On Performativity, Practical Ontology, and Intervention.” *Configurations* 12 (2): 229–61. doi:10.1353/con.2006.0004.
Jones, Dorothy L. R. 2011. “Academic Dishonesty: Are More Students Cheating?” *Business Communication Quarterly* 74 (2): 141–50. doi:10.1177/1080569911404059.
Kitto, Simon, and Vaughan Higgins. 2010. “Working around ERPs in Technological Universities.” *Science, Technology & Human Values* 35 (1): 29–54. doi:10.1177/0162243908329535.
Knobel, Cory, and Geoffrey C. Bowker. 2011. “Values in Design.” *Commun. ACM* 54 (7): 26–28. doi:10.1145/1965724.1965735.
Knorr-Cetina, Karin, and Urs Bruegger. 2002. “Traders’ Engagement with Markets.” *Theory, Culture & Society* 19 (5-6): 161–85. doi:10.1177/026327602761899200.
Knorr-Cetina, Karin, Theodore R. Schatzki, and Eike von Savigny, eds. 2000. *The Practice Turn in Contemporary Theory*. New York: Routledge.
Kooiman, Jan. 1999. “Social-Political Governance.” *Public Management: An International Journal of Research and Theory* 1 (1): 67–92. doi:10.1080/14719037800000005.
———. 2008. “Exploring the Concept of Governability.” *Journal of Comparative Policy Analysis: Research and Practice* 10 (2): 171–90. doi:10.1080/13876980802028107.
Kowalski, Robert. 1979. “Algorithm = Logic + Control.” *Communications of the ACM* 22 (7): 424–36. doi:10.1145/359131.359136.
Latour, Bruno. 1986. “Visualization and Cognition: Thinking with Eyes and Hands.” Edited by Henrika Kuklick. *Knowledge and Society: Studies in the Sociology of Culture Past and Present* 6: 1–40.
———. 1988. *The Pasteurization of France*. Cambridge Mass.: Harvard University Press.

———. 1999. *Pandora's Hope: An Essay on the Reality of Science Studies*. Cambridge Mass.: Harvard University Press.

———. 2005. *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford: Oxford University Press.

Latour, Bruno, and Steve Woolgar. 1986. *Laboratory Life: The Construction of Scientific Facts*. Princeton: Princeton University Press.

Law, John. 1991. *A Sociology of Monsters: Essays on Power, Technology, and Domination*. London: Routledge.

Law, John, and Marianne Elisabeth Lien. 2013. "Slippery: Field Notes in Empirical Ontology." *Social Studies of Science* 43 (3): 363–78. doi:10.1177/0306312712456947.

Lessig, Lawrence. 2006. *Code and Other Laws of Cyberspace*. New York: Lawrence Lessig.

Lyon, David. 1994. *Electronic Eye: The Rise of Surveillance Society*. 1 edition. Minneapolis: Univ Of Minnesota Press.

———. 2001. *Surveillance Society: Monitoring Everyday Life*. McGraw-Hill International.

———. 2003. *Surveillance as Social Sorting: Privacy, Risk and Automated Discrimination*. London: Routledge.

Macdonald, Ranald, and Jude Carroll. 2006. "Plagiarism—a Complex Issue Requiring a Holistic Institutional Approach." *Assessment & Evaluation in Higher Education* 31 (2): 233–45. doi:10.1080/02602930500262536.

Machill, Marcel, Christoph Neuberger, and Friedemann Schindler. 2003. "Transparency on the Net: Functions and Deficiencies of Internet Search Engines." *Info* 5 (1): 52–74. doi:10.1108/14636690310473890.

Mackenzie, Donald. 2008. *An Engine, Not a Camera: How Financial Models Shape Markets*. Cambridge, Mass.: MIT Press.

Marsh, Bill. 2004. "Turnitin.com and the Scriptural Enterprise of Plagiarism Detection." *Computers and Composition* 21 (4): 427–38. doi:10.1016/j.compcom.2004.08.002.

McNeilage, Amy, and Lisa Visentin. 2014. "Students Enlist MyMaster Website to Write Essays, Assignments." *The Sydney Morning Herald*. Accessed December 11. http://www.smh.com.au/national/education/students-enlist-mymaster-website-to-write-essays-assignments-20141111-11k0xg.html.

Miller, Peter. 2004. "Governing by Numbers: Why Calculative Practices Matter." In *The Blackwell Cultural Economy Reader*, edited by Ash Amin and Nigel Thrift, 179–89. Blackwell Publishing Ltd. http://onlinelibrary.wiley.com/doi/10.1002/9780470774274.ch10/summary.

———. 2008. "Calculating Economic Life." *Journal of Cultural Economy* 1 (1): 51–64. doi:10.1080/17530350801913643.

Miller, Peter, and Christopher Napier. 1993. "Genealogies of Calculation." *Accounting, Organizations and Society* 18 (7–8): 631–47. doi:10.1016/0361-3682(93)90047-A.

Miller, Peter, and Nikolas Rose. 1990. "Governing Economic Life." *Economy and Society* 19 (1): 1–31. doi:10.1080/03085149000000001.

Mol, Annemarie. 2003. *The Body Multiple: Ontology in Medical Practice*. Durham: Duke University Press.

Molesworth, Mike, Elizabeth Nixon, and Richard Scullion. 2009. "Having, Being and Higher Education: The Marketisation of the University and the Transformation of the Student into Consumer." *Teaching in Higher Education* 14 (3): 277–87. doi:10.1080/13562510902898841.

———. 2011. *The Marketisation of Higher Education and the Student as Consumer*. London: Routledge.

Ngai, STEPHANIE, JENNIFER L. Gold, SUDEEP S. Gill, and PAULA A. Rochon. 2005. "Haunted Manuscripts: Ghost Authorship in the Medical Literature." *Accountability in Research* 12 (2): 103–14. doi:10.1080/08989620590957175.

Nissenbaum, H. 2001. "How Computer Systems Embody Values." *Computer* 34 (3): 120–119. doi:10.1109/2.910905.

Norris, Clive. 1995. "VIDEO CHARTS: Algorithmic Surveillance." *Criminal Justice Matters* 20 (1): 7–8. doi:10.1080/09627259508552710.

Olssen, Mark. 2004. "Neoliberalism, Globalisation, Democracy: Challenges for Education." *Globalisation, Societies and Education* 2 (2): 231–75. doi:10.1080/14767720410001733665.

Pickering, Andrew. 1995a. *The Mangle of Practice: Time, Agency, and Science*. Chicago: University of Chicago Press.

———. 1995b. *The Mangle of Practice: Time, Agency, and Science*. Chicago, Illinois: University of Chicago Press.

Pollach, Irene. 2007. "What's Wrong with Online Privacy Policies?" *Commun. ACM* 50 (9): 103–8. doi:10.1145/1284621.1284627.

Reichmann, Felix. 1938. "The Book Trade at the Time of the Roman Empire." *The Library Quarterly* 8 (1): 40–76.

Rhodes, R. a. W. 1996. "The New Governance: Governing without Government1." *Political Studies* 44 (4): 652–67. doi:10.1111/j.1467-9248.1996.tb01747.x.

Roig, Miguel. 2001. "Plagiarism and Paraphrasing Criteria of College and University Professors." *Ethics & Behavior* 11 (3): 307–23. doi:10.1207/S15327019EB1103_8.

Rose, Nikolas. 1998. *Inventing Our Selves: Psychology, Power, and Personhood*. Cambridge: Cambridge University Press.

———. 1999a. *Governing the Soul: Shaping of the Private Self*. 2nd Revised edition edition. London; New York: Free Association Books.

———. 1999b. *Powers of Freedom: Reframing Political Thought*. Cambridge: Cambridge University Press.

Rose, Nikolas, and Peter Miller. 1992. "Political Power beyond the State: Problematics of Government." *The British Journal of Sociology* 43 (2): 173–205. doi:10.2307/591464.

———. 2008. *Governing the Present: Administering Economic, Social and Personal Life*. 1 edition. Cambridge: Polity Press.

Schleimer, Saul, Daniel S. Wilkerson, and Alex Aiken. 2003. "Winnowing: Local Algorithms for Document Fingerprinting." In *Proceedings of the 2003 ACM SIGMOD International Conference on Management of Data*, 76–85. SIGMOD '03. New York, NY, USA: ACM. doi:10.1145/872757.872770.

Scott, Susan V., and Wanda J. Orlikowski. 2012. "Reconfiguring Relations of Accountability: Materialization of Social Media in the Travel Sector." *Accounting, Organizations and Society* 37 (1): 26–40. doi:10.1016/j.aos.2011.11.005.

Seo, J. Mira. 2009. "Plagiarism and Poetic Identity in Martial." *American Journal of Philology* 130 (4): 567–93. doi:10.1353/ajp.0.0084.

Shore, Cris. 2008. "Audit Culture and Illiberal Governance Universities and the Politics of Accountability." *Anthropological Theory* 8 (3): 278–98. doi:10.1177/1463499608093815.

Shore, Cris, and Susan Wright. 2004. "Whose Accountability? Governmentality and the Auditing of Universities." *Parallax* 10 (2): 100–116. doi:10.1080/1353464042000208558.
Simmons, Sue C. 1999. "Competing Notions of Authorship: A Historical Look at Students and Textbooks on Plagiarism and Cheating." In *Perspectives on Plagiarism and Intellectual Property in a Postmodern World*, edited by Lise Buranen and Alice M. Roy, 41–51. Albany: State University of New York Press.
Sismondo, Sergio. 2009. "Ghosts in the Machine Publication Planning in the Medical Sciences." *Social Studies of Science* 39 (2): 171–98. doi:10.1177/0306312708101047.
Slaughter, Sheila, and Larry L. Leslie. 1999. *Academic Capitalism: Politics, Policies, and the Entrepreneurial University*. New Ed edition. Baltimore: Johns Hopkins University Press.
Sommers, Nancy, and Laura Saltz. 2004. "The Novice as Expert: Writing the Freshman Year." *College Composition and Communication* 56 (1): 124. doi:10.2307/4140684.
Stavisky, Leonard Price. 1973. "Term Paper 'Mills,' Academic Plagiarism, and State Regulation." *Political Science Quarterly* 88 (3): 445–61. doi:10.2307/2148993.
Stoker, Gerry. 1998. "Governance as Theory: Five Propositions." *International Social Science Journal* 50 (155): 17–28. doi:10.1111/1468-2451.00106.
Suchman, Lucille Alice. 2007. *Human-Machine Reconfigurations: Plans and Situated Actions*. Cambridge: Cambridge University Press.
Terry, Richard. 2007. "'Plagiarism': A Literary Concept in England to 1775." *English* 56 (214): 1–16. doi:10.1093/english/56.214.1.
Thompson, Charis. 2007. *Making Parents: The Ontological Choreography of Reproductive Technologies*. New Ed edition. Cambridge, MA: MIT Press.
Thrift, Nigel, and Shaun French. 2002. "The Automatic Production of Space." *Transactions of the Institute of British Geographers* 27 (3): 309–35. doi:10.1111/1475-5661.00057.
Ullman, Ellen. 1997a. *Close to the Machine: Technophilia and Its Discontents*. San Francisco: City Lights Books.
———. 1997b. "Elegance and Entropy: Interview by Scott Rosenberg." *Salon*. http://www.salon.com/21st/feature/1997/10/09interview.html.
Van Couvering, Elizabeth. 2007. "Is Relevance Relevant? Market, Science, and War: Discourses of Search Engine Quality." *Journal of Computer-Mediated Communication* 12 (3): 866–87. doi:10.1111/j.1083-6101.2007.00354.x.
Walters, William. 2004. "Some Critical Notes on 'Governance.'" *Studies in Political Economy* 73 (0). http://spe.library.utoronto.ca/index.php/spe/article/view/5728.
Weiss, Kenneth R. 2000. "Focus on Ethics Can Curb Cheating, Colleges Find." *Los Angeles Times*, February 15. http://articles.latimes.com/2000/feb/15/news/mn-64455.
Whitehead, Alfred North. 1978. *Process and Reality: An Essay in Cosmology*. New York, NY: Free Press.
Winner, Langdon. 1980. "Do Artifacts Have Politics?" *Daedalus* 109 (1): 121–36.
Winsbury, Rex. 2009. *The Roman Book: Books, Publishing and Performance in Classical Rome*. London: Duckworth.
Wittgenstein, Ludwig. 2001. *Philosophical Investigations: The German Text, with a Revised English Translation*. Translated by Gertrude Elizabeth Margaret Anscombe. Oxford: Wiley-Blackwell.

Woolgar, Steve, and Javier Lezaun. 2013. “The Wrong Bin Bag: A Turn to Ontology in Science and Technology Studies?” *Social Studies of Science* 43 (3): 321–40. doi:10.1177/0306312713488820.

Zwagerman, Sean. 2008. “The Scarlet P: Plagiarism, Panopticism, and the Rhetoric of Academic Integrity.” *College Composition and Communication* 59 (4): 676–710.