Algorithmic Media Need Democratic Methods: Why Publics Matter

Fenwick McKelvey
Concordia University

ABSTRACT *Algorithms increasingly control the backbone of media and information systems. This control occurs deep within opaque technical systems far from the political attention capable of addressing its influence. It also challenges conventional public theory, because the technical operation of algorithms does not prompt the reflection and awareness necessary for forming publics. Informed public deliberation about algorithmic media requires new methods, or mediators, that translate their operations into something publicly tangible. Combining an examination of theoretical work from Science and Technology Studies (STS) with Communication Studies–grounded research into Internet traffic management practices, this article posits that mediating the issues raised by algorithmic media requires that we embrace democratic methods of Internet measurement.*

KEYWORDS *Internet; Network policy; Technology theory; Research methods; Computer science*

RÉSUMÉ De plus en plus, les algorithmes gouvernent la base des médias et des systèmes d'information. Ce contrôle s'exerce au plus profond de systèmes techniques obscurs, loin de l'attention du monde politique et de responsables aptes à encadrer une telle influence. En outre, il remet en question la théorie classique du public. En effet, l'exploitation technique des algorithmes ne suscite pas la réflexion et la sensibilisation propres à éduquer le public. Ainsi, pour qu'ait lieu un débat éclairé, ouvert à tous, sur les médias algorithmiques, il faut privilégier de nouvelles méthodes, ou médiateurs, qui permettront de transposer les activités de ces médias en notions publiquement tangibles. La démarche proposée dans cet article associe l'étude de la communication, étayée par la recherche sur les pratiques de gestion du trafic Internet, à une analyse des travaux théoriques émanant de l'étude des sciences et des technologies. On y pose en principe que la résolution des questions soulevées par les médias algorithmiques passe par l'adoption de méthodes de mesure Internet démocratiques.

MOTS CLÉS *Internet; Politique de réseau; La théorie de la technologie; Les méthodes de recherche; Informatique*

Introduction

We increasingly hear that communication has become more algorithmic (Napoli, 2013) or, more specifically, that communication infrastructures depend on computational routines to control the information they acquire, produce, and diffuse. But what is an

Fenwick McKelvey is Assistant Professor in the Department of Communication Studies at Concordia University, 7141 Sherbrooke Street West, Montréal, QC H4B 1R6. Email: fenwick.mckelvey@concordia.ca .

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algorithm? Why does it matter? How are we to study it? Algorithms refer to the components of software that make up information and communication infrastructures. If software "is the set of instructions that direct a computer to do a specific task" (Ceruzzi, 1998, p. 80), then algorithms are the instructions. They "do things and their syntax embodies a command structure to enable this to happen" (Goffey, 2008, p. 17). Doing things, following Beniger (1986), involves processing an input toward an output. One algorithm informs another, creating a continuous modulation that Gilles Deleuze (1992) identified as distinct to contemporary power. Algorithmic media emphasize these computational routines as general characteristics—as overall processes that dynamically adjust outputs and inputs.

Algorithms function as control technologies in all sorts of media and information systems, dynamically modifying content and function through these programmed routines. Search engines and social media platforms perpetually rank user-generated content through algorithms. Google depends on its PageRank algorithm and other propriety code to tailor Google results according to the searcher (Feuz, Fuller, & Stalder, 2011). Facebook relies on algorithms to populate users' Newsfeeds (Bucher, 2012). YouTube depends on algorithms—in the form of its ContentID system—to compare video uploads to known copyrighted works and, subsequently, flag matches (Dayal, 2012). Delegating copyright enforcement to automated high-capacity algorithms allows it to handle 72 hours of uploaded video material every minute. The sleeping policeman has become the algorithmic cop.

Algorithmic control has significant social consequences, not the least of which is the creating of associations that resemble publics (Gillespie, 2014). When a customer finds an app in the Google Play Store, algorithms recommend similar ones, but these recommendations may make troubling assumptions about users. Mike Ananny (2011) found one such troubling assumption when examining the Grindr app, an online dating app for gay men. When looking at this particular app, the Google Play Store recommended a Sex Offender Search tool as another app to download. Why, Ananny asked, would the app store's algorithms link sex offenders with Grindr? His question provoked a critical examination of the reasons for the linking of these two apps in a manner that implicitly associated being gay with being a sex offender.

In Canada, algorithms became a major policy issue in 2008 when Internet service providers (ISPs) were found to be using Internet routing algorithms—or Internet traffic management practices—to limit peer-to-peer file-sharing through their networks. These practices demonstrated a new-found capacity for detecting specific applications and constraining their bandwidth consumption on residential broadband networks. The delegating of network management to algorithms sparked a public controversy about how to regulate their use. In response to these concerns, the Canadian Radio-television and Telecommunications Commission (CRTC) formulated Telecom Regulatory Policy CRTC 2009-657, which sought to balance the interests of ISPs in managing traffic on their networks with those of Internet users.

Given the shared interest of Communication Studies and Science and Technology Studies (STS) in media and information technologies as "the backbone of social, economic and cultural life in many societies" (Boczkowski & Lievrouw, 2008, p. 951),

scholars must attend to algorithms precisely because media and information systems cannot be wholly understood without a sense of the underlying routines that regulate them.[1] The concept of algorithmic media seeks to avoid overemphasizing the importance of any single algorithm in a system or of written code.[2] This is because algorithms only have an influence when they are running. No one algorithm is constitutive of the Internet or any algorithmic media. Information and communication media are systems composed of algorithms that cooperate and compete with one another (McKelvey, 2010; van Schewick, 2010). The concept, then, encourages looking at these many processes and how they interact.

As its stands now, algorithms leave little room for debate about the forms of cultural, economic, and social control they exert. Yet, as noted by Tarleton Gillespie (2014), "insights into the inner workings of information algorithms is a form of power, vital to participating in public discourse, essential to achieving visibility online, constitutive of credibility and the opportunities that follow" (p. 185). Thus, researchers must address not only algorithmic media, but also its general condition of imperceptibility. If algorithms matter—and I believe they do—they require greater democratic accountability.

A democratic response to algorithmic media requires translating the fleeting operations of software system routines into knowledge that is conducive with democratic debate. However, methods must be created to study algorithmic media. In this article I argue that democratic inquiry as imagined by John Dewey (1927, 1990) offers a promising means for doing so. Democratic inquiry, one of the many ways to describe Dewey's work, refers to a belief that those affected by particular issues—what he calls publics—have a direct stake in contributing to resolving them. When applied to contemporary information and communication environments, the tenets of this perspective suggest that publics offer a valuable means of generating knowledge about algorithmic media.

For the most part, algorithmic media do not capture the public's attention. Their operation happens instantaneously within opaque technical systems. Their running code is often imperceptible and hardly ever known to its users. A packet does not arrive with an explanation of what decisions it took along its journey. As such, algorithmic media behave differently and have different subjectivities than the media that Dewey associated with early publics theory.

The perspective advanced in the pages that follow examines the relation between algorithms and publics theory. Drawing on work from Communication Studies and Science and Technology Studies, the approach presented juxtaposes ideas from these two fields in working toward a model of democratic inquiry for algorithmic media. While the former attends to the specifics of media and information systems, the latter has discussed publics primarily in relation to technical and/or scientific controversy. The underlying hypothesis guiding the discussion set out below is that democratic inquiry contributes to identifying and remembering the operations of control by algorithms, thereby allowing for more tangible political and policy debates.

New media, new control, old questions

Processes of command, control, communications and intelligence (C^3I)) have long been a subject of shared concern for both critical communications and media studies,

and Science and Technology Studies (see Haraway, 1985). James Beniger (1986) and Gilles Deleuze (1992) theorize a control that describes the power of algorithmic media. According to Beniger (1986), control is broad and "encompasses the entire range from absolute control to the weakest and most probabilistic form, that is, any purposeful influence on behaviour, however slight" (p. 8). Deleuze focuses on societies of control wherein dynamic feedback replace the enclosure of Foucaultian disciplinary societies. Despite never being mentioned in his *Postscript*, algorithms resemble a Deleuzian mechanism of control.

Alexander Galloway (2004, 2006) introduces algorithms as an important consideration for understanding contemporary video game culture. Algorithms, he argues, control the activities of players in a video game. For him, winning is contingent on gamers mastering the controlled environment, or learning the algorithm. Scott Lash's (2007) reappraisal of cultural studies echoes Galloway's interest in algorithms as mechanisms of control, calling for a shift away from emphasizing hegemony and its tendency toward epistemology to a post-hegemonic age that stresses ontology. He posits that the study of ontology in a "society of pervasive media and ubiquitous coding" should focus on "algorithmic or *generative* rules" that are "virtuals that generate a whole variety of actuals" (p. 71). According to this view, algorithms constitute actualities by limiting, or controlling, the virtualities of digital media.

Algorithms enact many kinds of control when it comes to content. They play a key role "selecting what information is considered most relevant to us, a crucial feature of our participation in public life" (Gillespie, 2014, p. 167). These computational routines involve matters of representation and inclusion. Social activity—what is popular, what one should know, and who to know—addresses the link between material and symbolic processes and involves the subtle influence of algorithms. In addition to making certain people and posts visible and others invisibles to users, algorithms calculate publics and opinions by defining trends, suggesting friends, and identifying products one may be interested in purchasing (Bucher, 2012; Gillespie, 2014; Mager, 2012).

Algorithms also define and control the circulation of information within media. Raiford Guins (2009) expounds on the link between algorithms and control by investigating home media players. Devices such as DVD players that can be updated with new firmware to fix bugs and prevent exploits—what Guins calls "control at a distance." They offer a variety of techniques of control that "block, filter, sanitize, clean and patch" digital information to allow open circulation while embedding certain constraints within this freedom. McKelvey (2010) examines differences in the capacity of Internet routing algorithms to monitor and control flows of Internet packets, observing that whereas the conductivity of wires or the range of the human voice once defined conditions of media, today it is algorithmic control that defines the operation of media like the Internet.

Those studying algorithmic control must contend with a number of issues. First, most of the code of algorithmic media is proprietary. Consequently, researchers do not generally have access to it. Second, even if access to the written code is possible, it must be noted that reading code differs from running a script in a complex network (McKelvey, 2011). Therefore, algorithmic media researchers must find ways to observe

their objects of study in operation. Within the context of controlling Internet traffic flows, for example, this means examining the algorithms routing packets. Third, given that algorithmic media operates on the basis of myriad algorithms interacting with one another, it is extremely difficult to zero-in on one lone algorithm enacting control. Although it can be useful to describe the function of social media by focusing on their ranking algorithms (e.g., Facebook's EdgeRank algorithm, Twitter's Trending algorithm), it is important to situate individual algorithms within larger agglomerations of the other algorithms involved in data-mining, profiling, and ranking on Web 2.0 platforms.

In contrast to Gillespie's (2014) concern with how algorithms represent publics, the guiding question for my purpose centres on how publics can represent algorithms and whether algorithms can be made more apparent through the work of publics. Chris Kelty (2008) and Gabriella Coleman (2013) suggest hackers have been vital to communicating the politics of technology. I seek to contribute to these voices, by examining the formation of publics as envisioned by John Dewey (1927, 1990) and elaborated on by some STS scholars. Publics form through becoming self-aware of their common symptoms and issues. Given that the concept of publics has proven instructive for addressing environmental and scientific controversies, it seems plausible that it can also be applied to the study of algorithmic media.

In search of a reflexive apparatus for algorithmic media

The political writings of John Dewey (1927) and Walter Lippmann (1997) recognize publics as important democratic agents. Dewey defines publics as "all those who are affected by the indirect consequences of *transactions* to such an extent that it is deemed necessary to have those consequences systematically cared for" (Dewey, 1927, pp. 15–16, italics added). Indirect consequences demand a response, and people get drawn into participating in a collective understanding. As they become more aware of the consequences, they become more aware of their identity as a public and as a potential solution. Put simply, publics form from "those affected." According to Dewey—and to a lesser extent Lippmann—no definition of a public pre-exists the transaction, but once formed, publics function as a way to knowledge and political resolution. Democracy succeeds in resolving the complexities of life through this process of "affected" persons "systematically caring" for the "indirect consequences of transactions" that first got them involved.

Within the STS field, Noortje Marres (2004, 2005, 2010) and Bruno Latour (2004, 2005) have re-introduced the concept of the public as a conceptual and normative frame for addressing both scientific controversies and the production of technical knowledge. Marres (2005), for example, suggests "publics are called into being by issues" (p. 209) and their becoming involves collective learning about the constituent issue. After the moment of invocation, a public can develop into a tangible political force capable of "systematically caring for" the catalyzing issue. Publics have the possibility of becoming aware, becoming engaged.

Michel Callon, Pierre Lascoumes, and Yannick Barthe (2009) investigate how forming a public provides an opportunity to transform uncertainty into new knowledge about the world. They suggest publics function as a collective process of "com-

posing" a common world. For these authors, the term "composing" refers to "the uncertainties of groupings that simultaneously define (or redefine) the significant entities" (p. 132). The "uncertainties of groupings" refers to the lack of a collective sense in the formation of the public. Composing designates a collective that seemingly creates a new grouping, while also casting the identity of its members in flux. Becoming aware, then, is not an orientation to reality, but a *composition* of a common world. According to Callon et al. (2009), moments of scientific controversy constitute "powerful apparatuses for exploring and learning about possible worlds" (p. 28). It seems plausible therefore that with growing awareness of the effects of algorithms, publics will increasingly emerge in response to algorithmic media—a becoming aware of algorithmic media as a public affected by its control.

Michael Warner (2002) argues that traditional public theory depends upon "reflexive apparatus" to designate how publics become aware of themselves. If publics begin as "a relation among strangers" (p. 55), then some thing must cause people to think they might be affected by a common issue. This is the reflexive apparatus and it plays a crucial part in forming publics, allowing people to think of themselves as part of a common endeavour. The reflexive apparatus begins the process of self-awareness and reconciliation, allowing for the possibility of "systematically caring for" an issue. Marres (2010), for example, suggests the arrival of a new dishwasher brings with it the political opportunity for its owners to reflect on water usage, and its consequences for the environment. In her view, domestic appliances have the potential for "dramatizing connections between practices 'in here' and changing climates 'out there' " (p. 204). This suggests an approach to climate change advocacy focusing on raising awareness of direct connections between the private space of home and the environment instead of attempting to inject environmental awareness into a detached domestic sphere.

While the reflexive apparatus may be obvious as in the case of an environmental disaster or the work of political activism in making the arrival of a dishwasher a moment of reflection, media also contain subtle causes of reflection. Anderson (1991) expounds on this notion by linking the publics' reading of newspapers to early nationalism. In his words, "the date at the top of the newspaper, the single most important emblem on it, provides the essential connection—the steady onward clocking of homogeneous empty time" (p. 33). He posits that the date allows individuals to imagine they exist in a common time with others, thus enabling them to relate to issues as nations rather than as individuals or families. Seen in this light, newspapers and television programs have a punctual temporality of circulation that produces a routine capable of fostering a subjectivity, or publicness, among those consuming these products. Looking at a masthead or the nightly television news broadcast initiates (and reinforces) the formation of a public, and when this news involves an uncertainty, it launches processes of public knowledge formation.

Most algorithmic media lack as visual a reflexive apparatus as a newspaper masthead. Indeed, the vast majority of algorithmic media lack any similar sort of reflective apparatus, because algorithmic control operates a-semiotically and instantly. Algorithms leave little trace. Screens depict only the outputs of the calculations. Users rarely witness the back end of the Web unless it is revealed by some error, yet this is where significant

power resides (see Hill, 2010). Langlois (2011) distinguishes between what users see as represented onscreen and the *a-semiotic encodings* "that work through the transformation of human input (meaningful content and behaviour) into information that can then be further channelled through other informational processes and transformed, for instance, into a value-added service" (p. 22). Not only do algorithmic media lack traditional forms of representation, the representations do not endure. Algorithms function in the micro-temporalities of computing—a scale imperceptible to humans, with calculations occurring so quickly that users may be affected without ever being informed (Gehl, 2011). Bit by bit, algorithms promote and delay as well as show or hide our communications. Since algorithms do not leave a record, by default moments of refection evaporate even though their implications endure.

The emerging publics of algorithmic media are engaging with "continuous media" as opposed to tradition punctual media. Commenting on this dichotomy, Warner (2002) observes that "highly mediated and highly capitalized forms of circulation are increasingly organized as continuous ('24/7 Instant Access') rather than punctual" (p. 69), as exemplified by the newspaper. He continues his reflection, noting:

> Web discourse has very little of the citational field that would allow us to speak of it as discourse unfolding through time. Once a Web site is up, it can be hard to tell how recently it was posted or revised, or how long it will continue to be posted. Most sites are not archived. For the most part, they are not centrally indexed. The reflexive apparatus of Web discourse consists mostly of hypertext links and search engines, and these are not punctual. So although there are exceptions—including the migration of some print serials to electronic format and the successful use of the Web by some social movements—the extent to which developments in technology will be assimilable to the temporal framework of public discourse remains unclear. (p. 69)

Continuous temporality distinguishes the reflexive apparatus of Web discourse from its print-based counterpart. And, while Warner's discussion of the Web may seem outmoded given the move to social media and interactive Web 2.0 platforms, digitally mediated continuous temporality has only intensified since the publication of his work.

The absence of a reflexive apparatus for algorithmic media means that its publics do not neatly correspond with *reading publics* or those invoked by static objects like dishwashers. Publics of algorithmic media resemble what Gilles Deleuze (1992) describes as "dividuality." In his words, "we no longer find ourselves dealing with the mass/individual pair. Individuals have become 'dividuals,' and masses, samples, data, markets, or 'banks' " (p. 5). An online media user may have some of their traffic throttled while the traffic of other actors is accelerated. Although such experiences appear unique or individual, they are the product of targeting and redlining (see Sandvig, 2007). Dividuality increases differences and fragmentation as it dissects users into a variety of profiles and data types. The body public, in other words, is constantly being dissected and re-assembled. Deseriis (2011) expresses this condition well.

> [B]y breaking down the continuity of the social bios into dividual sessions and transactions, the engineer of control produces what Franco Berardi

> (2009) calls a "cellularized" info-time, an abstract time that is no longer attached to the body of any specific individual but generated by the automated recombination of dividual fragments of time in the network. (p. 392)

He suggests the "social bios" become "dividual sessions and transactions." People remain dividualized. Algorithmic media seemingly destabilizes the traditional subjectivity of media and publics. This suggests that publics simply cannot form because the moment of being collectively affected never presents itself amid myriad dividual sessions. However, publics can be compatible with algorithmic media, but this requires accounting for the unique temporality of these technologies and the particular reflexive apparatus that may emerge.

Democratic methods: Mediators as a reflexive apparatus

Both Lippmann (1997) and Dewey (1927, 1990) pondered ways of bringing intangible issues to the public's attention. Their contrasting modes of democratic public inquiry offer a useful basis for investigating the formation of a reflexive apparatus for algorithmic media. According to Lippmann, a realistic vision of democracy requires a government or press that functions as a group of insiders to watch the world and present an observable reality to its citizenry.[3] In his view, knowledge results from an already constituted reality that is observed, or spectatorship. Citizens observed and composed opinions based on their observations. Since a citizen cannot *see* the complex global politics, they cannot form an appropriate pseudo-environment (i.e., mental image that mediates people's interactions with their political environments) necessary for informed decision-making. "The analyst of public opinion must begin then," Lippmann (1997) writes, "by recognizing the relationship between the scene of action, the human picture of the scene, and the human response to that picture working itself out upon that scene of action" (p. 11). As such, the public's role is secondary to the work of expert institutions because people simply do not have the time or the requisite attention span to understand and process events of the day. A principal shortcoming of democratic theory, as he saw it, is that it all too frequently depends on a mythic omnipotent citizen capable of processing volumes of information daily.

The purpose of what Lippmann (1997) labels intelligence work "is not to burden every citizen with expert opinions on all questions, but to push that burden away from him towards a responsible administrator" (p. 251). Intelligence work consolidates the instruments of knowledge collection, assigning it to a scientific administration. Aspects of this are visible in the CRTC approach to algorithmic media, which too often relies on intelligence work. The learning process begins at the CRTC. Industry representatives, public interest advocates, lawyers, and policy experts convene in Gatineau, Québec, where expert opinions and industry insiders portray the operations of algorithmic media as facts to be judged (cf. Shepherd, Taylor, & Middleton, 2014). Two noteworthy hearings related to algorithmic media were Telecom Regulatory Policy CRTC 2009-657, which investigated Internet traffic management practices (ITMPs), and Telecom Regulatory Policy CRTC 2011-703, which focused on usage-based billing. Both hearings investigated the issues by soliciting presentations from various invested parties before leaving the CRTC commissioners to make a decision. The process assumed that the

presentation of expert observations about the Internet in Canada is sufficient for understanding the state of the Internet in the country. These instruments favour the tendencies of experts and CRTC directors who have been trained to use the Commission's legal framework for the investigation of technical matters. Citizens were included, but sidelined to largely being spectators to the "real" work of experts. The work of the Canadian public, then, involves making decisions on the basis of the *facts* presented to them by the experts.

A notable shortcoming with expert-based approaches in this context is a failure to recognize the diverse influences of algorithmic media on everyday life, or to acknowledge that the institutional attention algorithms have garnered is due in large part to public research. Since 2007, at least, Internet service providers (ISPs) have been using traffic management algorithms to shape information flows throughout their networks. This practice was first identified in the United States by the Electronic Frontier Foundation (EFF) and the Associated Press (AP), who monitored BitTorrent traffic on Comcast's network.[4] Their Deep Packet Injection Study revealed that Comcast was injecting "reset" packets into BitTorrent traffic to disrupt BitTorrent communication by causing a computer at on one end of the network to think the machine on the other end of the network had hung up. This practice allowed Comcast to reduce BitTorrent traffic flowing through its network. The EFF/AP study provided some of the first publicly available tangible evidence about U.S.-based ISP traffic management practices, prompting the U.S. Federal Communication Commission to investigate these activities (Kravets, 2008).

The study suggests that algorithmic media operate according to certain general logics that can be discovered through collaborative research. Packet by packet, flow by flow, they identify patterns, build models, and in accordance with network policies use these findings to manage communications dynamically. It is this process that produces dividuality. The distinguishing feature in a networked environment is that the commonalities of dividuality and control reside on private servers and, as such, remain opaque and inaccessible to the public. Linkages between dividuals simply cannot be read and understood. The challenge for publicly minded researchers is to develop methods that can function as a reflexive apparatus for algorithms.

On the heels of the EFF/AP study, the Vuze BitTorrent application launched its Bad ISP project, in 2007–2008, which sought to investigate ISP traffic management practices globally. For the study, Vuze developers created a plug-in to monitor network interruptions caused by false reset packets. Activating the plug-in enabled Vuze platform users to directly transmit the results back to Vuze for analysis. Eight thousands users logging 100,000 hours of traffic usage data responded. With this data Vuze created a global list of Internet service providers who throttled BitTorrent traffic (ISP Network Monitor, 2013).

Prior to the publication of the findings, many of the ISPs listed had not publicized their traffic shaping activities. At the time, Bell Canada and Rogers Cable Communications Inc. were subject to growing criticism for suspected traffic shaping activities in Canada. However, the study identified Cogeco Corp as the second-worst offender globally for Internet reset connection rates. The revelation spread through

the news, provoking public concern and fuelling CRTC's hearings on Internet traffic management practices (Nowak, 2008).

Since then publics have continued learning about traffic shaping. In 2011, for instance, the Canadian Gamers Organization (CGO) noticed traffic shaping was affecting the World of Warcraft play of Rogers Internet customers. After some searching they found that Rogers relied on Cisco routers that were running "buggy" software. Cisco admitted that a bug misclassified World of Warcraft traffic as peer-to-peer in some cases and released a patch to address the issue. However, as the CGO discovered, Rogers had not applied the patch (Bode, 2011; Lasar, 2011; Canadian Gamers Organization, 2011). Their explorations traced a linkage—a sense of the common—between different gamers in spite of never knowing exactly how Rogers configured its network.

These projects stand in contrast to Lippmann's (1997) expert-centred notion of administration, exemplifying an experimental approach that Dewey would likely favour for algorithmic media. According to Dewey, Lippmann subscribed to a *spectator theory of knowledge* that conflates the ways to knowledge with perception. Spectatorship imposes an unnecessary distinction between reality and the knowledge of reality. If knowledge is only seen through what Lippmann calls *pictures in people's heads,* it follows that the limits to attention prevent the democratic citizen from full participation. Dewey (1927) contends that publics are an "immense intelligence" (p. 219). For him, the public is a participant, not a spectator. He writes, "[I]f we see that knowing is not the act of an outside spectator but of a participator inside the natural and social scene, then the true object of knowledge resides in the consequences of directed action" (Dewey quoted in Ezrahi, 1999, p. 318). Put simply, one cannot see without also being an active part of the world. Commenting on Dewey, Yaron Ezrahi (1999) adds, "seeing is always an aspect of acting and interacting, of coping with problems and trying to adapt and improve, rather than just contemplate, mirror, or record" (p. 322). We see in this passage an inversion wherein the public no longer simply receives information, but rather produces it. Knowledge results from experience and process, not just witnessing and spectacle.

Dewey's (1927, 1990) political writings argue for the necessity of an experimental way to acquire knowledge and the importance of creating conditions for literacy to foster democratic methods of knowledge collection. If publics are a way to knowledge, the key challenge is how to actualize experiential learning in democratic society. Methods, in other words, are reflexive apparatuses. The immense intelligence needs democratic methods to support its learning. "Democratic ends," as Dewey (1990) recognizes in the title of a message sent to the first meeting of the Committee for Cultural Freedom in 1939, "need democratic methods for their realization." He continues:

> [A]n American democracy can serve the world only as it demonstrates in the conduct of its own life the efficacy of plural, partial, and experimental methods in securing and maintaining an ever-increasing release of the powers of human nature, in service of a freedom which is cooperative and a cooperation which is voluntary. (p. 386)

The use of experimental method remains important given that Dewey never presupposed to direct the public and its quest for self-awareness. Publics, he maintained,

follow their own path. This suggests that publics can form as a response to algorithmic media through their gradual awareness of the effects of algorithms—a becoming aware of algorithmic media as a public affected by its control. The investigation of algorithmic media therefore requires plural, partial, and experimental methods—democratic methods—to assist the public in their self-reflection and learning.

Projects such as those mentioned above closely resemble, and function to support, Dewey-esque democratic inquiry with algorithmic media. They show that despite the absence of a mass reflexive apparatus, publics can create tools that make the effects of algorithmic media more tangible. These democratic methods resemble the mediators or processes that Deleuze (1995) claimed should inform the activities of the French Left when he wrote:

> [i]t's about not so much a matter of winning arguments as of being open about things. Being open is setting out the 'facts,' not only of a situation but of a problem. *Making visible* things that would otherwise remain hidden. (p. 127, italics added)

It is important to note his use of the term "making visible" here. In the original French text Deleuze uses the word *render,* which means to render, to make or to return, as opposed to finding or revealing (cf. Latham, 2010).

Understood from a Dewey-based perspective, democracy as public discussion is itself a mediator:

> The method of democracy—inasfar as it is that of organized intelligence—is to bring these conflicts out into the open where their special claims can be discussed and judged in the light of more inclusive interests than are represented by either of them separately. (Dewey, 1998, p. 331)

Seen in this light, the EFF/AP and Vuze studies are also mediators. They compose the instant activity of algorithms into common memories, thereby revealing operational logics. These memories, in turn, function like a reflexive apparatus. Publics become aware of their common issues through the records created by these mediators.

Mediators also offer a way to continually produce knowledge for algorithmic media defined by variation and change. Facts in this context are not fixed, but subject to reconsideration. Bruno Latour's (2005) provocative example of Colin Powell speaking before the United Nations with *proof* that Iraq had weapons of mass destruction is a useful analogy. Latour (2004) focused on this fact-cum-lie in seeking to develop a theoretical means for democracies to properly represent *things;* to create a parliament of things. Underlying his effort was an acknowledgment that the proof needed to be reconsidered. One cannot be concerned only with the rhetorical representation of the truth, because the process by which a society comes to regard a fact as truthful is equally important.

Faced with the need to find new facts, journalists—the ideal intelligence workers—have begun to both recognize the need for public research that addresses algorithms, and to design these mediators. In his report on algorithmic accountability, Nicholas Diakopoulos (2013, 2014) documents a number of such journalism-based initiatives. ProPublica, for example, launched the Message Machine during the 2012 U.S.

presidential election to research email messaging from the Romney and Obama campaigns. They asked the public to send in messages they had received and subsequently developed a tool to compare these messages. Not only could the public contribute emails, but they could also use the Message Machine's data visualization to understand the differences in messages (for more details, see Beckett & Larson, 2012). By enlisting the public directly in the research, this type of project, along with the others Diakopoulos documents, differs from traditional journalist practice. Publics are integral to the project, not spectators.

While such projects, and other similar undertakings, are often referred to as crowdsourcing, I maintain that this is a kind of experimental public research adhering to the notion that those affected are the best people to carry out research. In Dewey's (1927) words, "the man who wears the shoes knows best that it pinches and where it pinches, even if the shoemaker is the best judge of how the trouble is to be remedied" (p. 207). When applied to algorithmic media, this suggests that those affected by traffic shaping or copyright filtering know best the implications of these activities on lived experience. It is the affected public that can best explain the consequences of algorithms and why they matter. So although finding resolutions to less desirable aspects of algorithmic media might be another step, people have an important role to play in making algorithms matter. While this process might be imperfect, it remains the most viable for algorithmic media.

Conclusions

The projects outlined above exemplify some of the ways in which mediators and publics form in tandem around algorithmic media. In the case of traffic management practices, home users only experienced the effects of their peer-to-peer traffic being delayed. Without any actual evidence, people had only dividualized feelings of being affected—a sense of uncertainty about their Internet connection. Researchers, journalists, and hackers have a role to play in developing mediators to record and remember algorithmic media and thereby expanding the learning public. Computational cycles are inaccessible without mediators, but once recorded theses logs constitute a public memory. The pooled results contribute to a broader understanding of the network traffic management policies of ISPs domestically and internationally and of the content ranking activities of social media platforms. This memory enables the studying and interpretation of network traffic management patterns. In short, the presence of evidence combined with a mechanism to participate enable publics to observe algorithms as an issue of common concern and to work toward finding a resolution. Mediators—as in the Internet test discussed here—instantiate the publics of algorithmic media.

That said, we must be cognizant that the technologically mediated democratic methods outlined above risk treating publics as simply parts of a defined technical system (Wolin, 2004, pp. 518–523). Hence, there is a need for caution lest these methods inspire faith in finding technical solutions to political problems. Drawing on Lippmann's catchphrase, Wolin (2004) argues that the scientific methods exposed by Dewey have been mostly embraced by a class of political administrators: those who rely on the science of opinion polls and other instruments to ensure the effective man-

ufacturing of consent. Although human intuition offers a markedly different form of computation, many public research projects already consider humans as interchangeable with computers.

For example, a recent and widely known project examining and calculating protein folding switched from digital computing to human computing because "even a small protein can have several hundred amino acids, so computers have to plod through thousands of degrees of freedom to arrive at an optimum energy state. But humans, blessed with a highly evolved talent for spatial manipulation, can often see the solution intuitively" (Hand, 2010, p. 685). Research must continue to acknowledge the balance between the process of learning and the function of technical mediators. Democratic methods cannot be only technical. They must balance political and social concerns, and the participants need to be people actually experiencing algorithmic media, not just "research subjects." Dewey (1927) said as much in averring that "the apparatus [of social science] will no longer be taken to be itself knowledge, but will be seen to be intellectual means of making discoveries of phenomena having social import and understanding their meaning" (p. 203). This approach may be more complicated and messy, but mediating the problems of algorithmic media requires that we embrace democratic methods and Internet measurement as a public capable of mediating and responding to its challenges.

In this article, I have argued that the study of algorithms requires embracing new methods and forms of research participation. Democratic inquiry as envisaged by John Dewey offers a way forward in understanding and responding to the challenges of the algorithmic media environment. Publics respond to algorithmic media by creating reflexive apparatuses. Part of this formation process includes the development of mediators like EFF/AP, Vuze, ProPublica, and many others. These mediators translate the continuous operations of algorithmic media into records for reflection and deliberation.

Publics form around issues, these issues catalyze the development of tools, and, in turn, these tools augment the formation of the public. The truth is messy, and it is not an answer resolved by moving away from the public, as Lippmann (1997) suggested. Without public research of the sort described above, the traffic management practices of ISPs might have eluded the watchful eye of institutions like the Federal Communications Commission in the United States and the CRTC in Canada (Kravets, 2008; Nowak, 2008). The projects discussed here all succeeded in enlisting publics and, importantly, in developing an adaptive response to the invisibility of algorithms by overcoming their a-semiotic and instant nature. They flourished because they combined democratic inquiry with an awareness of the qualities of algorithmic media. In doing so, they demonstrate the viability of Dewey's (1927, 1990) public theory as a basis for further research investigating both algorithms and algorithmic media.

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Notes

1. A similar claim has been made by software studies (see Fuller, 2008), but software is much more front and centre than the hidden, infrastructural work of algorithms. Algorithms function as the background of the material, symbolic, cultural, or communicative processes of new media and information technologies. Despite its association with and indebtedness to software studies, the study of algorithmic media focuses on specific facets of software.

2. It may be easier to hear the work of algorithms than to see the code. In computer science, for example, sorting algorithms are explained through the use of sounds—a process of audibilization—so students can hear algorithms work as they sort through a sonic range (Bingmann, 2013; Miyazaki, 2012).

3. I do not mean to accuse Walter Lippmann of being anti-democratic. See Schudson (2008) for a more detailed discussion of the history of the debate between Dewey and Lippmann.

4. The EFF discovered the traffic shaping using *WireShark,* a free software packet inspection tool (see Sanders, 2007). For a history of the issue, see the footnotes of the report released by the Electronic Frontier (Eckersley, von Lohmann, & Schoen, 2007).

Hearings

Canadian Government. (2009, October 21). *Telecom regulatory policy CRTC 2009-657.* Ottawa, ON: CRTC.

Canadian Government. (2011, November 15). *Telecom regulatory policy CRTC 2011-703.* Ottawa, ON: CRTC.

References

Ananny, Mike. (2011, April 14). The curious connection between apps for gay men and xex offenders. *The Atlantic.* URL: http://www.theatlantic.com/technology/archive/2011/04/the-curious-connection-between-apps-for-gay-men-and-sex-offenders/237340/ [March 11, 2013].

Anderson, Benedict. (1991). *Imagined communities: Reflections on the origin and spread of nationalism.* New York, NY: Verso.

Beckett, Lois, & Larson, Jeff. (2012, March 6). *Reverse-engineering Obama's message machine.* ProPublica. URL: http://www.propublica.org/article/reverse-engineering-obamas-message-machine [April 4, 2014].

Beniger, James R. (1986). *The control revolution: Technological and economic origins of the information society.* Cambridge, MA: Harvard University Press.

Bingmann, Timo. (2013, November 26). The sound of sorting—"Audibilization" and visualization of sorting algorithms. Panthema.net. URL: http://panthema.net/2013/sound-of-sorting/ [March 22, 2014].

Boczkowski, Pablo, & Lievrouw, Leah A. (2008). Bridging STS and Communication Studies: Scholarship on media and information technologies. In E. J. Hackett, O. Amsterdamska, M. E. Lynch, J. Wajcman, & W. E. Bijker (Eds.), *The handbook of science and technology studies* (3rd ed., pp. 951–977). Cambridge, MA: MIT Press.

Bode, Karl. (2011, September 16). *CRTC to Rogers: Fix your broken throttling system—Regulator gives Rogers until September 27.* ISP Information, *DSLReports.com.* URL: http://www.dslreports.com/shownews/CRTC-to-Rogers-Fix-Your-Broken-Throttling-System-116160 [September 23, 2011].

Bucher, Tania. (2012). Want to be on the top? Algorithmic power and the threat of invisibility on Facebook. *New Media & Society, 14*(7), 1164–1180.

Callon, Michel, Lascoumes, Pierre, & Barthe, Yannick. (2009). *Acting in an uncertain world: An essay on technical democracy.* Cambridge, MA: MIT Press.

Canadian Gamers Organization. (2011). *Rogers—WoW throttling history* [Yuku comments page]. URL: http://cdngameorg.yuku.com/topic/15/Rogers-WoW-throttling-historyDocument1 [October 16, 2014].

Ceruzzi, Paul E. (1998). *A history of modern computing.* Cambridge, MA: MIT Press.

Coleman, Gabriella. (2013). *Coding freedom: The ethics and aesthetics of hacking.* Princeton, NJ: Princeton University Press.

Dayal, Geeta. (2012, September 9). The algorithmic copyright cops: Streaming video's robotic overlords. Threat level, *Wired.com.* URL: http://www.wired.com/threatlevel/2012/09/streaming-videos-robotic-overlords-algorithmic-copyright-cops/ [March 15, 2013].

Deleuze, Gilles. (1992). Postscript on the societies of control. *October, 59*(1), 3–7.

Deleuze, Gilles. (1995). Mediators. In *Negotiations, 1972–1990* (M. Joughin, Trans.) (pp. 121–134). New York, NY: Columbia University Press.

Deseriis, Marco. (2011). The general, the watchman, and the engineer of control. *Journal of Communication Inquiry, 35*(4), 387–394.

Dewey, John. (1927). The public and its problems. Denver, CO: Swallow Press/Ohio University Press.

Dewey, John. (1990). Democratic ends need democratic methods for their realization. In J.A. Boydston & R.W. Sleeper (Eds.), *The later works of John Dewey, 1925–1953: Vol. 14. 1939–1941* (pp. 367–368). Carbondale, IL: Southern Illinois University Press.

Dewey, John. (1998). *The essential Dewey: Vol. 1. Pragmatism, education, democracy* (L.A. Hickman & T.M. Alexander, Eds.). Bloomington, IN: Indiana University Press.

Diakopoulos, Nicholas. (2013). *Algorithmic accountability reporting: On the investigation of black boxes.* Tow Center for Digital Journalism. New York, NY: Tow Center for Digital Journalism. URL: http://towcenter.org/algorithmic-accountability-2/ [October 16, 2014].

Diakopoulos, Nicholas. (2014). *AlgoBeat: The compendium of publicly significant algorithms.* Knight News Challenge. URL: https://www.newschallenge.org/challenge/2014/feedback-review/algobeat-the-compendium-of-publicly-significant-algorithms/ [October 16, 2014].

Eckersley, Peter, von Lohmann, Fred, & Schoen, Seth. (2007, November 28). *Packet forgery by ESPs: A report on the Comcast affair.* Electronic Frontier Foundation (EFF). URL: https://www.eff.org/wp/packet-forgery-isps-report-comcast-affair [October 16, 2014].

Ezrahi, Yaron. (1999). Dewey's critique of democratic visual culture and its political implications. In David M. Kleinberg-Levin (Ed.), *Sites of vision: The discursive construction of sight in the history of philosophy* (pp. 315–336). Cambridge, MA: MIT Press.

Feuz, Martin, Fuller, Matthew, & Stalder, Felix. (2011). Personal Web searching in the age of semantic capitalism: Diagnosing the mechanisms of personalisation. *First Monday, 16*(2). URL: http://www.firstmonday.org/htbin/cgiwrap/bin/ojs/index.php/fm/article/view/3344/2766 [October 16, 2014].

Fuller, Matthew (Ed.). (2008). *Software studies: A lexicon.* Cambridge, MA: MIT Press.

Galloway, Alexander. (2004). *Protocol: How control exists after decentralization.* Cambridge, MA: MIT Press.

Galloway, Alexander. (2006). *Gaming: Essays on algorithmic culture.* Minneapolis, MN: University of Minnesota Press.

Gehl, Robert W. (2011). The archive and the processor: The internal logic of Web 2.0. *New Media & Society, 13*(8), 1228–1244.

Gillespie, Tarleton. (2014). The relevance of algorithms. In T. Gillespie, P. Boczkowski, & K. Foot (Eds.), *Media technologies: Essays on communication, materiality, and society* (pp. 167–194). Cambridge, MA: MIT Press.

Goffey, Andrew. (2008). Algorithm. In Matthew Fuller (Ed.), *Software studies: A lexicon* (pp. 15–20). Cambridge, MA: MIT Press.

Guins, Raiford. (2009). *Edited clean version: Technology and the culture of control.* Minneapolis, MN: University of Minnesota Press.

Hand, Eric. (2010). Citizen science: People power. *Nature, 466,* 685–687.

Hill, B. Mako. (2010). Revealing errors. In Mark Nunes (Ed.), *Error: Glitch, noise, and jam in new media cultures* (pp. 27–41). New York, NY: Continuum International Publishing Group.

Haraway, D. J. (1985). Manifesto for Cyborgs: Science, Technology, and Socialist Feminism in the 1980s. Socialist Review, (80), 65–108.

ISP Network Monitor. (2013, May 4). *Vuze wiki.* URL: http://wiki.vuze.com/w/ISP_Network_Monitor [October 16 , 2014].

Kelty, Christopher. (2008). *Two bits: The cultural significance of free software.* Durham, NC: Duke University Press.

Kravets, David. (2008, January 8). FCC opens file-sharing probe (Charade) into Comcast traffic-management practices. Threat level, *Wired.com.* URL: http://www.wired.com/threatlevel/2008/01/fcc-opens-file/ [July 11, 2012].

Langlois, Ganaele. (2011). Meaning, semiotechnologies and participatory media. *Culture Machine, 12.*

Lasar, Matthew. (2011, September 19). *Canada to Rogers Cable: We want fix for game throttling by next week.* Ars Technica. URL: http://arstechnica.com/tech-policy/2011/09/canada-to-rogers-cable-fix-game-throttling-by-friday/ [July 22, 2012].

Lash, Scott. (2007). Power after hegemony: Cultural studies in mutation? *Theory, Culture & Society, 24*(3), 55–78.

Latham, Robert. (2010). Border formations: Security and subjectivity at the border. *Citizenship Studies, 14*(2), 185–201.

Latour, Bruno. (2004). *Politics of nature: How to bring the sciences into democracy.* Cambridge, MA: Harvard University Press.

Latour, Bruno. (2005). From realpolitik to dingpolitik or how to make things public. In Bruno Latour & Peter Weibel (Eds.), *Making things public: Atmospheres of democracy* (pp. 14–41). Cambridge, MA: MIT Press.

Lippmann, Walter. (1997). *Public opinion.* New York, NY: Free Press Paperbacks. (Original work published 1922)

Mager, Astrid. (2012). Algorithmic Ideology: How capitalist society shapes search engines. *Information, Communication & Society, 15*(5), 769–787.

Marres, Noortje. (2004). Tracing the trajectories of issues, and their democratic deficits, on the Web. *Information Technology and People, 17*(2), 124–149.

Marres, Noortje. (2005). Issues spark a public into being: A key but often forgotten point of the Lippmann-Dewey Debate. In Bruno Latour & Peter Weibel (Eds.), *Making things public: Atmospheres of democracy* (pp. 208–217). Cambridge, MA: MIT Press.

Marres, Noortje. (2010). Front-staging nonhumans: Publicity as a constraint on the political activity of things. In Bruce Braun & Sarah J. Whatmore (Eds.), *Political matter: Technoscience, democracy, and public life* (pp. 177–210). Minneapolis, MN: University of Minnesota Press.

McKelvey, Fenwick. (2010). Ends and ways: The algorithmic politics of network neutrality. *Global Media Journal—Canadian Edition, 3*(1), 51–73.

McKelvey, Fenwick. (2011). FCJ–128 a programmable platform? Drupal, modularity, and the future of the Web. *Fibreculture, 18.* URL: http://eighteen.fibreculturejournal.org/2011/10/09/fcj-128-programmable-platform-drupal-modularity-and-the-future-of-the-web/ [October 16, 2014].

Miyazaki, Shintaro. (2012). Algorhythmics: Understanding micro-temporality in computational cultures. *Computational Culture, 2.* URL: http://computationalculture.net/article/algorhythmics-understanding-micro-temporality-in-computational-cultures [March 3, 2014].

Napoli, Phillip M. (2013). The algorithm as institution: Toward a theoretical framework for automated media production and consumption. *SSRN Scholarly Paper No. 2260923.* Rochester, NY: Social Science Research Network. URL: http://papers.ssrn.com/abstract=2260923 [October 16, 2014].

Nowak, Peter. (2008, May 15). *CRTC opens net neutrality debate to public.* CBC News, Technology & Science. URL: http://www.cbc.ca/news/technology/story/2008/05/15/tech-internet.html [July 10, 2012].

Sanders, Chris. (2007). *Practical packet analysis: Using Wireshark to solve real-world network problems.* San Francisco, CA: No Starch Press.

Sandvig, Christian. (2007). Network neutrality is the new common carriage. *Info: The Journal of Policy, Regulation, and Strategy, 9*(2/3), 136–147.

Schudson, Michael. (2008). The "Lippmann-Dewey Debate" and the invention of Walter Lippmann as an anti-democrat, 1986–1996. *International Journal of Communication, 2,* 1031–1042.

Shepherd, Tamara, Taylor, Greg, & Middleton, Catherine. (2014). A tale of two regulators: Telecom policy participation in Canada. *Journal of Information Policy, 4*, 1–22. URL: http://jip.vmhost.psu.edu/ojs/index.php/jip/article/viewArticle/163 [October 16, 2014].

van Schewick, Barbara. (2010). *Internet architecture and innovation.* Cambridge, MA: MIT Press.

Warner, Michael. (2002). Publics and counterpublics. *Public Culture, 14*(1), 49–90.

Wolin, Sheldon. (2004). *Politics and vision: Continuity and innovation in Western political thought.* Princeton, NJ: Princeton University Press.