Why Map Issues?

On Controversy Analysis as a Digital Method

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Media are never impartial, they always participate.

David Garcia and Geert Lovink, 1998

Abstract

This paper takes stock of recent efforts to implement controversy analysis as a digital method, in the study of science, technology and society (STS) and beyond, and outlines a distinctive approach to addressing a key challenge: the problem of digital bias. Digital media technologies exert significant influence on the enactment of controversy in online settings, and this risks to undermine the substantive focus of controversy analysis conducted by digital means. To address this problem, I propose a shift in thematic focus from controversy analysis to issue mapping. The paper begins by distinguishing between three broad frameworks that currently guide the development of controversy analysis as a digital method: demarcationist, discursive and empiricist. While each of these frameworks has been adopted in STS, I argue that the last one offers the best opportunities to further develop its distinctive approach to controversy analysis and address the problem of digital bias: this last framework allows us to digitally implement the "move beyond impartiality" in the study of knowledge, technology and society. To clarify how, I distinguish between two opposing solutions to the problem of digital bias in controversy analysis: a precautionary approach that seeks to render controversy independent from digital platforms, and an affirmative approach, which deploys specifically digital formats such as hyperlinks and hashtags to map controversies. Endorsing the latter approach, I argue that it needs to be developed further in order to secure the substantive focus of digital controversy analysis. We must broaden the scope of digital controversy analysis and examine not just controversies, but a broader range of issue formations, including public relations campaigns and activist mobilizations. I explore the practical implementation of this approach by discussing a pilot study in which we analyzed issues of Internet governance with the social media platform Twitter.

1. Introduction

Digital media technologies have in many ways become ubiquitous, but there continue to be widespread concerns about the 'bias' of online information and knowledge. Commentators still sound the alarm about the dangers inherent in the spread of dubious claims via digital media, as when the well-known Internet critic Evgeny Morozov cried foul of 'dodgy' anti-vaccine activists, who have 'half a million followers on Twitter.' In a popular online article, he argued that it was time to build

proactive measures into Internet infrastructures, most notably by having search engines identify and label suspect sources as "compromised."[1] Morozov's red banner proposal itself set alarms ringing, and was probably designed with that purpose in mind. Among others, in setting up the search engine as arbiter, Morozov's proposal effectively places these powerful digital platforms themselves beyond the reach of 'bias critique'. As a central institution of the digital information economy, however, search engines have precisely been criticized for introducing bias into online environments, most notably via their selection and ranking algorithms: these tend to favour popular, fresh and institutionally accredited sources (Introna and Nissenbaum, 2000; Gillespie, 2013), thereby providing an influential platform and de facto accreditation for sources biased along these lines.

The biased nature of online information is then problematized in various ways today. This persistence of public concern with bias in the digital context poses several challenges for the study of science, technology and society (STS). For several decades, work in this field has criticized the idealization of 'impartial' knowledge, and has developed arguments to the effect that *all content* should be expected to exhibit a certain degree of 'bias'. In the famous language of the Strong Programme, all knowledge, whether true or false, reflects partisan interests (Bloor and Barnes, 1998). This 'generalized' understanding of the politics of knowledge was subsequently integrated into various STS approaches including actor-network theory (Bijker and Law, 1992; Latour, 2005). Work in STS, then, has long argued that there is no such thing as 'bias-free' knowledge or information, and that we must learn to come to terms with the interested nature of all content. Indeed, some authors expected this insight to become more widely accepted: Ezrahi (1990) argued that late-modern societies are marked by an *increasing public realization* of the inevitable partisanship of knowledge and information. A reader of STS classics should then be forgiven for asking: why does the biased nature of online information continue to generate such outrage?

Whatever the answer to this question, recent work in STS has certainly found ways to engage with the situation. STS researchers have treated the 'scandal' of the biased nature of digital information as a welcome opportunity to make the case, once again, for a less negative, more generous understanding of the politics of knowledge (Latour, 2011; Marres and Rogers, 2000). Specifically, they have proposed that digitization makes possible the further development of a distinctive approach for

studying the partiality of knowledge: controversy analysis (see also Leydesdorff & Hellsten, 2006; Venturini, 2012). It was through historical and fieldwork studies of controversies about scientific issues that STS had established its distinctive claim, that the formulation of knowledge claims and the organisation of political interests tend to go hand-in-hand (Bloor, 1982; Collins & Pinch, 1998; Hagendijk & Meeus, 1993). In the early 2000s this methodology was put forward as highly suitable for analysing the politics of *digital* knowledge and information (Rogers and Marres, 2001; Prawobo et al, 2008). For more than a decade now, efforts have then been underway to render STS methods of controversy analysis compatible with the new sources of data and analytic techniques spawned by the Internet and wider processes of digitization. As I will discuss below, this has resulted in various implementations of controversy analysis as a digital method, but the project continues to face significant problems, not least, and rather paradoxically, the problem of digital bias.

Efforts to implement controversy analysis as a digital method are hampered by the fact that digital media technologies like search engines and social media platforms exert a notable influence on the enactment of controversy online (Madsen, 2012). Among others, this circumstance seems to place serious limits on the generalizability of the insights of digital controversy analysis. The problem of digital bias threatens to undermine the substantive focus of controversy analysis: in mapping controversies with digital methods, we can't be sure that it is controversies that we are analysing, and not just the digital settings that render these controversies analysable (Venturini and Guido, 2012).

STS-informed work in digital controversy analysis has proposed various ways to address this challenge. Most importantly, this work has drawn on the generalized understanding of the politics of knowledge advanced by the Strong Programme in order to make the case for an affirmative approach to the biased nature of information online: rather than treating the biased nature of online information as a scandal or outrage, we should *expect* the organisation of content and the mobilization of interests to go hand-in-hand in digital settings. In this article, I will endorse and explicate this affirmative approach to 'bias' in the digital analysis of controversies, but I argue that it needs to be developed further, if it is to be viable as an empirical strategy for the study of science, technology and society. If we are serious about affirming the 'influence of the setting' in the enactment of controversy online, then we must accept

a shift in the thematic focus of controversy analysis. We must adopt a more open-ended approach and not just analyse controversies, but map issues.

2. Situating controversy analysis as a digital method

It seems helpful to provide a definition of controversy analysis as a digital method at the outset. Broadly defined, it involves the use of computational techniques to detect, analyse and visualise public contestation over topical affairs (for a discussion see Marres and Rogers, 2005). Importantly, while methods of controversy analysis have been central to the development of STS over the last decades, the digital implementation of controversy analysis is best understood as *an interdisciplinary undertaking*. Different fields currently contribute to this project including the sociology of science and technology, computer science, media studies, communication and policy analysis (Thelwall and Fairclough, 2006; Benkler, 2012; Chateauraynaud, 2009; Rogers and Marres, 2000; Rogers and Ben-David, 2008; Yasseri et al, 2012; Venturini, 2010), as well as various professional fields including design, journalism and advocacy (Marres and Weltevrede, 2013; Borra et al, 2014).[2] While there are notable differences between approaches, work accross these fields deploys digital techniques for the capture, analysis and visualisation of - often Internet-based - data in order to render legible disputes about public issues. It builds on existing approaches in the above fields: at least from the 1970s onwards computational techniques have been used to analyse public and policy debates, both inside and outside the university. As to the latter, digital controversies analysis has clear affinities with the applied research method of 'debate mapping', which offers graphical representations of key positions in public debates, and this visual research strategy has been used for several decades in activism, journalism, design and policy research to engage publics and influence decision-making (for a discussion see Rogers, 2009, Whatmore, 2009).

The rise to prominence of the Web from the mid-1990s onwards, however, offered significant new opportunities for the implementation and development of controversy analysis (Rogers and Marres, 2001; Latour, 1998; Thellwall et al, 2006). It is not just that the Internet and attendant processes of the digitization of social life have made available *masses of data* that are useful for controversy analysis, from online newspaper archives to campaign websites and debate forums. Digital sources also tend to be *organised or structured* in ways that make them highly suitable for

controversy analysis: the networked character of online information makes it possible to trace the unfolding of controversies across different sites as well as through time (Venturini, 2010; Marres and Rogers, 2005). Thirdly, the digital data explosion has been accompanied by a proliferation of digital *instruments for data analysis and visualisation*, and many of these tools implement methods suitable for controversy mapping such as network and textual analysis and visualisation. These prominently include Web-based tools, which can be accessed online in order to locate, analyse and visualise networks of sources, from hyperlink networks on the Web to the more strictly formatted friend, follower and hashtag networks in social media like Facebook and Twitter (Rieder, 2013).

By way of example, Figure 1 shows a so-called issue-network located on the Web with the aid of hyperlink analysis. This network was found with the aid of Issuecrawler, an web-based tool that delineates topical formations online by crawling, analysing and visualising hyperlinks on the Web. This particular network brings together sources dealing with WCIT, the World Conference on International telecommunications that took place in Dubai in December 2012, which became the focus of debates about Internet governance during this time, as I will discuss in more detail below. What distinguishes this formation from other types of online networks is its 'issue specificity': the sources this network brings together each address a current affair, in this case, WCIT. Importantly, such a topical assemblage is delineated with the aid of hyperlinks only, by following and analysing hyperlinks from starting points (Web pages) suggested by users as relevant to the issue at hand - in the case of Figure 1, by two experts on issues of Internet governance. The *formal* technique of crawling and analysing hyperlinks then provide a way to locate *substantive* formations online, making these networks available for further examination, for instance with the aid of textual analysis (Marres and Rogers, 1999; 2005; see also Leydesdorff and Hellsten, 2006).

Figure 1 WCIT network on the Web, located with the aid of Issuecrawler, December 2012

Digital techniques for network and textual analysis then offer potentially powerful instruments for controversy analysis. To be clear, these techniques are used for a variety of purposes including social network analysis and trend mapping (Mutzel, 2009), but they nevertheless make for a remarkably good match with the methodological sensibilities of controversy analysis: they allow us to analyse public disputes across 'heterogeneous' domains, such as science and the media, or governmental and civil society sources. In this spirit, a younger generation of researchers has taken up digital tools of network and textual analysis to map controversies online, including climate change (Venturini and Guido, 2012; Marres and Rogers, 2000; Niederer, 2013), food technologies (Beck and Kropp, 2011; Marres and Rogers, 2001), biofuels (Eklof and Mager, 2013), nanotechnology (Madsen,

2013) and the Fukishima disaster (Plantin, 2011; Moats forthcoming). While these digital studies have attracted significant interest, it is not self-evident what methodological innovation precisely they undertake, as computational techniques of network and textual analysis have been used since at least the 1980s to detect dynamics of controversy in electronic data-bases of scientific journal articles (Callon et al, 1983; Leydesdorff and Hellsten, 2006). Indeed, in my view, the availability of digital analytic techniques or digital networked data, in and of themselves, cannot explain what is new or specific about current efforts to implement controversy analysis by digitally means. Rather, it has to do the manner in which the wider apparatus of controversy analysis is being configured (Marres, 2012).

One thing we must consider, in this regard, is that controversy analysis is deployed interactively online, as a way to *intervene* in networked information environments. As mentioned in the introduction, in recent years applications have been put forward for the analysis of knowledge disputes online with the aim of mitigating against bias. Morozov's provocative proposal was inspired by a prototype application developed by Intel Research called 'Dispute finder', which provides Web users with an overview of contesting claims whenever he or she browses an disputed information source (Ennals et al, 2010).[3] Digital methods of controversy analysis, then, are deployed not just to analyse but to interactively intervene in online information environments. Partly for this reason, they can be called *interested methods* (Asdal, 2014): they present a site where the apparatus for the evaluation of online information is currently being assembled, and in this undertaking not just epistemic, but also political and economic normativities come into play. To give a more precise sense of what is at stake in the configuration of controversy analysis as a digital method, and of how STS can intervene in relation to this broader endeavour, I want to distinguish between three different frameworks that give direction to this project.

3. Three frameworks for digital controversy analysis: demarcation, discourse analysis, radical empiricism

No doubt the strongest case for the digital implementation of controversy analysis has been made by advocates of the demarcationist approach. Latching on to widespread public concern in todays digital societies about the biased nature of networked information, demarcationists propose to deploy computational methods of controversy

analysis to separate the wheat from the chaff, to delineate legitimate from illegitimate knowledge sources and disputes. The aforementioned 'Dispute finder' prototype presents an applied example, but the approach also informs projects in large-scale data analysis, such as the study of controversy on the online Encycopledia platform Wikipedia undertaken by Yasseri and colleagues (2012; for another example see Weber et al, 2012). Analysing a sizeable set of Wikipedia articles using statistical methods, this project developed a technique for detecting the 'controversiality' of topics on Wikipedia. Proposing indicators like the number of edits, and 'mutual edits' ('reverts'), to establish the relative level of 'substantive disagreement' in Wikipedia articles, the project produced rankings of the most controversial Wikipedia topics, including a 'top 10' which was recently featured in *The Economist* magazine ("global warming" made it into the English-language Top 5 and "Sigmund Freud" into the French one).[4] Besides this popular output, the project also produced a formalized procedure for identifying sites of epistemic contestation, which Yasseri et al (2012) define as conflicts with an 'internal' cause, to differentiate them from disputes that are caused by 'external events', and thus not concerned with knowledge claims (!). Adopting an 'internalist' understanding of knowledge controversies, this work seeks to implement by digital means the prescriptive ambition of 20th-century philosophy of science - to demarcate legitimate or relevant knowledge disputes from illegitimate or irrelevant disagreements about non-epistemic things.[5]

A second prominent framework guiding the digital implementation of controversy analysis builds on sociological methods of discourse analysis. Here, the objective is not to determine the status of statements or topics as such, but to map positions in a debate (Beck and Kropp, 2011; Yaneva, 2012; Venturini et al, 2013). This approach does not seek to establish the legitimacy of knowledge disputes; controversy analysis instead serves an exploratory purpose, namely to detect relations between substantive arguments and socially and politically located actors and to render such relations available for interpretation by various audiences (Beck and Kropp, 2011). In many cases, researchers do this by analysing which claims and issue terms have the support from which actors, demonstrating which issues are becoming subject to contestation between heterogeneous actors. Thus, Beck and Kropp (2011) produced detailed discursive maps of food security debates, showing for example how the controversy over the food colouring agent 'beta-carotene' in Germany in the early 2000s brought food producers, retailers, and consumers into relations with one

another.[6] The objective, then, is detect socio-epistemological formations and to render these patterns visible for both academic, professional and ideally, lay audiences. Such a discursive approach to controversy analysis is adopted by many social scientific projects in controversy mapping, including those informed by STS (Beck and Kropp, 2011; Eklof and Mager, 2013; Leydesdorff and Hellsten, 2006).

The project to map substantive statements ("knowledge content") onto social interests resonates well with STS sensibilities, and evokes the principle of the Strong Programme that *all content* is likely to be associated with factional interests of a more or less determinate kind. However STS-informed projects of digital controversy analysis have also attempted to move beyond the discursivist approach. To a significant extent, these efforts reflect the notable influence of actor-network theory on the development of controversy analysis as a digital method.[7] Bruno Latour and colleagues have over the last years developed a range of software tools and research protocols that facilitate the digital implementation of actor-network theory, and controversy analysis has provided the overarching framework for much of this work (Venturini, 2010; Latour, 1998; see also Yaneva, 2012; Munk, forthcoming). Richard Rogers, myself and colleagues have equally drawn on actor-network theory in the development of digital methods of issue mapping, among others in the development of the IssueCrawler, the web-based tool for the analysis of 'issue-networks' on the Web presented in Figure 1. These various ANT-informed initiatives are in many ways alligned with the discursive framework, but they also make distinctive assumptions which expand and complicate it.

Crucial in this respect are the empirical capacities of controversy analysis. One way in which recent work in STS has built on the Strong Programme is by *extending* the empirical scope of controversy analysis. Controversies, according this work, do not just bring into view relations between scientific statements and social or political interests, they provide a 'empirical occasion' for a wider social inquiry : controversies render visible relations between science, technology and society, making these available for analysis (Collins and Pinch, 1998; Latour, 2005). In what I call the empiricist implementation of controversy analysis as a digital method this ambition is extended to online settings. This approach proposes that the enactment of controversy in digital media settings present us with especially useful or productive empirical occasions: they can tell us what the issues of contestation are, who the actors and where they are based (Marres and Rogers, 2009). However, while STS

scholars previously turned to controversies in order to analyse the relations between actors, institutions and practices, digital researchers today have taken up the approach to practice *controversy detection.* With the aid of digital methods like the issue-network analysis shown in Figure 1, we can determine *whether* a given topic constitutes a controversial issue: did an active network get organised online around a topic like WCIT? If so, do the pages in the network engage in contestation, and what about? [8]

Different analytic frameworks then guide the digital implementation of controversy analysis. To be sure, demarcationists, discursivists and empiricists share various assumptions. Both demarcationists and empiricists are interested in the detection of controversy dynamics, using techniques of online data analysis to determine what are relevant, active topics of controversy? Both discursivists and empiricists take up digital tools to analyse the *composition* of controversies: who are the actors? where are they based? what is relevant issue language? how do they change over time? But there are also significant differences. While demarcationists deploy controversy analysis to *adjucate* between sources, discursivists' primarily aim is to facilitate the *exploration* of controversy. Demarcationists propose that knowledge controversies should be clearly distinguished from non-epistemic debates online, whereas discursivists and empiricists deploy digital methods in order to demonstrate the entanglement between epistemic and political dynamics. Finally, discursivists tend to posit a social ontology of controversy stipulating actors, positions, and societal domains. Empiricists, however, seek to minimize ontological assumptions, arguing that controversy in digital settings is heterogeneously composed in ways that can't, and shouldn't, be predetermined by the analysist. They ask: are the issues enacted through policy reports or in situ protests? Communicated through pdfs of tweets?

Perhaps unsurprisingly, I believe that discursivist and empiricist approaches are the best suited to pursue the intellectual and normative project invoked in the introduction, 'to move beyond impartiality' in the analysis of knowledge, technology and society - to develop an understanding of the biases of digital information that does not fall back on the imagined ideal of neutral, non-interested, knowledge (Venturini, 2012). However, considering the perceived societal relevance – and computational implementability – of demarcationist approaches to controversy analysis, it is crucial that we offer a clear definition of the latter project. In a context

in which 'digital bias' is widely perceived as a public problem, what do we gain by 'moving beyond' the ideal of the impartiability of knowledge? I will argue that this long-standing project faces important new challenges in digital environments, as problems of bias here pertain not only to content but to the settings of controversy. This, in turn, has methodologogical implications for what is required to succesfully 'move beyond impartiality' in digital research. I shall argue that the empiricist approach is especially well-equipped to satisfy these requirements.

3. Two approaches to problems of digital bias in controversy analysis

It is widely recognized that online environments pose significant problems for the implementation of controversy analysis, and not least among these is the problem of digital bias. Indeed, each of the three frameworks introduced above recognize that digital media technologies, insofar as they provide a platform for controversies, can*not* be considered neutral. Some STS-informed studies of online controversies are specifically concerned with the problem of digital bias, demonstrating how online devices like search engines and platforms like Wikipedia exert significant influence on the mediation of controversies online.[9] Mager and Elkof (2012) have compared the presentation of controversial 'biofuels' in the press and in search engines, showing that the latter are more biased towards commercial sources (see also Madsen, 2013), and others have demonstrated the biases in the Wikipedia reporting on specific issues like climate change and nuclear energy towards industry and scientific sources (Niederer, 2013; Weltevrede and Borra, 2013, Moats, forthcoming). Of course, STS scholars have for many decades been interested in media bias, and the influence they exert on what claims and actors gain public attention during controversy (Nelkin, 1979; Hillgartner, 2000). In digital controversy analysis, however, the problem of bias touches on the very viability of digital media as settings for the enactment of controversy, and for its analysis.

That is to say, in digital controversy analysis the problem of bias emerges as an important *methodological* problem. Interestingly, this problem is framed and addressed in very different ways by the different frameworks for controversy analysis introduced above. Discurvists tend to frame digital bias in negative terms, treating it as a source of noise that risks to undermine the epistemic viability of digital controversy analysis: because online information is partial and biased, a controversy analysis that relies primarily on this type of information will suffer from the very

same problem (Venturini et Guido, 2012). For this reason, discursivists tend to advocate the use of data from mixed sources in digital controversy analysis (both online and offline), arguing that controversy analysis must take active steps to militate against online biases and 'purge' their controversy analysis from these effects. In this vein, Thelwall and Faircloughs' (2006) recommend that in conducting issue analysis with the Web, it is advisable to "remove from the data wherever possible all occurrence of web phenomena that serve to obscure [the issue]" (see also Rogers, 2013). Whenever the process of online data capture results in some sources figuring more prominently than others in the data set, for instance because some sources receive comparatively more hyperlinks than others, this effect has to be neutralized, by removing duplicates (see also Pearce et al, 2014).

Others, however, have questioned the suitability of this 'precautionary' approach to problems of bias in online research. Advancing an 'affirmative' approach to digital bias, they propose that the online dynamics that precautionists define negatively as sources of noise or corruption of data, may also present a positive, constitutive aspect of controversy online (Marres and Rogers, 2009). The use of hyperlink analysis for controversy research helps to make this clear. On the one hand, hyperlinking presents a socio-technical phenomenon that is specific to digital networked media, and accordingly hyperlinks analysis can be used to demonstrate biases that are specific to these settings. We can ask, for instance, whether overall hyperlinks patterns on the Web are relatively centralized or de-centralized (Kelly, 2010), or whether and how innovations in hyperlinking, such as the introduction of Twitter or Facebook buttons, influence which type of sources feature prominently online (Helmond and Gerlitz, 2012). However, hyperlink analysis may also be used to detect substantive dynamics of controversy online, as in the case of the issue-network presented in Figure 1. Digital devices like hyperlinks may introduce effects of digital bias into online content, and as such are reflective of media-technological dynamics. But as they provide instruments for the organisation of issues online, they may equally carry a substantive 'charge'.

The affirmative approach to digital bias latches onto this ambiguity of digital devices, arguing that we can rely on them as empirical means for detecting controversy dynamics (Marres and Rogers, 2005). One of the striking features of digital settings like the Web, we then say, is the close connection between technological dynamics and dynamics of topic or issue formation (see also Foot and

Schneider, 2004). From an empirical point of view, it is often unclear which of these two dynamics we are dealing with when analysing controversies online. To return to the example of the WCIT issue-network presented in Figure 1, the fact that the social media platform Twitter is the central node in this network could be due to a variety of effects: it could be because Twitter buttons are becoming increasingly common on the Web, but equally because Twitter presents a key site of mobilization in the controversy around the WCIT conference. That hyperlink analysis throws up Twitter as a relevant source may then be due either to media-technological dynamics of 'digital bias' or to the substantive dynamics of controversy, or both.

There are then two very different ways to treat the methodological problem of digital bias in online controversy analysis: the precautionary approach treats digital media technologies as a source of noise that must be neutralized, while the affirmative approach treats digital devices as an empirical resource for controversy analysis. The former proposes that digital content must be dis-embedded from online settings in order to secure the validity of issue analysis (Thelwall, 2009). The latter seeks to bring publicity devices that are specific to digital culture within the empirical frame of controversy analysis (Marres and Rogers, 2009).[10] To be clear, both approaches recognize that digital devices like hyperlinks may result in the privileging of some sources over others in online settings: Hyperlinks do not offer 'neutral' tools for delineating data sets, they are instruments for the organisation of networked information, and as such they participate in the (de-)valuation of digital content. Where the two approaches differ is on the methodological issue of whether controversy analysis must militate against these effects, or should affirm their role in the enactment of controversy online.[11] The affirmative approach proposes that digital devices are in part *formative and therefore potentially indicative* of controversy dynamics online: they organise sources in ways that bring substantive contestations to the fore (Gillespie, 2013).

The three frameworks for controversy analysis introduced above are associated, to an extent, with one of the two approaches to digital bias. Discursivists tend to adopt a precautionary stance, as their aim is to map 'positions in a debate.' Indeed, the metaphor of 'debate' is generally deployed precisely to dis-embed contributions from media-technological settings (Thompson, 2011). Empiricists are inclined to outsource epistemic capacities to empirical settings, and accordingly they are generally quite happy to rely on technical formations like a hyperlink network to

tell them who the actors and what the issues are. Demarcationists, however, might go either way. While a focus on substantive disagreement tends to go together with a negative understanding of technological bias, this is not necessarily so: Yasseri et al (2012)'s project on Wikipedia controversies leans towards an affirmative approach to digital bias, as it relies on the measurements of platform-specific features such as the number of page edits to determine the 'controversiality' of Wikipedia pages. One's approach to digital bias is then *not* pre-determined by the broader normative framework for controversy analysis: the relation between the two is not straightforward. However, the affirmative approach to digital bias is in my view of critical importance for the further development of controversy analysis as a digital method. It provides a way to translate the project of the "move beyond partiality" in the social study of knowledge, technology and society into a methodological strategy for digital research. In the next sections I will discuss how this is so, but first I want to discuss a key problem with the affirmative approach.

4. The promise and problem of an affirmative approach to online bias

The proposal to affirm media bias in the empirical study of controversy is certainly not a new proposal. Especially useful in this regard I find Hilgartner (2000; drawing on Bogen and Lynch, 1996)'s discussion of the problem of the 'warm record' in controversy analysis. Hilgartner argues that media accounts of controversial affairs can under no circumstances be treated as neutral records of controversy, *because the act of publicizing a controversy* – for instance by sending out a press release or leaking policy documents to the press – *inevitably constitutes an intervention in controversy*. In other words, public records of controversy are not external to the controversy, but partly internal to and inflected by it. An affirmative approach to the bias of media technologies can also be recognized in scientometrics, a well-established analytic approach that relies on citations and other formal features of scientific journal articles - such as the key-words used to index articles - to investigate the dynamics of scientific fields (Leydesdorff, 2001). As it analyses and visualises citation and key-word relations, scientometrics too deploys formal devices that are specific to a publicity genre – the scientific journal article - in order to address substantive questions: 'who are the principal actors? 'which topics are prominent in this field?'[12]

Indeed, digital methods of controversy analysis have been defined as the attempt to extend scientometric methods to new media environments (Scharnhorst & Wouters, 2006). And it can be argued that the digital equivalents of publication, citation and indexation allow not just for the extension but the *expansion* of the analytic capacities of network and textual analysis as compared to their pre-digital counter-parts. Whereas citation analysis used to be limited to the scientific literature, digital devices like hyperlinks and hashtags are deployed across domains, from science to advocacy, journalism, policy and activism, allowing us to study the inter-relations between fields. Secondly, the rise of digital platforms for user-generated content – 'social media' - has broadened the range of digital devices available as empirical resources for controversy analysis. Besides linking, online platforms such as Twitter and Facebook enable several other 'informational actions' such as 'tagging', 'following' and 'mentioning' (Rieder, 2013). To be sure, the rise to prominence of such 'information-actional' formats present important topics for the social study of media technology in their own right (Crawford and Gillespie, 2014). But they also present promising instruments for controversy analysis, perhaps most of all hashtags, the key-words identified and applied by users as #tags to identify relevant topics in social media content (Rieder, 2013).

Like the key-words used to index scientific articles, hashtags can be analysed to detect emerging topics. When faced with a relatively opaque and complex topic, such as the WCIT conference, or the associated topic of 'internet governance', issue detection becomes especially important (Hoffman, 2013) and hashtag analysis offers a useful instrument for this. Thus, in our WCIT case study, we analysed the hasthags used on Twitter in relation to this topic in the period surrounding the summit, in order to determine to which issues WCIT is related, and how 'active' these are (see Figure 2). [13] As it turned out, the profile of the WCIT hashtag on Twitter contained a high proportion of campaign and issue terms (surveillance, bigbrother, privacy), and this may be taken as a rough indication of the controversiality of WCIT. However, our hashtag analysis also points towards some problems with our reliance on hashtags to analyse controversy. This problem can be summed up in the question: Are we mapping controversies or the effects of media technology? We already saw above that the composition of an 'issue-network' located with the aid of hyperlink analysis may be indicative of either substantive or media-technological dynamics. Something similar applies to hashtags on Twitter, When we analyse hashtag relations, are we

perhaps analysing which type of messages are more likely to be accompanied by hashtags? Are we mapping the privacy settings of different sources, where some remain inaccessible to our crawlers and scrapers?

The problem seems especially tenacious in the analysis of social media data, as these platforms are explicitly designed to facilitate promotional forms of publicity (i.e. advertising). Hashtags are one of the principal instruments for gaining an audience in these settings, and are widely used to that effect by marketeers, in ways that frequently have little to do with the informational content being 'pushed' (Gillespie, 2010). Indeed, our WCIT hashtag analysis not only showed that WCIT is associated with issue terms such as 'internet freedom' (#netfreedom) deep packet inspection (#dpi) and censorship. Equally prominent on Twitter were more generic tags like #anonymous, referring to the anonymous 'hacktivist' collective which has a reputation for latching onto any content with 'currency' to gain attention (Coleman, 2011). While we set out to map a controversy in online media, we may then easily end up analysing phenomena that tells us more about digital media platforms than about the controversy in question. To affirm the bias of online settings in digital controversy analysis does not simply enhance the empirical capacities of controversy analysis, it comes at significant price: it puts at risk the substantive focus of digital controversy analysis.

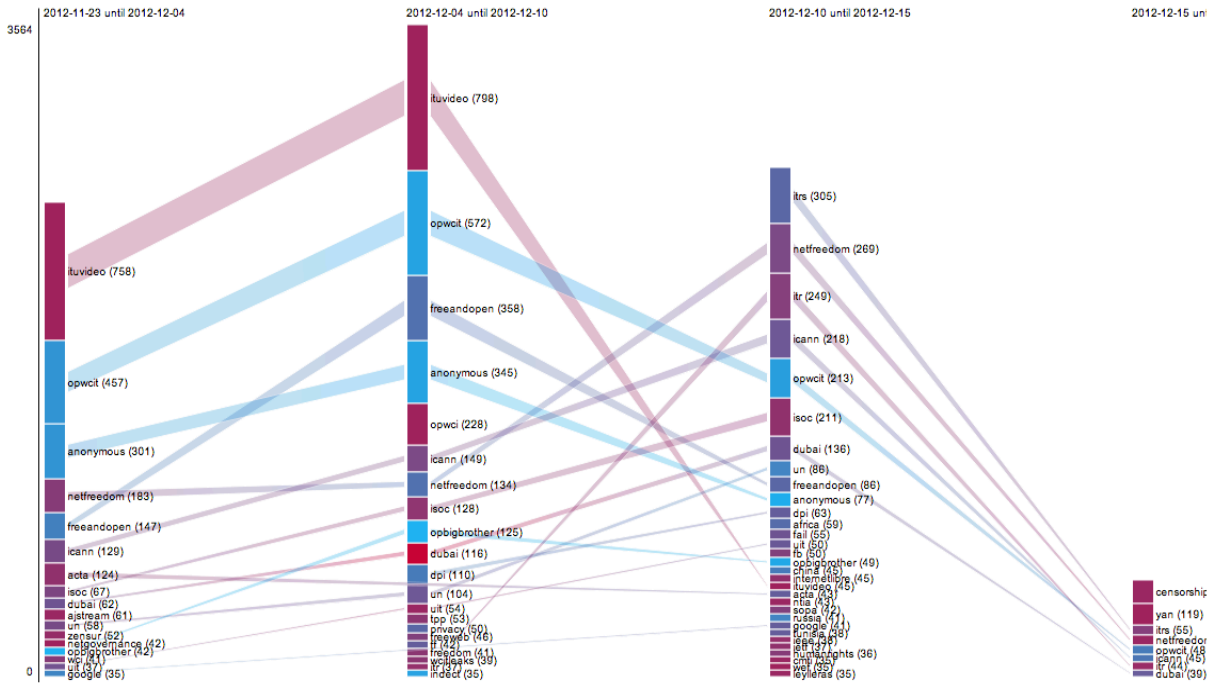

Figure 2: Hashtag profile for "WCIT", showing its hashtags associations per interval (before, during (x2) and after the summit), produced with the Associational Profiler, February 2013.

In order for an affirmative approach to digital bias to be methodologically viable, we must then find ways to address the following question: how to ensure that we map *controversy dynamics*, rather than *media-technological dynamics*? Digital bias *is* a problem for controversy analysis, though the problem I highlight here is different from the one precautionists worry about. The latter do not really recognize that acts of publicity - interventions that push certain topics, actors and locations into the foreground - are part of the empirical object of controversy analysis, as they propose that we should actively disregard such publicity effects and remove this bias from the data. However, another problem of digital bias comes into focus once we recognize publicity effects are in part constitutive of controversy: the problem of the *inherent ambiguity* of the empirical object of online research. The recognition that instruments of digital publicity like hyperlinks and mentions may help to produce controversy does not relieve us analysts from the obligation to configure a robust empirical object.[14] In the remainder of this paper, I would like to discuss ways to address this challenge. I will argue that if we are serious about affirming the participation of digital media technologies in controversy, then we must re-define the empirical object of controversy analysis: we must map issues and not only controversies.

5. From controversy analysis to issue mapping

To adopt an affirmative approach to digital bias is not only a methodological choice, it

raises empirical questions: How are digital media technologies affecting the manner in which controversies are conducted in our societies? If we affirm that digital media technologies participate in the enactment of controversy online, then surely digital controversy analysts must take a positive interest in the influence they have on public controversy and the forms it takes today. At this point too, the online controversy around the WCIT conference provides a useful example: one significant intervention in this controversy took the form of a digital act of publicity, namely an 'information

leak.' While the conference was still going on, a large number of official summit documents, which had not previously been made public, were made available for download via websites like dot-nxt.com.[15] On the one hand, such a 'data dump' is a form of publicity that is to an extend specific to Internet culture (Coleman, 2014; on leaks as an intervention in controversy, see also Hilgartner, 2000). At the same time, however, this intervention can be understood as contextually specific to the WCIT controversy. Unlike other recent Internet-related international summits, WCIT expressly excluded civil society organisations from participation, and was held behind closed doors. This was widely considered a decisive feature of the summit, and the target of much public criticism online. In this regard, the prominence of hashtags like #WCITleaks, #leak, #anonymous, #opwcit (for operation WCIT) on Twitter are not necessarily a sign that WCIT has been hijjacked by generic online campaigns on this platform, but may be interpreted in substantive terms. Specifically digital interventions such as an online data dump cannot as a matter of course be considered 'external' to controversy proper.

This discussion can also help us to articulate further what is the problem with the precautionary approach to digital bias. As this approach proposes to strip controversies of effects that are specific to the digital settings in which they are enacted, it is not a good position to appreciate that media-technological interventions - such as a leak or the high volume of tweets that announced it – in and of themselves may present a significant contribution to public controversy. Precautionists wrongly suggest that the empirical object – controversies – should ideally remain the same 'with or without digital media', as if their form, content and character is and/or should be unaffected by the media-technological settings in which they unfold. However, 'informactional' formats - like leaks, or social media 'trends,' and so on – may well influence the very form that public controversies are taking in the context of digitization (Anderson and Kreiss, 2013). While informed by important methodological concerns with bias, the precautonist endeavour to 'disembed' controversies from digital media settings could result in distortions of the empirical object.

This is not the place to discuss the digital transformation of forms of publicity in detail, but there is one development that I would like to mention here, because it is likely to affect the role and status of public controversy in digital societies: the changing role and status of 'issue dynamics' in informational environments.[16] As has

been discussed extensively by digital media scholars, digital platforms and infrastructures are increasingly oriented towards the dynamic valorization of content: search engines privilege fresh information, and social media seek to keep their users engaged by continuously informing them of 'what is happening' (Gillespie, 2013; Rogers, 2013; see also Marres and Weltevrede, 2013). As a consequence, the formatting of topics as 'happening issues' has become increasingly common, as a way of promoting the visibility of said topics in media environments. This in turn raises the question of whether the very distinction between stable and 'active' topics of knowledge and interest is shifting today. Could it be that the digitization of public media and interaction is precipitating a *generalization* of issue dynamics? It can seem that today anything, from a toothbrush to the sighting of a strange species of dog, may become the focus of issue making activity.

I can offer no more than a speculative hypothesis here, but these observations suggest that it would be unwise for digital controversy analysts to assume the stability of 'public controversy' as an empirical object. *If digital media technologies are leaving their traces in the very form, content and character of public controversy, then this would surely present an important topic of inquiry for controversy analysis. We should then actively investigate what forms, shapes and genres of public controversy are taking in digital settings, not just to secure a viable methodological strategy but as part of the empirical project of controversy analysis. The investigation of how digital settings influence the public articulation of contested affairs must then become part of our empirical inquiry.* Digital controversy analysts should ask not just substantive questions but also formal ones like: how is doing issues through data leaks different from doing issues with press releases?[17]

If digital devices play a role in the organisaiton of public controversy, then controversy may be constituted differently depending on what devices and formats are deployed in its enactment. *Indeed, it is now no longer self-evident why we would privilege public controversy as the focus of empirical analysis.* Public engagement with contested affairs may also take other forms. Thus, in our analysis of the WCIT hashtags, hashtags associated with corporate advocacy (#freeandopen), hactivist campaigning (#opwcit), small talk (#justsaying) turned out to be prominent, besides more issue-specific hashtags (#humanrights and #dpi for "deep packet inspection"). If we would adopt a critical approach in digital controversy analysis, we could be tempted to disregard the former hashtags as a distraction from the WCIT controversy

proper, i.e the substantive issues. But their prominence on Twitter can also be taken to suggest that a variety of different types of issue engagements were facilitated by this platform, from informal conversation to corporate advocacy and hactivist intervention, and indeed, that these type of engagements in particular gained prominence in relation to WCIT in this setting. When we analyse controversial issues with online media technologies, the form of controversy emerges as an relevant empirical question: does WCIT primarily feature as an object of activist mobilization or a topic of expert disagreement, or a combination thereof? Controversy may have to be regarded as one format of issue articulation among others.

This has implications for our framing of the empirical object of digital controversy analysis. If we are serious about affirming the role of digital settings in controversy, then we should adopt a more-open ended empirical approach in my view: we must map issues, and not only controversies.[18] To propose this is to further elaborate the empiricist commitment of controversy analysis. Classic work in STS has famously posited that controversies are analytically useful for social inquiry, insofar as these events render available wider social relations for empirical analysis. In turning to digital settings to analyse controversies, however, a different set of questions arises. As noted, issue mapping online shifts the emphasis to issue detection. We ask: is this topic really an active issue? One of the classic innovations of controversy analysis as an STS method was to defer to the empirical setting in answering substantive questions like: Who are the protagonists? What is the topic of contention? (Latour, 2005) In doing controversy analysis with digital platforms, we defer a further question to the empirical: what form does engagement with the issue take? Are they topics of public debate or objects of activist mobilization? Are they thematized through information leaks or through the promotion of factual statements? The analytic sequence of digital controversy analysis is also different: whereas controversy analysis used to begin with an robust controversy in order to detect given actor-relations, issue mapping begins with a given topic in order to detect emerging issue-formations.[19]

To be clear, while the move from controversy analysis to issue mapping is informed by an affirmative understanding of digital bias, it is certainly *not* an un-critical approach. That controversies in digital settings so often revolve around 'campaigns', 'gaffes' and 'publicity initiatives' is surely a problematic development. Not unrelatedly, some commentators now talk about digital 'issue fatigue.'[20]

Digitization doesn't seem to favour the type of issue dynamics that historically have been appreciated by controversy analysts: those that involve the articulation of clear points of contention, effectively address institutional actors, and have the capacity to produce enduring shifts in actor alliances and the balance of power.[21] However, precisely because of their unsettling effects on public controversy, the emergence of digital forms of publicity requires our empirical attention. It is with this critical aim in mind that I propose to expand the scope of inquiry from controversy to issues. As is clear by now, this creates a significant degree of uncertainty about our empirical object. To conclude this paper, I would like to show that digital methods of issue mapping can also be used to reduce this uncertainty.

6. Mapping issues with, and against, digital media technologies

Informational (or 'inform-actional') dynamics like linking and tagging may be indicative of issue formation, but these digital practices are nevertheless biased towards highly particular dynamics, not least the promotional effects of hyping and trending. This situation makes it neccesary to take steps to ensure that issue mapping research does what it says on the tin, to map issues. On the one hand, it is a crucial precondition for issue mapping research that we accept the inherent ambiguity of its empirical object – issues formation involves both substantive and media technological dynamics. On the other hand, issue mapping should actively mitigate against the collapse of the former into the latter, whereby issue formation would be reducible to media technological processes. We must then treat the ambiguity of online issue formations as a topic of *critical* inquiry. Issue mapping research should militate against one important danger in particular: the risk that we end up assuming the platform's definition of what counts as a relevant issue, when we derive our indicators of issue activity from specifically digital formats - like hashtags or edits.[22] From the standpoint of Twitter and Wikipedia, a topic becomes an issue when tagging and editing activity in relation to this topic intensifies. This is when the issue appears in the list of 'top trends' (in the case of Twitter) or Wikipedia's "List of controversies."[23] However, it is far from self-evident that the intensification of editing or tagging activity is the relevant criterion of issue formation from the standpoint of political epistemology. It won't do for issue mapping research to call an 'issue' whatever the platform says is one.

The ‘inherent ambiguity’ of issue formations online then also works the other way: for a topic to count as an issue, it must be *collectively* accomplished as such by the various actors and entities involved. As such, it cannot be reducible to digital settings and dynamics. If we are to advance the purposes of issue mapping as a social research approach, we must then do more than ‘follow the media’ (Rogers, 2009). *We must push back against digital settings in equal measure*: we must put in place specific safeguards to ensure that our analysis reveals issue-specific activity and not just medium-specific features of the formations under study. We must prevent online issue analysis from uncritically going along with digital platform settings in its operationalization of what counts as an issue. A last example from our WCIT pilot study can help to clarify what such a critical but affirmative approach to digital issue mapping would entail.

In our study, we realized at an early stage that by relying on hashtag analysis to qualify the issues of WCIT, our study risked to be overdetermined by Twitter, and we devised a number of ways to militate against this form of platform bias. We used a form of hashtag analysis that would minimize the influence of the promotional dynamics of Twitter: we analysed not how often hashtags occur (a frequence-based measure), but the relations between them, detecting which hashtags occur together in Tweets (a co-occurrence measure). This helped to militate against sudden bursts of key-word occurrence, which tend to derive purely from massive re-tweeting and related efforts to get a hashtag to ‘trend’ on Twitter (for a more detailed discussion of co-occurrence methods, see Marres and Gerlitz, forthcoming). Second, to determine which issue terms to map with Twitter, we did not just rely on the platform itself, but also consulted issue experts and activists working in the area of Internet governance.[24] Intriguingly, the issues identified by advocates were very different from those that our hashtag analysis identified as relevant (i.e. well-connected) (see Figure 3). Many of the Twitter-derived terms refered to Internet-based campaigns, while the expert and advocates singled out substantive issues. From the start, it was clear that the ‘issues of the platform’ couldn't be conflated with the ‘issues of the field’.[25]

Terms suggested by issue experts and advocates (top 20)	Hashtags with top overall co-word frequency (top 20)
netneutrality	itu
telecommunications	wcit
privacy	handsoffinternet
spam	manosfueradeinternet
deep packet inspection	wcit12
access	ituvideo
internet regulation	opwcit
internet governance	internet
transparency	anonymous
multi-stakeholder	netfreedom
freedom of expression	freeandopen
censorship	icann
itu	isoc
cybersecurity	itrs
human rights	dubai
personal data	un
cost of service	opbigbrother
filtering	censorship
sender pays	dpi
etno	acta

Figure 3: WCIT issue terms suggested by respondents and by Twitter, December 2012

Thirdly, and finally, we actively involved the aforementioned issue activists and experts in the project of interpreting our issue and hashtag profiles. Their responses widely differed: some provided constructive commentary, for instance by pointing us to the sites where #WCITleaks occurred and were discussed. Others were critical of our Twitter analysis. One respondent noted: "Having been on the ground in Dubai, involved in substantial planning w/NGOs leading up to the event over many months, and participating in the US delegation (and conversations w/many other governments' officials), I must tell you I don't see much connection between this analysis and what actually happened."[26] The latter, critical reply, we found especially interesting: it mobilized what happened "on the ground" against Twitter and Twitter analysis, and thereby inadvertently underlined the rift between civic engagement with WCIT in digital settings and the conference proceedings #behindcloseddoors. It helped to convince us that the famous opposition between the online and the offline does not just present a methodological problem. The question of which settings qualify as relevant locations for issue formation was clearly *at stake* in this controversy, and featured as an issue in and of itself.

Our study of WCIT with Twitter is discussed in more detail elsewhere,[27] but this brief account should make it clear that online analysis can be configured to ensure that it serves the substantive ends of issue mapping. In analysing issues with digital settings, we can, and must, take specific steps to resist the capture of our analysis by media technological dynamics, as those of Twitter in relation to WCIT, where campaign key-words were pushed to the top of rankings by massive, often automated (re-)tweeting offensives, in the effort to make particular terms trend. However, I have argued that in militating against platform bias, it should *not* be our objective to remove the traces of digital devices from our data, in order to offer an 'neutral' presentation of controversy. Rather, we should specify how digital settings participate in issue formation, alongside and in close association with an open-ended set of other equally partial entities. In doing so, our overall objective should be to *qualify* issue formation, not in the restricted, anti-quantitative sense of determining their 'meaning', but in the broad sense of establishing what forms of intervention are enabled in the process of issue articulation.

7. Conclusion

We are now in a position to state more clearly what is at stake in the configuration of controversy analysis as a digital method. One of the critical question facing controversy analysis today is how it positions itself in relation to prominent digital platforms and infrastructures, such as search engines and social media. Will controversy analysis as a digital method align itself with the methods, features and objectives promoted by and through prominent platforms? Or will controversy analysis take the form of *a re-constructive project,* one that actively configures a digital apparatus to serve the empirical ends of issue analysis? In my view, the latter requires that we recognize that controversy analysis is *always partial*, and that it is our task to formulate a methodological strategy that is partial to the intellectual and normative aims of the study of science, technology and society (STS). I offer an argument that may seem paradoxical, but is not: if we want to ensure that controversy analysis as a digital method enable substantive research on issue formation, then we must *not* seek to bracket the role of digital technology in controversy. We must more closely engage with the phenomenon of 'digital bias', and offer an affirmative but critical assessment of how the digital participates in controversy and issue formation.

Of the three frameworks that currently guide the digital implementation of controversy analysis - demarcation, discourse analysis and empiricism - the last approach is in my view best equipped to realize this objective. Demarcationist and discursivist approaches to controversiy analysis, too, are centrally concerned with problems of digital bias, and they too configure controversy analysis as a way to address these very problems. However, these approaches tend to define the "influence of digital settings" in negative terms. They presume that to analyse controversies with digital methods, we must *bracket* the influence of digital settings on controversy: they treat digital bias as something that undermines the substantive concerns of controversy analysis. As such, they leave unchallenged our blind spots for the participation of media technologies in controversy and are unable to address a central question of issue formation today, that of how digital media technologies participate in the enactment of controversy.[28] The problem with demarcationist and discursivist approaches is thus *not* the substantive aim of their projects – to adjucate between sources, or to explore controversies – but the fact that they assume that these projects require us to pay as little substantive attention as possible to digital technology itself.

Rather than treating digital bias as a negative phenomenon to be bracketed, we should then develop methodological and empirical tactics that address the question of how digital devices participate in the enactment of controversy and the formation of issues. As I have shown, such an approach is not without risks and has consequences for the very framing of controversy analysis. Once we affirm that "media technologies always participate" in the enactment and analysis of controversies by digital means, then we must broaden the empirical focus of controversy research: we should not just analyse controversies, but map issues. That is to say, we should not limit our analysis to topics that are subject to explicit and focused disagreement among actors, but investigate a broader range of engagements with public affairs, including advocacy campaigning, public relations initiatives and activist mobilization. These latter forms of engagement may sometimes be indicative of media-technological 'takeover' of the process of issue formation, but in other cases they may enable substantive engagement.

The move from controversy analysis to issue mapping entails a significant shift in the empirical focus, but at the same time it simply *extends* two long-standing commitments of controversy analysis as an STS method. I have argued that its digital implementation allows for an expansion of the empiricist commitments of STS

research. Turning to digital settings to analyse controversies, these settings become available as empirical resources that allow us to address questions like: is this topic an issue? where is it happening, and what forms does it take? Secondly, the digital implementation of controversy analysis allows us to expand an important intellectual and normative project, the move beyond impartiality in the study of science, technology and society (STS). As noted, controversy analysis came to play a pivotal role in the development of STS precisely *because* it enabled the operationalization of this intellectual project. The shift from controversy analysis to issue mapping in digital research extends this 'move beyond partiality": it takes up the affirmative argument that all knowledge content is marked by bias and extends it to the media-technological settings of public life. All sites of publicity are likely to come with determinate biases built in, such as those of 'promotional culture' and efforts to 'lock' users into using these platforms. To be sure, these biases pose important problems both for the conduct of public controversy and for controversy analysis, but these problems deserve to be investigated rather than bracketed.

As noted, there are important precedents in the STS literature for such a proposal, not least in the work on 'warm records' (Hilgartner, 2000; Boden and Lynch, 1996). The digital implementation of controversy analysis offers significant opportunities to explicate and more firmly establish the methodological sensibilities this work evinces. Faced with the significant biases that digital media technologies introduce in the enactment of controversy, it might be tempting to some to look for safety in the semblance of neutrality offered by established empirical methodology. In my view we should actively resist the temptation to reach for ideals of epistemic 'impartiality' which STS has so convincingly shown to be flawed. This field offers significant conceptual and methodological resources for the development of a *partial methodology* for researching controversy by digital means: a methodology that suspends the ideal of the neutrality of digital settings, without however sacrificing the substantive focus of digital research on issue formation.

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References

Anderson, C. W., & Kreiss, D. (2013). Black Boxes as Capacities for and Constraints on Action: Electoral Politics, Journalism, and Devices of Representation. *Qualitative Sociology*, 1-18.

Asdal, K, "Making things cohere: Climate change, carbon economics and the ordinary technologies of politics" *Environment and Planning A*, Special Issue "Performing environmental change: the role of social science methods", K. Asdal and N. Marres (eds), forthcoming.

Beck, G and C Kropp (2011) Infrastructures of risk: a mapping approach towards controversies on risks. *Journal of risk research 1 (14): 1-16*

Benkler, Y. (2012) 'Truthiness and the Networked Public Sphere', Symposium on Truthiness in Digital Media, Berkman Centre for Internet and Society, Harvard University, March 6-7.

Bijker, W and J Law (Eds) (1992) Shaping society/Building technologies: studies in socio-technical change. Cambridge: MIT Press.

Bloor, David, and B. Barnes (1998) "Sociology of knowledge." *Routledge encyclopedia of philosophy*.

Bloor, D. (1982) 'Durkheim and Mauss Revisited: Classification and the Sociology of Knowledge', *Studies in History and Philosophy of Science* 13 (4): 267--97

Borra, E., E. Weltevrede, P. Ciuccarelli, A. Kaltenbrunner, D. Laniado, G. Magni, M. Mauri, R. Rogers, T. Venturini (2014) Contropedia-the analysis and visualization of controversies in Wikipedia articles, *Conference Proceedings of The International Symposium on Open Collaboration, ACM*, New York, doi 10.1145/2641580.2641622

Bogen, D., & Lynch, M. (1989) Taking account of the hostile native: plausible deniability and the production of conventional history in the Iran-Contra hearings. *Social problems*, 197-224.

boyd, d. and Crawford, K., (2011), 'Six Provocations for Big Data', paper presented at Oxford Internet Institute's *A Decade in Internet Time: Symposium on the Dynamics of the Internet and Society,* pp.1-17.

Callon, M., Law, J., & Rip, A. (Eds.). (1986). *Mapping the dynamics of science and technology* (p. 19). London: Macmillan.

Chateauraynaud, F. (2009) 'Public controversies and the Pragmatics of Protest: Toward a Ballistics of collective action', Working Paper EHESS, Paris.

Coleman, G. (2011). Hacker politics and publics. *Public Culture*, *23*(3 65), 511-516.

Collins, H. M., & Pinch, T. (1998). *The golem: What you should know about science*. Cambridge University Press.

Crawford, K. and Tarleton G. (2014) "What is a flag for? Social media reporting tools and the vocabulary of complaint." *New Media & Society*: 1461444814543163.

Eklof, J. and A. Mager (2013) Technoscientific promotion and biofuel policy: How the press and search engines stage the biofuel controversy *Media Culture Society 4 (35) 454-471*

Ennals, R. & B.Trushkowsky, J. M. Agosta, T. Rattenbury, and T. Hirsch (2010), Highlighting Disputed Claims on the Web. *Proceedings of the 19th international conference on World wide web* (pp. 341-350). ACM.

Ezrahi, Y. (1990). *The Descent of Icarus: Science and the Transformation of Contemporary Democracy.* Cambridge: Harvard University Press.

Gerlitz, C., & Helmond, A. (2013). The Like economy: Social buttons and the data-intensive web. *New Media & Society*, 1461444812472322.

Garfinkel, H. (1967). Studies in ethnomethodology. Cambridge: Polity

Gillespie, T. (2013) The Relevance of Algorithm. In: *Media Technologies: Essays on Communication, Materiality, and Society*, Tarleton Gillespie, Pablo Boczkowski, and Kirsten Foot (Eds). Cambridge, MA: MIT Press

Gillespie, T. (2010) The Politics of 'Platforms. *New Media & Society* (v12n3, 2010): 347-364

Hagendijk, R & Meeus, J. (1993). Blind faith: Fact, fiction and fraud in public controversy over science. *Public Understanding of Science*, *2*(4), 391-415.

Herring, S. (2010) Web content analysis: Expanding the paradigm. *International handbook of Internet research*. Springer Netherlands: 233-249.

Hilgartner, S. (2000). *Science on stage: Expert advice as public drama*. Stanford University Press.

Hofmann, J. (2013). Narratives of Copyright Enforcement: The Upward Ratchet and the Sleeping Giant. *Revue française d'études américaines*, (4), 64-80.

Introna, L and H Nissenbaum (2000) Shaping the Web: Why the Politics of Search Engines Matters. *The Information Society* 3 (16): 169-185

Kelly, J., (2010), 'Parsing the Online Ecosystem: Journalism, Media, the Blogsphere'' *The Economics of Information, Communication and Entertainment,* (2): 93-108.

Latour, B. (2011) Bruno Latour on Mapping Controversies. Video. Assessed November 11, 2011. http://www.mappingcontroversies.eu

Latour, B (2005) *Assembling the Social. An introduction to actor-network theory*. Oxford: Oxford University Press.

Leydesdorff, L., & Hellsten, I. (2006). Measuring the meaning of words in contexts: An automated analysis of controversies about 'Monarch butterflies,"Frankenfoods,'and'stem cells'. *Scientometrics*, *67*(2), 231-258.

Leydesdorff, L. (2001). *The challenge of scientometrics: The development, measurement, and self-organization of scientific communications*. Universal-Publishers.

Madsen, A. Koed (2013) Web-visions: Repurposing Digital Traces to Organize Social Attention, doctoral dissertation, Copenhagen Businesss School.

Madsen, A. Koed (2012) Web-Visions as Controversy-Lenses. *Interdisciplinary Science Review*, 1 (37): 51-68.

Marres and Gerlitz, Interface methods: renegotiating relations between digital research, STS and sociology, *Sociological Review,* submitted.

Marres, N. and E. Weltevrede (2013) Scraping the Social? Issues in live social research. Journal of Cultural Economy, 6(3), pp. 313-335

Marres, N., & Rogers, R. (2009). Subsuming the ground: how local realities of the Fergana Valley, the Narmada Dams and the BTC pipeline are put to use on the Web. *Economy and Society*, *37*(2), 251-281.

Marres, N. and R. Rogers (2005) Recipe for tracing issues and their publics on the Web," *Making Things Public: Atmospheres of Democracy*. B. Latour and P. Weibel (Eds). Cambridge: MIT Press.

Moats, D., Mapping Controversies with Wikipedia: The case of Fukushima', doctoral dissertation (in progresss), Goldsmiths, University of London

Mol, A. (2002). *The body multiple: Ontology in medical practice*. Duke University Press.

Munk, A. (2013), A field guide to the Web: techno-anthropology and the digital natives. *What is techno-anthropology?* T. Borsen & L Botin (eds), Aalborg: Aalborg Universitetsforlag.

Mutzel, S. (2009) Networks as Culturally Constituted Processes: A Comparison of Relational Sociology and Actor-network Theory, *Current Sociology* 57(6): 871–887

Nelkin, D. (Ed.). (1979). *Controversy: politics of technical decisions*. Sage Publications.

Niederer, S. (2013). 'Global warming is not a crisis!': studying climate change skepticism on the Web. *Necsus, European Journal of Media Studies 3, June 3*

Plantin, J.-C**.** (2011) "The Map is the Debate": Radiation Webmapping and Public Involvement during the Fukushima Issue, *A decade in Internet Time: symposium on the dynamics of the Internet and Society*, Oxford Internet Institute, UK, September 21-24th

Pearce, W, Holmberg, K, Hellsten, I.R. & Nerlich, B. (2014). Climate change on Twitter: topics, communities and conversations about the 2013 IPCC Working Group 1 report. PLoS One, 9(4). doi:10.1371/journal.pone.0094785

Prabowo, Rudy & Thelwall M. & Hellsten I. & Scharnhorst A. (2008) "Evolving debates in on-line communication: A graph analytical perspective. *Internet Research*, 18(5): 520-540

Rogers, R. (2013) *Digital Methods*. Cambridge: MIT Press

Rogers, R. (2009). *The end of the virtual: Digital methods* (Vol. 339). Amsterdam University Press.

Rogers R. and A. Ben-David (2008) "The Palestinian-Israeli peace process and trans-national issue networks: the complicated place of the Israeli NGO," *New Media & Society* 1 (10): 41-72

Rogers, R. and Marres. N. (2001) 'Landscaping Climate Change: A Mapping Technique for Understanding Science and Technology Debates on the World Wide Web', *Public Understanding of Science* 9 (141): 141-163.

Rieder, B. (2013). Studying Facebook via data extraction: the Netvizz application. In *Proceedings of the 5th Annual ACM Web Science Conference* (pp. 346-355). ACM.

Savage, M. (2012) *Identities and social change in Britain since 1940: the politics of method.* Oxford: Oxford University Press

Scharnhorst, A., & Wouters, P. (2006). Webindicators: a new generation of S&T indicators. *Cybermetrics*, *10*.

Schneider, S.M. and Foot, K.A. (2005) Web Sphere Analysis: An Approach to Studying Online Action. In: Hine, C. (ed.), *Virtual Methods: Issues in Social Research on the Internet*. Oxford, New York: Berg: 157-170.

Thelwall, M & R. Fairclough (2006) "Web Issue Analysis: An Integrated Water Resource Management Case Study", Journal of the American Society for Information Science and Technology 57: 1303-1314

Thompson, J. B. (2011). Shifting boundaries of public and private life. *Theory, Culture & Society*, *28*(4), 49-70.

Tkacz, N. (2014) *Wikipedia and the Politics of Openess*. Chicago: University of Chicago Press.

Yaneva, A. (2012). *Mapping controversies in architecture*. Ashgate Publishing.

Venturini, T., Gemenne, F., & Severo, M. (2013). Des Migrants et des Mots. Une analyse numérique des débats médiatiques sur les migrations et l'environnement. *Cultures & Conflits*, *88*(4).

Venturini, T. et D. Guido (2012) Once Upon a Text : an ANT Tale in Text Analysis. *Sociologica*, 62 (3).

Venturini, T (2012) Building on faults: how to represent controversies with digital methods *Public Understanding of Science* 7 (21): 796-812

Weber, I., Garimella, V. R. K., & Borra, E. (2012). Mining web query logs to analyze political issues. In *Proceedings of the 3rd Annual ACM Web Science Conference* (pp. 330-334). ACM.

Weltevrede, E and E Borra (2013) Repurposing Wikipedia as a Controversy Exploration Device, working paper presented at the DMI Winterschool 2013, January 22, University of Amsterdam.

Whatmore, S. J. (2009). Mapping knowledge controversies: science, democracy and the redistribution of expertise. *Progress in Human Geography*, *33*(5), 587-598.

Yasseri, T., Sumi, R., Rung, A., Kornai, A., & Kertész, J. (2012). Dynamics of conflicts in Wikipedia. *PloS one*, *7*(6), e38869.

[1] Morozov proposes that "whenever users are presented with search results that are likely to send them to sites run by pseudoscientists or conspiracy theorists, Google may simply display a huge red banner asking users to exercise caution and check a previously generated list of authoritative resources before making up their minds." Morozov, E. (2012) Warning: This Site Contains Conspiracy Theories, *Slate*, January 23.

[2] Controversy analysis can also be called *inherently* interdisciplinary insofar as it relies on a diverse set of competences: social research, computing, graphic design, and so on.

[3] This prototype application was developed by Intel's Confrontational Computing Programme. Implemented as a browser extension, the tool 'highlights disputes on the Web' with a pop-up window presenting an overview of 'evidence pro- and con-' " (Ennals et al, 2012). Development was stopped in 2011.

[4] Daily Chart, Edit Wars, August 5, 2013, The Economist Website, http://www.economist.com/blogs/graphicdetail/2013/08/daily-chart-1

[5] In the context of digitally induced 'information overload,' knowledge controversy is appreciated not just as a marker of legitimacy but also of relevance: *that which is currently contested on substantive grounds, deserves our attention*.

[6] In other cases, a causalist explanatory framework is adopted, as when researchers aim to establish the relative influence of a particular actor grouping, type of argument, or form of public intervention, in an effort to demonstrate who or what 'decided' the issue (Benkler, 2012). At least in first instance, such a causalist approach is in tension with the insights into co-production and the heterogeneous composition of action championed in STS.

[7] Besides actor-network theory, scientometrics has been an important influence on the development of controversy analysis as a digital method (Scharnhorst and Wouters, 2006), and in what follows I will explore the connections between these traditions.

[8] Such STS-inspired approaches can be called 'object-centred', insofar as they propose that the formation and transformation of issues itself is the primary dynamic to be detected and analysed. This approach differs from actor-centred approaches, in which the mobilization of organisations, individuals and institutions figures as the primary dynamic, something which is then expected to account for the substantive framing and reframing of issues (see Chateauraynaud, 2009).

[9] The problem of digital bias is particular complex, as such bias derives from multiple devices, from search engines to browsers, APIs and so on, as well as from the instruments of controversy analysis themselves. Furthermore digital bias is of course not limited to online settings, but also affects offline data-sets, as for example, a corpus of policy reports contained in an digital data-base. Online settings nevertheless present an especially clear case of digital bias, and much data today is marked by its mediation in these settings.

[10] This problem of the 'influence of the setting' (Garfinkel, 1967) and efforts to contain it by disembedding empirical phenomena from the settings in which they occur, are not just relevant to controversy analysis, but to a wide range of social research methodologies, including survey methods (Savage, 2012) and content analysis (Herring, 2010). My account in this article is limited to controversy analysis. I argue that controversy analysis as an STS method offer special resources for dealing with the intractable problem of digital bias.

[11] There are many other differences: precautionists tend to work with stable data sets, while many of those who affirm the bias of the setting are attracted by the dynamic data sets that online platforms make available.

[12] This affirmative use of citations has *not* prevented citation analysts from criticizing the biases that citations and indexing devices introduce into the scientific literature. For instance they identified the problematic that well-cited sources attract more citations for the simple reason that they are well-cited. Indeed, it was to militate against these very biases that some of the important methodological innovations in citiation analysis – such as co-citation analysis - were developed.

[13] This hashtag profile was produced with the aid of the Associational Profiler, a tool-in-progress developed by myself and colleagues at Goldsmiths and the University of Amsterdam in order to analyse issue activity wth digital methods. The profiler applies co-occurrence measures in order to detect associations between key-words, and plots relations in these key-word relations over time, from interval to interval. The colours indicate high (blue) and low (red) specificity, that is whether terms appear with one another proportionally more often than with other terms (hashtags) in the data set.The data set for our WCIT study included all tweets that contain the words WCIT or ITU (for UN International Telecommunications Union, which hosted the conference), posted between 23/11/12 and 19/12/12 inclusive, the period within which the 2-week summit took place, which we divided into four intervals of about a week. Our data set contained 108.781 tweets. This WCIT study was designed to trial the Associational Profiler tool. For more information, see:
http://issuemapping.net/Main/WCITProfiles (last accessed, December 2014)

[14] It is probably for this reason that some STS-informed work advocates a platform-independent approach to digital controversy analysis (Venturini and Guide, 2013; Beck and Kropp, 2012).

[15] Personal communication, anonymous source.

[16] To make matters more complicated, this is a reflexive effect. The dynamization of digital content is partly a consequence of the implementaiton of methods of network and textual analysis in digital infrastructures: platforms like Google and Twitter increasingly rely on such methods of data analytics to valuate, select and push content. I discuss the implications of these reflextive effects for the politics of STS methods elsehwhere (Marres and Gerlitz, forthcoming).

[17] The role of issue framing has been of long-standing interest in policy analysis, and as the digital implementation of controversy analysis raises the question of the information and action format, controversy analysis may significantly benefit from exchanges with this fields. Here, however, I am primarily interested in the methdological framing of controversy analysis as a partial methodology informed by STS.

[18] The focus on 'public controversy' in the study of knowledge politics in STS has been criticized before, among others by Annemarie Mol (2000), who suggested that to analyse controversies is to privilege the evolution of arguments over time, and entails a disregard for situated practices in which problems make themselves felt. But while Mol's critique mobilized ethnography against scientometrics, this paper offers a mixed methodology.

[19] If we inflate this distinction, it begins to resemble the difference between studying social order and researching social change. In issue mapping, the aim is to determine which topics become the scene of socio-tech-epistemic-and-so-on transformation. In controversy analysis, however, the aim has often

been to trace the relations between actors that constitute the taken-for-granted background of social life, i.e. its 'order'.

[20] Oliver Burkeman's Blog (2013), "Here are the correct opinions to hold about this week's social media outrages," The Guardian, July 19 http://www.guardian.co.uk/news/oliver-burkemans-blog/2013/jul/19/social-media-outrage-tsarnaev-zimmerman

[21] Arguably, controversy analysts in STS as in other fields have privileged sustained forms of issue-engagement facilitated by peer-reviewed publications, public consultation events and public policy debate. Digital platforms like Twitter facilitate engagement with similar topics (climate change, internet governance) but the the style and tone is often humourous, timeliness, and 'controversies' is frequently short-lived.

[22] For a discussion of the inherent partiality of theWikipedia platform, see Tkacz, 2014

[23] http://en.wikipedia.org/wiki/List_of_Wikipedia_controversies (Last accessed December 2014).

[24] In the week before the conference started, we sent out an email survey to roughly 25 issue advocates and experts active in the area of Internet governance, asking them to name 5 issues they considered especially relevant to WCIT.

[25] Of the top 20 issue terms on the lists of Twitter terms and expert terms, only two were the same.

[26] Email response received 17 April 2013.

[27] For a more detailed account see http://issuemapping.net/Main/WCITProfiles (Last accessed December 2014)

[28] Where proponents of these approaches do rely on platform-specific formats, such as Wikipedia edits, they tend to frame this reliance in purely instrumental terms, and remain silent about the active role played by these devices in the formatting of 'controversy' itself.