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FILTER BUBBLES, ECHO CHAMBERS, ONLINE COMMUNITIES

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1 Introduction

In Neal Stephenson’s fictional novel, *Diamond Age* (1995), the protagonist Nell acquires a prototype of what we might today recognise as a highly sophisticated e-reader with a voice-assistant. This e-reader, the “Young Lady’s Illustrated Primer”, uses artificial intelligence to serve as Nell’s personal teacher.

What is key to the Primer is how it is designed to respond to Nell. The Primer has a theory of Nell – her needs, her real-world situation, her abilities – and it tailors its lessons for her. The Primer is a highly personalised artificially intelligent device. For many readers – myself included – the Primer was a utopian vision of the bespoke digital tutors of the future. The appearance of new media and technologies in the early 2000s all pointed to the near-term reality of devices like Primers.

The real-life experience of personalised digital media, though, is so far from Stephenson’s vision that it is hard to imagine we will ever get there. Nell’s time with the Primer develops her intellectually, emotionally, and physically. Our “bespoke” media experience, by contrast, is more likely to turn us in on ourselves rather than guide us to live well in our societies. Personalised media is making us more like Narcissus: our consumption is driven by personal choices and automated algorithms that reflect what we already want to hear, see, and consume, and we are captivated.

Central to our understanding of the problems with the personalisation of digital media are filter bubbles and echo chambers. These phenomena are used interchangeably by some, but in distinct ways by others. I take the position that filter bubbles and echo chambers are distinct phenomena, but ones that raise similar epistemic worries.

I begin with a general discussion of filter bubbles and echo chambers, and I introduce the concept of “selective exposure” as central to both phenomena. There is minimal uniformity across uses of the terms “filter bubble” and “echo chamber”. Consequently, I divide the later discussion into two more precise topics: homophily and polarisation. I conclude with some future-looking comments about responsibility and the epistemic risks posed by digital personalisation.
1.1 What are filter bubbles and echo chambers?

We now know with great certainty what writers of all stripes have long bemoaned: left unchecked, we gravitate towards information that reinforces what we already believe and what we want to hear. Terry Pratchett explains this disposition in his novel, *The Truth*, in the words of Lord Vetinari:

> Be careful. People like to be told what they already know ... They like to know that, say, a dog will bite a man. That is what dogs do. They don’t want to know that man bites a dog, because the world is not supposed to happen like that. In short, what people think they want is news, but what they really crave is olds...Not news but olds, telling people that what they think they already know is true. (Pratchett, 2000)

In principle, there’s nothing wrong with wanting to have one’s beliefs reaffirmed. What is problematic, though, is when we’re excluding new information because it justifiably challenges the beliefs we already have. The phrases “filter bubbles” and “echo chambers” are both metaphors designed to express ways that we surround ourselves with – or find ourselves surrounded with – “olds” and not “news”. The olds that we’re after might be particular beliefs, or a more general ideological picture or world view.

1.2 Filter bubbles

Our collective awareness of the risks of filter bubbles increased with the publication of Eli Pariser’s (2011) book, *The Filter Bubble*. According to Pariser, “filter bubble” describes digital media curation gone wrong because algorithms that are designed to present us with content we are likely to be interested in are causing us to be enclosed in “a unique universe of information for each of us”. The concern is that as we are increasingly informationally isolated, either at the level of groups or individuals, we lose important common ground that is essential for a well-functioning society.

The filter bubble idea is related to several other slightly older terms used to describe ways that our online experience is increasingly personalised, including both “cyberbalkanization” and “splinternet” (Bozdag and van den Hoven, 2015). Preferred metaphors aside, these terms all express a collection of epistemic, social, moral, and political concerns about what might happen if digital personalisation causes us to be isolated from those with whom we don’t share much common ground.

Prior to Pariser’s book on filter bubbles, Cass Sunstein had published *Republic.com* in 2001, followed by *Republic.com 2.0* (2009) and *#Republic* (2017). In each of these three publications, Sunstein explores how the Internet is making it easier to close ourselves off from one another, and to informationally isolate ourselves into a “Daily Me” newsfeed of content that reflects our own values, beliefs, and desires. This alienates us from those other members of our political community who do not share our worldview.

While both Pariser and Sunstein agree on a range of the political and epistemic risks from filter bubbles (and echo chambers), they differ in their identification of the cause. For Pariser, the issue is how the algorithms behind social media platforms and search engines filter our online experience. For Sunstein, the concern is how these same platforms better enable us to choose what content we want to see. A full picture of the epistemic risks posed by new media will surely have to appeal to both our personal choices and automated personalisation algorithms.
Crucial to both Pariser and Sunstein’s different diagnoses about our apparently fracturing public sphere is a concept in social science known as “selective exposure”. Selective exposure describes our preference for “olds”, or, put more precisely, the fact that “given the chance, individuals will choose to consume media that reinforces their previous beliefs” (Cardenal et al., 2019a). Selective exposure is arguably made worse by new technologies including personalised search engines and social media. This claim, however, is ambiguous about exactly how new technologies and selective exposure interact.

First, it might be that, given a widespread and natural tendency to consume content we want to see, new media makes it far easier to engage in more radical forms of selective exposure. Cardenal et al. (2019a) refer to this as “voluntary exposure” to reflect that it is ultimately our personal choices that are the cause of filter bubbles (466). Second, it might be that the new technologies that utilise personalisation algorithms are exacerbating the voluntary exposure that we are otherwise engaging in – what Cardenal et al. call “involuntary exposure” by algorithmic filtering.

As Cardenal et al. (2019a) note, it is common to find the filter bubble hypothesis in the literature framed in terms of this second claim that involuntary exposure amounts to being in a filter bubble (see, e.g., Dubois and Blank, 2018). Exactly how much of our new media experience is the product (or cause) of selective exposure of either kind is a contested issue. 1

C. Thi Nguyen has a slightly modified account of filter bubbles that is widely gaining traction in philosophy. For Nguyen, a filter bubble is a special case of an epistemic bubble. An epistemic bubble is “a social epistemic structure which has inadequate coverage through a process of exclusion by omission” (Nguyen, 2018, 3). To some degree, epistemic bubbles are just our epistemic reality – we simply can’t attend to all of the relevant information out there.

The unintentional nature of omission is important, as Nguyen points out, because the lack of exposure to other relevant information can easily be corrected by simply “popping” one’s epistemic bubble.

This ameliorative action, though, can only be taken by those who know that they are in an epistemic bubble. Boaz Miller and Isaac Record (2013) have more fully developed the epistemic problems that lie in “secret Internet technologies” like those described by Pariser. Miller and Record argue that a lack of awareness or understanding of digital personalisation undermines our ability to get fully justified beliefs online. Miller and Record’s piece is a useful starting place for reconsidering our epistemic theories of concepts like justification and knowledge in the context of new media.

### 1.3 Echo chambers

Echo chambers are plausibly similar to filter bubbles in both their causes and their epistemic consequences. However, the strength of these similarities, unsurprisingly, depends on one’s chosen characterisation of both types of structures. It is not uncommon – particularly in popular media – to find the two terms used interchangeably for the same underlying phenomenon. In many cases, this is the siloing of ourselves into epistemic bubbles by voluntary exposure.

What makes echo chambers distinct, according to Nguyen (2018), is that membership in an echo chamber undermines one’s epistemic trust in either some or all non-group testifiers. Echo chambers are “a social epistemic structure in which other relevant voices have been actively discredited”.2 One, therefore, can’t simply “pop” an echo chamber by diversifying one’s sources. Nguyen’s fairly specific definition of echo chambers is not widely shared, particularly not in the social science research that models social information networks. I will use
“exclusionary-type echo chamber” to refer to the specific definition provided by Nguyen and just “echo chamber” elsewhere with appropriate caveats.

Echo chambers are commonly identified as groups of homophilous (“like-minded” or “similar”) individuals, where members have mostly interactions with other members, and make choices about what information to attend to that amounts to varieties of voluntary exposure. It is also common for “echo chamber” to refer specifically to politically homophilous groups, for example “Democrats”, “Liberals”, or “Conservatives”.

Another commonality across uses of the echo chamber metaphor in discussions of digital personalisation is the amplifying nature of what is said inside the echo chamber. Choi et al. (2020), for example, examined how “rumour echo chambers” (defined by the properties of voluntary exposure and political homophily) amplify rumours by causing them to propagate more widely than rumours spread by non-members. Another relevant idea and metaphor in the neighbourhood is that of “information cascades”, Sunstein’s (2017) discussion of cyber-cascades is a useful introduction to this phenomenon.

1.4 Pre-existing concerns about epistemic segregation and identity

It is worth priming ourselves with some general comments about why echo chambers and filter bubbles are problematic. One epistemic response is simply that we are not infallible, and neither are the like-minded individuals that we will be inclined to surround ourselves with. So, selective exposure makes it likely that we may miss out on knowledge.

A fuller response isn’t easily separated from both social epistemic concerns and political epistemic concerns. Nor are the epistemic risks easily separated from identity facts about Internet users – something that Anglo-analytic epistemology has tended to shy away from. Relevant identity facts may include, e.g., race or ethnicity, gender identity, or political affiliation. At the dystopian end of the spectrum of the consequences of filter bubbles and echo chambers is the worry that we will end up “living in different political universes—something like science fiction’s parallel worlds” (Sunstein, 2017, Chapter 1). A possibility on the table, then, is that we risk taking a path that leads us to a society divided by political communities of “alternative facts”.

The idea that our identities are structurally significant for our epistemic lives has been a core theme in epistemologies of ignorance and feminist epistemology. As we’ve just seen, our identities – our values, beliefs, desires – determine the trajectory of selective exposure.

Charles Mills paper, “White Ignorance” (2007), might not strike one as relevant for understanding filter bubbles and echo chambers. However, the project is one of understanding how group identity, in this case racial groups, leads to patterns of false belief and a lack of true belief within particular groups, i.e., the white American community. Mills’ characterisation of the social-structure of white ignorance is similar to characterisations of media echo chambers. For epistemologists, Mills’ critiques of theorising about ideal cognition are especially relevant for future normative work on digital personalisation.

Lorraine Code (1993) similarly criticises mainstream analytic epistemology for erasing epistemically significant properties from knowers, i.e., their gender. Both Mills and Code argue that we must understand that our everyday epistemic actions are differently enabled and constrained by our (perceived) identities. Recent work by Kristie Dotson (2011) and Jose Medina (2012) develops the importance of identity for shaping our testimonial communities, including normative arguments about the failures to live up to our duties to one another as knowers. These works lay important foundations for theorising about what we ought to be aiming for in reforming online communities to avoid the more dystopian possibilities that could result from filter bubbles and echo chambers.
Concerns about the segregation of epistemic life on the basis of group identity have long been with us. Moreover, philosophers working on epistemic ignorance and related subjects recognise and highlight the interaction between epistemic and political agency. There is certainly room for exploring how these literatures overlap with major themes in research on filter bubbles and echo chambers with respect to topics like polarisation, homophily, and trust networks.

Recall that it’s not necessarily bad that we engage in selective exposure, and the sheer volume of content online means that we are going to have to be selective in some way about what we look at. Aiming for truth is one goal we can optimise for, but the social–historical context that creates the groups that we are likely to align with are not created by such a goal. It is likely that the ignorance that prevails in some communities will not be overcome by actions as simple as popping filter bubbles, so understanding ignorance in context is crucial.

2 Bespoke or biased?

The idea of personalised media has widespread appeal. The epistemic (and moral and political) concerns arise when the resulting diet of information has some other problematic property. Exacerbating or causing cognitive biases is one such problematic property. A second is the tailoring of the very communities that we have online conversations with – not many of us are designing our social media friends bubbles with lofty aims of truth and wisdom in mind.

Confirmation bias is one of the most studied clusters of cognitive biases and generally describes the “seeking or interpreting of evidence in ways that are partial to existing beliefs, expectations, or a hypothesis in hand” (Nickerson, 1998). If the experience of being in filter bubbles or echo chambers leads to higher levels of confirmation bias, then that would be epistemically problematic because it undermines the goal of rational cognitive action.

Similarly, if confirmation bias is playing a role in causing filter bubbles or echo chambers, e.g., by voluntary exposure, then we have a situation where people are choosing to attend to and exclude information for irrational reasons. One study supporting this concern is Geschke et al. (2018), who found via agent-based modelling that confirmation bias analogues in their models were sufficient for generating echo chambers.

Homophily is a widespread theme in research and discussions of filter bubbles and echo chambers, and describes the tendency of individuals to form groups with like-minded others. The causal arrows between homophily and digital personalisation run in both directions in discussions of these phenomena: a filter bubble is caused by homophily, or homophily is a cause of filter bubbles.

Cyberbalkanization refers to a concern that, in some loose similarity with the real-world division of the Balkan Peninsula (and other regions), the Internet will in practice be divided into a number of small and politically (or ideologically) aligned groups. Bozdag and van den Hoven (2015) provide a detailed discussion of how cyberbalkanization and filter bubbles threaten different democratic models.

The filter bubble and echo chamber hypotheses are often presented as claims about the basic nature of the online epistemic ecosystem. While it seems right to be concerned about the consequences of homophilous groups online, it is a jump to assume that all online discourse takes place in siloes. Furthermore, we don’t have good reasons yet to believe that cyberbalkanization is a necessary end point for online communities. We do have some good reasons, though, for being worried that particular features of our online experience interact with our tendency to form like-minded groups in epistemically problematic ways.
Yosh Halberstam and Brian Knight (2016) investigated both the effect of homophily and group size on the spread of political information on Twitter. They note that “the degree of homophily in the political network is similar to that documented in other social networks” (74). This is important context given the frequently made observation that filter bubbles and echo chambers are not wholly “new”. Halberstam and Knight’s results suggest that homophily in social networks does cause restricted access to political information.

Barberá et al. (2015) found that conversations about national events that are not political issues were better characterised as “national conversations” – conversations between people of a diverse range of political and ideological leanings. They found that political topics of conversation typically took place within echo chambers, which they define as being characterised by “selective exposure, ideological segregation, and political polarization” (2015, 1532).

Results from both Barberá et al. (2015) and Williams et al. (2015) suggest that the politicisation of an issue changes the social epistemic structure of the online community. Barberá et al. (2015) observed shifts from national conversations to echo chambers. Williams et al. (2015) found that Twitter conversations about climate change were likely to occur in both echo chambers (like-minded groups with similarly positive or negative attitudes), and “open forums” (mixed user groups with mixed attitudes, similar to national conversations).

Flaxman et al. (2016) looked at ideological segregation in US online news consumption. They found the people who consume the most news consume a broad range of mostly reliable sources. Thus, new media are in some ways increasing the diversity of news consumption. However, they also found that reading news through primarily social networks and search engines is associated with an increase in ideological segregation not reflected in consumption via online news outlets.

Cardenal et al. (2019b) found no evidence of online partisan media echo chambers with their analysis of the Spanish media system, but they found that voluntary exposure increases with individual interest in news consumption. So, we may need to look more closely at what kinds of online platforms lead to undesirable social epistemic structures, and that negatively affect belief-formation.

While the subject is still contested, there is a growing body of research into whether filter bubbles and echo chambers are more concentrated among certain political groups. The majority of the present research into partisan differences focuses on the United States and their associated two-party partisan system, so cross-cultural analysis will be an interesting development for this work in the future. One such study has already been mentioned in the work of Jamieson and Capella (2008) who argue that the US conservative media establishment is an exclusionary-type echo chamber.

Andrei Boutyline and Robb Willer (2017) examines homophily in online networks. They found that among Twitter users, individuals with extreme political beliefs across political affiliations, but also conservative individuals in particular, were more homophilous than other groups. Interestingly, Barberá et al. (2015) found that liberal Twitter users were more likely to engage in cross-ideological re-tweeting than their conservative counterparts.

Benkler et al. (2018) look directly at partisan differences in news consumption. If “the Internet” is the problem, and not anything peculiar to particular online communities, then we should expect to see “a symmetric pattern of segmentation, assuming that users on the left and the right operate under similar social psychological dynamics and algorithms decisions” (2018, 291). In other words, if “the internet” is constituted by filter bubbles and echo chambers, then we should see the same patterns across the partisan spectrum.
From their analysis of readership trends, around 70% of the US population “exists in a mixed-media ecosystem that is not fragmented and is more or less normally distributed in its attention around a core of traditional professional media outlets” (ibid.). The remaining 30%, however, is primarily consuming right-wing media that exhibits problematic filter bubble and exclusionary-type echo chamber dynamics. Importantly, these asymmetric tendencies on the left and right pre-date the Internet (2018, 341–51).

3 Polarisation of beliefs, politics, or communities?

Polarisation is another key phenomenon in this area of research and is often used as a measurable proxy for filter bubbles and echo chambers. It is also another concept that deserves precification, as there are a range of distinct polarisation processes under study, and many are plausibly relevant for understanding filter bubbles and echo chambers – which might be either the cause or the consequence of polarisation. We should note, too, that across disciplines there are varied uses of “polarisation”. To a greater degree than usual, then, it is important to closely evaluate the detailed description of the process under discussion or analysis than just the label. I begin with some remarks on the epistemic concerns underlying polarisation, then discuss some examples of polarisation research.

The primary epistemic concern about polarisation concerns its underlying cause. In almost all cases this is that what is driving the poles apart is not truth, rational argument, or evidence, but some irrational or non-rational processes. Note that we do not yet know what these poles are and so we also do not know what the distance between them signifies. These poles could be the beliefs of a particular individual, the beliefs of some sports team, the population of an entire country in 2020, or even the same population measured 50 years apart. It is still a fair enough description, though, to say that the core epistemic concerns behind polarisation and filter bubbles and echo chambers is a concern about rationality.

A useful guide for disambiguation of “polarisation” (and the associated formal measures) can be found in Bramson et al. (2016) who distinguish nine kinds. Bramson et al. take the position that “polarisation” is a conceptual cluster denoting a broad range of properties and processes. As a property, polarisation research might look at the distribution of some belief across a population. As a process, polarisation might refer to the change of an individual’s or community’s beliefs over time given some event.

Two forms of polarisation include “spread” and “dispersion”. Spread provides a fairly simplistic model of the difference in attitudes within a population. If we take their sample question, “What percentage of the federal budget should be spent on education?”, the spread of our sample of results will be the distance between our two most extreme answers (2016, 83). As a measure of polarisation, spread will illuminate discussions of filter bubbles and echo chambers for some fairly simple measures of understanding, e.g., changes in one population over time. If we ran a study surveying people’s opinions on the education budget twice, we might see that the most extreme attitudes have grown much further apart.

What it won’t tell us is how many people endorse the extreme positions at the “poles”. Dispersion would be a more informative measure of polarisation in that case (Bramson et al., 2016, 84). Where spread is concerned only with tracking the distance between the most extreme attitudes in our sample, dispersion is a measure which accounts for the distribution of attitudes of the whole population.

It is not uncommon to hear that filter bubbles or echo chambers are making us “more polarised” about politics, as is shown by polling data. This quick survey gives us good grounds to wonder what that means! We might also be interested, for example, in the number of
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different attitudes that are present in our society, i.e., “coverage” (ibid., 84); or even the overlap (or lack thereof) between the attitudes of particular groups in our society about some important topic like climate change, i.e., “distinctness” (ibid., 89).

A philosophical carving of the polarisation terrain is provided in Overdoing Democracy by Robert B. Talisse (2019). Echo chambers and filter bubbles factor into Talisse’s discussion as enablers of polarisation. This is in line with other research investigating how the diversity of opinions available in a group is correlated with the degree of polarisation in that group over time (see, e.g., Flache and Macy, 2011; Turner and Smaldino, 2018).

Talisse presents three kinds of “political polarization” and distinguishes these from “belief polarisation”. “Belief polarisation” here refers to processes that shift one’s existing beliefs to more extreme versions of them as a consequence of interacting with primarily like-minded individuals (2019, 97). This is commonly referred to as “group polarisation”. This is a central subject in discussions of filter bubbles, where the concern is that filter bubbles are causing our beliefs to become more extreme.

There is important ambiguity in the idea of “extreme” belief as mentioned earlier, and Talisse discusses this in some detail (2019, 106). A belief may be extreme because of its contents, because of how it was formed, because of its evidentiary basis, because of its relationship to the mainstream beliefs of some relevant group, or a range of other factors. Talisse has us consider if extremeness refers to the commitment one has to one’s existing beliefs, a change in belief from a previous belief to a more extreme version of that belief, or whether it refers to the degree of confidence in a newly adopted belief.

Alfano et al. (2020) tested the widely held belief that online recommender systems that prompt users to watch or read further content can cause radicalisation. Radicalisation describes a process of belief polarisation for an individual, namely, one whose beliefs become more extreme in content as a consequence of watching the recommended videos. Alfano et al. found that the recommender system promotes increasingly extreme content, supporting the idea that it scaffolds belief polarisation.5

Political polarisation can be subdivided into at least three measurable kinds: platform polarisation, partisan polarisation, and affective polarisation (Talisse, 2019, 99). Platform polarisation describes the ideological distance between political parties. Partisan polarisation describes the ideological “purity” within a group, where we can understand this as the degree of homophily between members. For example, the current Democratic Party in the United States exhibits high levels of partisan polarisation with the split between moderate or centrist democratic members and progressive members.

Finally, affective polarisation describes the (typically, negative) emotional attitudes of one partisan group towards other groups, e.g., levels of antipathy and animosity. A recent Pew poll, for example, finds that US partisan attitudes towards the opposing party are more negative than they have been in a quarter of a century (Pew Research Center, 2016).

Thus, when we come across claims that filter bubbles or echo chambers are “polarising” us we should ask for further clarification. The metaphor at work in polarisation provides the image of two poles being drawn further and further apart. The first part of understanding a polarisation claim, then, is to understand what the poles are and what the nature of the distance between them is a measurement of.

4 Future directions: epistemic responsibility

Insofar as it is a personal choice to use any particular online platform or technology, we might think that it is up to each individual to decide to expose themselves to the risks that it
brings. However, this overlooks the opaqueness of many of these technologies and removes all accountability from companies or developers. Part of the complication is that there is a mixture of personal choices (e.g., voluntary exposure) alongside that choices of developers who create personalised digital media (e.g., involuntary exposure). The ethical exploration of such issues will be helped with the existing work in computer ethics, information ethics, and more generally bioethics.

A second sense of “epistemic responsibility” that’s also important in this discussion has to do with broader questions about what we owe to one another as members of epistemic communities. If membership in an epistemic community generates responsibilities to other members, then we may think there is action to be taken to reduce epistemic risks even though the causal claims about accountability and responsibility are not clear cut. A full list of the epistemic risks we face from filter bubbles or echo chambers might be very long, I wager that it will at least include being caused to have false beliefs, hermeneutical lacunae and failures to acquire true beliefs as a consequence of things like homophily, an undermining of one’s reasonable trust in the testimony of others, and the development vices like close-mindedness and arrogance.

Lorraine Code’s (1987) *Epistemic Responsibility* is one of the few book length treatments of these issues. Code’s vision of an epistemically responsible community builds up a theory of intellectual virtue, and connects this with the ethics of belief. There is certainly a public sentiment that we are responsible for forming our beliefs in epistemically rational ways, and that new media is challenging our ability to meet this demand. Whether a philosophical analysis of the situation will affirm this sentiment remains to be seen, though we have precedence for it in the literature on the ethics of belief.

Discussions of filter bubbles and echo chambers are complex, and much nuance can be found in exploring these phenomena in detail. Our present understanding of how new media and technological personalisation affects epistemic and political life is still incomplete. While we continue to develop our descriptive understanding, philosophers can make significant parallel progress on the normative dimensions of these phenomena. In particular, I have suggested that we attend to how existing work on identity and ignorance may help us understand and respond to epistemic segregation online. Further, I have proposed that understanding the many faces of responsibility in this area is critical for shaping online epistemic communities in line with our social epistemic goals and values.

**Notes**

1 Cardenal et al. (2019a) have a fairly thorough discussion about research on the prevalence of selective exposure. They find that personalised search engines, i.e., Google, can reduce selective exposure, and that some social media websites, i.e., Facebook, have no direct effect on selective exposure. Gentzkow and Shapiro (2011) report that online news consumption is both more segregated than offline news consumption and less segregated than our face-to-face interactions on a daily basis.

2 This particular proposal for defining echo chambers by Nguyen is a development of work by Kathleen Hall Jamieson and Frank Capella about American right-wing media in their *Echo Chamber: Rush Limbaugh and the Conservative Media Establishment* (2008). Jamieson and Capella’s thesis is that certain aspects of the conservative media establishment are in essence echo chambers that intentionally discredit other media sources.

3 In 2017, former Counsellor to the President Kellyanne Conway claimed that former White House Press Secretary, Sean Spicer, was appealing to “alternative facts” in an attempt to justify Spicer’s false claims about the crowd size at the presidential inauguration. Conway’s comments were widely criticised with explicit connections being drawn to George Orwell’s concept of “doublethink” in his book, *1984*. 

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4 See also Jasny et al. (2015) for a detailed exploration of echo chambers in the climate change debate in the United States.

5 In previous work, Alfano et al. (2018) coined the term “technological seduction” to describe how algorithms can lead people to consume content they otherwise would not have consumed.

Bibliography


