We are the Change that we Seek: Information Interactions During a Change of Viewpoint

Dana McKay†
iSchool
University of Melbourne
Melbourne, Australia
dana.mckay@unimelb.edu.au

Stephann Makri, Marisela Gutierrez Lopez, Andy MacFarlane & Sondess Missaoui
Centre for HCI Design
City, University of London
London, UK

Colin Porlezza & Glenda Cooper
Department of Journalism
City, University of London
London, UK

ABSTRACT

There has been considerable hype about filter bubbles and echo chambers influencing the views of information consumers. The fear is that these technologies are undermining democracy by swaying opinion and creating an uninformed, polarised populace. The literature in this space is mostly techno-centric, addressing the impact of technology. In contrast, our work is the first research in the information interaction field to examine changing viewpoints from a human-centric perspective. It provides a new understanding of view change and how we might support informed, autonomous view change behaviour. We interviewed 18 participants about a self-identified change of view, and the information touchpoints they engaged with along the way. In this paper we present the information types and sources that informed changes of viewpoint, and the ways in which our participants interacted with that information. We describe our findings in the context of the techno-centric literature and suggest principles for designing digital information environments that support user autonomy and reflection in viewpoint formation.

CCS CONCEPTS

• Information systems~Users and interactive retrieval • Human-centered computing~Empirical studies in HCI • Information systems~Retrieval tasks and goals

KEYWORDS

Change of view, information interaction, attitude change, search, information encountering, filter bubbles, echo chambers

1 Introduction

One of the cornerstones of liberal democracy is an informed populace, free to make their own decisions on important issues. The news media plays an key role in keeping people informed [6], but in a world where many now access news through social media or news aggregators [6; 25; 41], the veracity and diversity of information accessed can no longer be guaranteed.

There has been considerable coverage in the literature of filter bubbles and echo chambers; information structures that can restrict exposure to a diversity of information sources that encompass a variety of viewpoints [1; 19]. This has the potential to undermine democracy by facilitating the spread of misinformation and disinformation and to fragment society [48; 54]. There is also increasing evidence that, in spite of these restrictive structures, people *do* consume a variety of information that allows them to understand other (often opposing) viewpoints and, sometimes, to change their own views as a result [23; 30]. While the information interactions that underpin this engagement with alternative views have been hinted at [35], they have not been explicitly investigated.

What is missing from existing accounts of how people form views is a detailed understanding of how people interact with information to support reflection on (and potential change) of their views. Understanding view change from an information interaction perspective can provide ways of thinking about how best to design to support users in making productive view changes, by reflecting on their views, the information that argues for and against them and the values underpinning them.

This paper reports findings from interviews with 18 people about a self-identified change of view (from which party to vote for in an election to whether they believed in the moon landing) and the information touchpoints they engaged with along the way. We examine the information types they engaged with (e.g. video, text), the information sources they used (e.g. social information, apps, online communities, and the information interaction behaviours they used (e.g. active search, passive information encountering). This paper is the first detailed, human-centric account of the role of information during a view change, describing the information ecology around view change from the perspective of those making the change.

We begin by presenting the literature context for our research, then describe our interview approach in detail. We then present results, focusing on information types, sources and interaction behaviours. Next, we discuss our findings in the context of the literature, addressing the fit with existing models of information behaviour and offering avenues for system design. Finally, we draw conclusions and point to future work.

2 Background

In this section, we first discuss information seeking models in the context of view change. We then discuss technologies that may inhibit autonomous view change, addressing filter bubbles, fake news, and persuasive technology in turn.

2.1 Information Behaviour and View Change

Major models of information seeking share many features that can potentially facilitate view change; each includes search and browse, and some element of synthesis as the person looking for information concludes their seeking activities [20; 34; 42]. Each model also assumes a recognized information need (even if

vague), and an inclination to look for information. Not all information needs are well-recognized, though: some people have needs they do not recognize, or for which they are not inclined to seek information [4]. A rare, but important category of needs are those that are unrecognized and undemanded [4]: information we do not look for because we do not know we need it. There is evidence that people might be open to information that shapes their view [28], but evidence that they actively seek information to change their view is very limited [35]. As such, view change may be an effect of information acquisition, rather than a cause.

If information to facilitate view change is not actively sought, how might it be found? Information encountering [21] is one possibility, either during active information seeking, or when not looking for information at all [40]. These encounters may be experienced as serendipitous happy accidents involving an 'aha moment' [37; 38]. Serendipity has many preconditions: openness to the environment and new information, willingness to make connections and time and mental space to allow 'aha moments' to happen [26; 39]. Such encounters are more likely to expose people to alternative views [35], potentially supporting view change.

The psychology literature suggests attitudinal change comes from a misalignment between attitude and the world [49], much as information-seeking is prompted by a misalignment between what is known, and what needs to be known [10]. Will the same information behaviours that fulfil information needs address view change? This paper aims to answer that question. There also are several information interaction behaviours (e.g. active search and passive encountering) that may facilitate view change. We do not yet know, though, what behaviours are used in practice.

2.2 Filter Bubbles and Echo Chambers

The idea the Internet might divide political opinion by limiting the scope of alternative viewpoints people are exposed to [54] gave rise to a stream of research. This research suggested people of similar political affiliations form socially-closed online groups—creating 'echo chambers.' ([1; 19]). It also gave rise to the notion of 'filter bubbles'—algorithmic reinforcements of echo chambers through personalized search and online recommender systems [48]. The major concern about echo chambers and filter bubbles is if people only see information related to their existing interests, they will not see information necessary to change their view, or worse, their viewpoint will become radicalized. These concerns are understandable, but hard to research. Both terms lack a clear empirical definition, and there are methodological challenges in rigorously defining bias [51].

Despite these challenges, recent research has found that concerns about filter bubbles and echo chambers may be overstated; the evidence for filter bubbles influencing Web search behaviour is weak [51]. While there is evidence that information consumers prefer information that is ideologically aligned to their position, the converse—that ideologically opposed information is unwelcome—has weak support at most [27; 30]. Bruns further notes that restricting oneself to a single viewpoint online is likely to be difficult [17]. There is however, legitimate concern about digital platforms such as Google, Twitter, and Facebook storing masses of data, and the extent to which that data may be used to create filter bubbles or political division [6; 59].

While the concerns about filter bubbles and echo chambers may be overstated—even a way to blame technology for social problems [18]—it is not clear to what extent exposure to information from other viewpoints impacts a change of view. We do not know whether people who change their views notice or engage with these viewpoints, much less consider them useful or alienating. Our study aims to address this gap.

2.3 Misinformation and Disinformation

Access to credible news is a key determinant in being able to fully participate in democracy and make informed decisions [6]. How we access news has changed: much of our news is now delivered either through aggregators or social networking sites [6; 25]. Having grown up with social media, it is perhaps unsurprising that teenagers in particular find social news recommendations useful, and traditional news 'boring' [41].

Accessing news away from trusted news brands creates the opportunity for the spread of mis- or disinformation masquerading as news, often referred to under the colloquial umbrella term of 'fake news'; news that '*contains wholly false or misleading elements within its content or context*' [8]. Although this term is poorly-defined both in scholarly research [55] and by members of the public [47], it appeals to the public because it is emotionally-charged [8]. Scholars, however, prefer to use the more precise terms of mis- and disinformation; while both mis- and disinformation are inaccurate and misleading, disinformation is *intentionally* so (e.g. government propaganda or fake websites) [22]. Disinformation, being highly shareable, propagates faster, further and more deeply than equivalent accurate information [60]. Despite the prevalence of teens accessing news on social media, it is older adults who are over seven times more likely to have shared fake news than the general population [31].

The influencing potential for mis- and disinformation is clear, but we do not yet know the role that information (whether accurate or not) plays in viewpoint change.

2.4 Technology and Persuasion

The idea that the way we design systems can influence behavior is not new: indeed, this is the whole science of HCI. Where design has been used to subtly promote pro-social behavior (such as saving for retirement), while still providing user choice, this is known as 'nudging' [57]. There is a stream of HCI research on persuasive technology—using technology to persuade users to act in ways deemed to be beneficial, for example promoting exercise [50; 58].

Another form of persuasion exists in personalization, particularly in information seeking. It is one thing to personalize recommendations for books or music; this is likely to increase user satisfaction with little social cost [2]. What of recommendations or personalized search results for news, though? These have the potential to entrench, rather than challenge viewpoints, and reduce rather than increase information consumption [56].

There is also a dark side to persuasive technology: we can design 'dark patterns' into our interfaces, using our knowledge of psychology to encourage users to act against their own best interests [29]. Determining whether a technology is persuasive to users' benefit or detriment is an ethical question, and one that often falls to discussions of autonomy: users should be able to decide for themselves what is beneficial. It is important to remember, as designers, though, that users' choices are constrained by the systems we offer: design is not neutral, and the systems we build reflect our biases [11; 13]. This raises questions of 'should technology persuade?' and, if so, 'how can it do so responsibly?' There is a research gap, though, around the user

experience of being persuaded; we do not know what role technology plays in view changes perceived as autonomous by those making them. This paper addresses that gap.

3 Method

The study approach involved semi-structured interviews with 18 participants, aged 18-65; 11 female and 7 male. In this section, we first describe our recruitment strategy, then our interview approach. Next, we discuss how we analysed the data, and finally ethical considerations.

3.1 Participant Recruitment

We recruited participants who had changed their viewpoint on an issue of importance to them in the past year. We gave some examples of changes in our recruitment messaging to show potential participants the possible range and scope of topics: *becoming vegetarian (or not-vegetarian), Brexit, or which football team you support (if football is important to you)*' Recruitment messaging also asked for participants for whom digital information had played an important role in the change of view. We further asked that the change be something they felt they could discuss without becoming upset, and that it not involve illegal activity. Within these constraints, participants chose their own topics for discussion. We offered them a £10 voucher or charity donation of their choice as remuneration.

We used a multi-pronged recruitment process to attempt to mitigate against the cultural bias inherent to being at a university. We each leveraged our personal networks seeking friends, family members and acquaintances who had recently changed their view. We also contacted postgraduate students in the Computer Science and Journalism departments at the UK university where the study was conducted. We also posted messages on our social media channels and an advert on a large, UK-based parenting site. We further identified two news outlets with series about individual viewpoint change, and reached out to seven people featured in these series by email or LinkedIn. Finally, with permission from moderators, we posted advertisements on a Reddit forum for people looking to have their view changed (r/ChangeAView) and the spinoff website ChangeAView.com.

3.2 Data Collection

This study used a semi-structured interview approach. Interviews lasted between 37 and 120 minutes, depending on how many view changes they discussed and how much detail interviewees could recall. Only one interview lasted more than 75 minutes. Most interviews were conducted by two researchers, but due to researcher availability, three people were interviewed by only one. Prior to all interviews, participants signed an informed consent form, and after each interview researchers conducted a short debrief.

Each interview began by asking participants to describe their change of viewpoint in their own words, then we moved on to the role information interaction played. Despite our focus on digital information, we wanted a detailed, holistic picture of view change, so did not restrict our discussions to digital information sources. Instead we discussed the entire information ecosystem around a view change, including physical and social information sources. We asked participants to recall, if they could, all the information that affected their change of view, and how they found it. To provide context and aid our understanding, we examined some of the information sources participants discussed during interviews.

We took an empathy-first approach to our questioning, in recognition that interviewees were sharing view changes that were often highly personal and that true 'neutrality' was unlikely to be possible, or desirable. So as not to judge interviewees, we did not directly state our own views on any issue discussed. On the few occasions we expressed an opinion, we did so to demonstrate our awareness of and sensitivity to the issue being discussed. This took the form of demonstrating our awareness and understanding of the issue under discussion, for example acknowledging the severity of the crimes Michael Jackson was accused of. Interviews were audio-recorded, and one of the researchers made notes.

3.3 Data Analysis

Data was analysed using a thematic analysis [15]. Coding was done by hand, on hard copies of the transcripts. We focused our analysis, in particular, on the role information played in their change of views. Although the analysis had a specific focus on the role of information, it was entirely inductive—as it was not driven by an existing hypothesis or theory. We identified three broad themes: *information types* (e.g. video, images and text), *information sources* (e.g. recommendations, social information sources, online communities) and *information interaction behaviours* (e.g. active search, passive encountering, monitoring). These themes are described with examples in the results.

3.4 Ethical Considerations

This study was granted ethical approval by City, however ethical approval is a notoriously blunt instrument, [16], and this study had two major ethical complexities. The first of these was that a change of view is necessarily a time when participants could feel vulnerable or be prone to upset. The second is the scope of the study: given the freedom with which participants could select the topics they spoke to us about, there was also the potential for researcher distress, an under-recognised challenge [43].

In addition to the empathy-first interview approach and cautious recruitment strategy described above, we took other steps to minimize the risk of harm; at the beginning of the interviews, we advised participants we would not judge them for viewpoints they held now or in the past, and we maintained this position throughout the interviews. We also told participants we recognized that there was a small risk they may (unpredictably) find discussing the change of view difficult, and that they could pause or stop the interview at any time. When one participant did show signs of finding the discussion difficult, we paused the interview. Had the participant not emphatically insisted she wanted to continue, we would have stopped altogether. We debriefed participants after we stopped recording, asking them about their interview experience. None voiced concerns and many (including the participant where we paused) expressed it had been valuable and enjoyable to discuss their changes of view.

Finally, after each interview, we debriefed among the interviewers. We discussed whether our interview approach had been reliably sensitive and whether the interview had raised any feelings or issues for us. We found this useful for ensuring our approach was appropriate and for ensuring our own wellbeing.

3.5 Limitations

This study had two main limitations: recall and bias. The interviews were based on participant recall of their experiences, and recall is notoriously unreliable, especially for subtle details. While our study goes some way toward understanding the role information plays in changes of view, this understanding is high-level rather that granular. The bias inherent in our study is twofold; the first challenge is that we likely recruited participants who were comfortable discussing their view change with academic interviewers who are publically stereotyped as left wing and liberal (whatever the truth may be) [46]. This stereotype may have affected who volunteered for the study. The second bias comes from the study topic: participants who self-select as having recently changed their view on a topic are already potentially more open and reflective than the general population. This does not affect the validity or novelty of our findings, but future work is needed to assure their generalizability.

4 Results

In this section, we present the results of our study; the information *types*, *sources* and interaction *behaviours* reported by participants when discussing their changes of view. But first, we summarize the changes of viewpoint our participants described (see Table 1). Many described a clear change in view such as P10 going vegetarian or P2 and P9 changing which political party they support. Some, however, described *forming* a viewpoint, rather than changing one—P1 described choosing who to vote for, for example. Some described a viewpoint becoming stronger, such as P18 refining their view on climate change from challenge to crisis. Finally P12, described challenging his own viewpoints, in discovering some elements he agreed with in Trump's Twitter posts (even though he holds the view Trump is 'unfit for office'). We did not choose these topics for participants; they self-selected topics *they* regarded as a change of view. It is nonetheless interesting to note that, for participants, a 'change of view' ranged from forming an viewpoint on a topic on which they had not previously held a strong opinion, to strengthening an existing moderate view on a topic, right through to a complete change of view from one existing viewpoint to another.

The majority of changes represent a shift toward 'left wing liberal' ideals [46], reflecting possible bias in our participants' self-selection. Our findings on the role of information were consistent across the group, though, which suggests the role information plays in view change is likely to be similar, even if the specific information sources consulted and change outcomes are different. We now describe the information types, sources and interaction behaviours mentioned by participants.

Table 1: A Summary of Participants' View Changes

P#	Topic
P1	Decided who to vote for in a general election
P2	Changed from supporting Labour to Liberal Democrats
P3	Became vegetarian for ecological reasons
P4	Changed view on whether he thought Michael Jackson was likely guilty of child sexual abuse
P5	Became accepting of gay marriage
P6	Decided to change where she would study her Masters degree, after having accepted a place
P7	Changed position on Brexit from leave to remain
P8	Gave up beef for environmental reasons
P9	Now votes for Liberal Democrat instead of Labour
P10	Stopped eating meat for animal rights reasons
P11	Changed view on the best way to conduct political discussions, and became aware of societal reasons for youth crime
P12	Found relatability in surprising (to him) places: Trump tweets, and an EU-skeptical documentary
P13	Decided on a different treatment approach for a medical condition
P14	Formed a view on how best to advocate for a centre ground in British politics
P15	Became vegan again for animal rights reasons, changed her perspective on pro-Brexit voters
P16	Went from being concerned about climate change to becoming an activist
P17	Started considering what he termed 'alternative' views: that the earth is flat and the moon landing did not happen
P18	Became more concerned about the scale of the climate change challenge humankind is facing

4.1 Information Types

We identified several types of information used by participants during their change of view. We include these findings because typical information retrieval research focuses on text [7], but there has been some evidence that visual material (e.g. images) attracts reader attention [53]. All participants used more than one type of information. Some used as many as three or four of the types described here. We describe each information type, including (where relevant) subtypes, uses and finding strategies. We also explain the role each information type played in the changes of view reported.

4.1.1. Video. Of 18 participants, 16 mentioned video playing a role in their change of view. This video could take many forms—TED talks stumbled across in their social media feeds, documentaries found on Netflix or even on TV when *'I was in a hotel room on a work trip, and I was watching Al Jazeera because that was the only channel that looked interesting among the channels that were on there'* (P12). Some participants actively sought video after it was recommended to them: P15's homestay host told her *'just watch that [documentary] and you'll become vegan for sure'*. Some video was discovered through links from other sources. For example, P1 actively searched for video to follow-up on news she found interesting: *'after I read the article, I wanted to check the full conversation in the video…that's why I Googled it'*. Video was also serendipitously encountered on social media feeds and through recommenders like Netflix.

4.1.2. Images. In contrast to video, few participants mentioned still images. One role still images played was to provoke participants to consider their viewpoint. For example, P18 stated an image of plastic pollution was particularly 'hard-hitting': *'for me it's the Manila Bay image [of Manila bay covered in plastic bags] that is the most hard-hitting, because I live in Taiwan, and …when I go surfing a lot I see these things on beaches'*. For striking images to influence, though, participants had to be open to a view change;

P10 said she actively noticed animal rights images that were '*100% meant to shock and disturb'*. She said that in the past, she would have *'just scrolled past'*, but now stopped to think because she had become more acutely aware of animal rights issues. In contrast, P3 reported a graphic image of a slaughterhouse on Facebook as inappropriate content, as he felt it *'could be offensive to other people in the same way it is to me. I'm aware that these things are happening'*. P10 mentioned that she clicked on a video because *'maybe there was a picture of a puppy or something'* (P10), and suggested social media sites used images to do '*tricky psychological things*' to attract attention. Finally, P13 used images to support her decision-making: she looked up images of surgical treatment options for her osteoarthritis.

4.1.3. Audio. Audio was mentioned by three interviewees: the two who listened to podcasts mentioned them in passing as part of an information landscape. But for P16, producing a podcast was a key activity related to him re-identifying as an activist: *'and that is what my activity is now, with them. I work on the podcast'*.

4.1.4. Text. All participants mentioned textual information of some form, spanning micro-text such as hashtags and social media comments, through email, online discussions, news articles, to books and religious texts such as the Quran. News articles were the most frequently mentioned form of text, with all but one participant mentioning engaging with the news. P4 mentioned hashtags influencing his view: reading Tweets posted to #LeavingNeverland was pivotal to him questioning Michael Jackson's innocence. Some text was in print form: P8 was carrying a print copy of *The Economist* that she showed us, and said '*we do physical books in my house, yes'*. Text was found through active search, recommender systems and recommendations, and through monitoring social media feeds. All participants engaged with several text sources and sometimes one led to another, as with P12 who went from a Google News feed to *'the New York Times...then I went on Twitter and started following it [a discussion] and I read it...because I wanted to go to the source'*.

4.1.5. Data. Three participants specifically sought scientific or statistical data after they began to change their view after consuming other types of information; data was never the first thing they examined. Both P6 and P11 wanted to compare two situations using data, and both said it was '*hard to find*' what they were looking for. P13, in contrast, had no such difficulty finding scientific data on the treatment outcomes for various types of surgery for her osteoarthritis. She '*looked at National Medicine, ...NCHI...I am a librarian as well, so I looked at all...those sources'*.

4.2 Information Sources

As well as a variety of information types, participants also used a range of information sources, including search engines, social networking sites, and messaging tools. We do not exhaustively list every information source here. Instead, we only discuss those that specifically influenced a change of view.

4.2.1. Recommendations. Participants mentioned two kinds of recommendations: algorithmic and social (i.e. those from or to friends, relatives or social contacts). Most mentioned was news recommendations from either Google (in the Chrome browser or mobile app), or from news sites themselves. P12 said Google news was *'scarily good at knowing what you're interested in and adapting to it*'. But P2 commented *'I have notifications come into my phone, and I don't even really know why they target me for that stuff*', so participant experiences of recommendation relevance was varied. Participants also mentioned receiving and making social recommendations. Some social recommendations were quite impersonal, such as a link shared to an online community of 25 people. Others were highly personal, such as P13 having a health professional introduce her to a person who shared her condition to discuss potential treatment options. Some participants reported following-up on recommendations made by public figures, such as P1 who followed an online religious teacher, and *'paused the video and start Googling [the things he recommended].'* Participants also *gave* recommendations to others. For example, when friends mentioned a video about the experience of LBTIQ youth, P5 said *it's a very good documentary, you should watch that*.' Similarly, P8 who recommended a book on human treatment of animals to her spouse, saying *'you need to read this, it's really great*'.

4.2.2. Social Information Sources. It is perhaps surprising that our participants spoke so much about social information in a study on digital information, but the literature suggests nearly half of all information seeking is done in a person to person context [3; 32; 52]. Certainly, for our participants the conversations they had with those around them formed a key part of an information ecology that influenced their change of views. These conversations happened both in person, and on online communication tools such as WhatsApp.

Perhaps the most striking social experience was a dinner that P10 had with her partner at a sheep farm, where she *'had to eat that leg of lamb, where there was a sheep right next to me.'* While she had already started to consider going vegetarian, seeing the sheep while she was eating meant she did not enjoy her meal, especially after her partner made what she considered a *'horrible joke'* about the sheep *'missing their mummy'*. This was a turning point for P10; she did not eat meat again after this meal. In contrast to that experience, which was unplanned and purely social, P10 actively sought information from friends about going vegetarian. She used social strategies specifically because she '*wanted a personal experience*'. P10 also shared information with her social networks about animal rights issues and tried to correct what she saw as misinformation being shared by one of her friends. Both P10 and P8 mentioned having talks with their partners about going meat-free, and what it would mean for cooking and eating in their households. These conversations were a consequence of their view change, rather than informing it.

P6 described using social information to garner personal experiences to help her decide whether to change universities, even though she had already accepted a place on a course. She reached out to several previous students using LinkedIn and had conversations about her current course and the one she was considering switching to using a variety of media, including phone, video chat, and messaging. She found these conversations influential in her decision-making, because they were personal.
The challenges of social information were not lost on our participants, several of whom worried that talking only to those they knew could create an *'echo chamber'* (P8, P11, P14, P16, P17). Some actively tried to mitigate against this concern. Finally, social interactions could be a driver for change; P11 lost a friend in an online debate which led to him '*trying to...get away from the echo chamber effect'* by consuming a more diverse range of information sources. This, in turn, led him to an influential news article that helped him better understand the root causes of UK youth crime.

4.2.3. Online Communities. Participants used online communities to access personalized information from outside their immediate social circle. For example, P13 described using an online community to research her treatment options for

osteoarthritis, because she wanted to know what the options and recovery were like for keen sportspeople like her. The people she knew *'weren't in the same level in the terms of doing sports'*. By looking at an online forum for runners she was able to find other sports enthusiasts who had had various procedures, and this was a key element of her deciding to have surgery, rather than sticking with non-surgical management options. She said '*it was a gradual thing. Reading people's experiences and seeing that on the forum, often you'll see I had the surgery done and then in week two I was able to walk'*. She had followed one particular user who had the surgery several years ago and had been able to return to an elite level of sport; she found his story very reassuring.

P14 mentioned using a closed, small WhatsApp group to refine her view on how to manage centrist politics in Britain. She mentioned this could be like an *'echo chamber'*, but that '*it's obviously a group of people who share, at a more macro level, the same political views. But on a more micro level, it's a safe place to discuss your thoughts*'. Having this safe place gave her room to *'develop [her] views'* and was pivotal in her view change.

4.2.4. Apps and Online Tools. Many participants mentioned using news apps to curate a personal news feed, for example P1 used an app specifically to look at news from her home country and P8 found the Google news app *'scarily good'* at finding news that would interest him. P3 used the features of a news app to save articles to read later when he was on the underground without internet access. Other participants used news apps to get push notifications to their phones. News apps were a very common way of accessing text that might conceivably lead to a change of view.

Other app types were also mentioned; P15, described an online game produced by animal welfare group PETA that encouraged her to become vegetarian the first time. The game involved cartoon chickens being graphically slaughtered by cartoon blades unless the player rescued them. The participant was *'quite young then, and playing this game was so visual'*. In contrast P18 describes using an online tool to create compelling information for others to convince them to buy recycled textiles (which are more expensive than non-recycled ones): *'if you laid out all these plastic bottles [that are used in these textiles] how much of Manhattan would it cover…there are some funky websites out there that look at how to do that'*.

4.2.5. Topic-Specific Websites. Many participants mentioned visiting topic-specific websites to get more information after their viewpoint began to change. P8 and P10 both used the NHS website to get information about nutrition after going vegetarian, and P13 used it to inform herself about her surgical management options. They chose the NHS site because it was *'reviewed by* professionals' (P10) and therefore authoritative. P10 also leveraged this authority when trying to combat the spread of misinformation about vegetarian diets—when she wanted to be '*100% sure that what I'm saying is right*'. P17 also used a specific website (the official NASA channel on YouTube) when investigating the likelihood of the moon landing having happened, because he perceived the information there to be as authoritative as possible. He said that '*[NASA are] ultimately the holy grail when it comes to this, because they are the ones making the claim'*. P10 used a food specific website (BBC Food) to source good vegetarian recipes, not because it was authoritative, but because it included reviews. She would *'make sure it's always five stars'* because she was '*trying to convince someone vegetarian dishes are good*'.

All these examples illustrate interviewees using topic-specific websites after their view began to change, to fulfill information needs created by the change. The key element shared by these sites was a certain kind of authority—that information is indeed correct or of high quality.

4.3 Information Interaction Behaviours

When interacting with the different types and sources of information discussed in the previous sections, participants reported engaging in a variety of information interaction behaviours. The behaviours we discuss have been previously noted elsewhere in the information interaction literature (for example in existing models of information-seeking and encountering). However, here we discuss them in a specific *change of viewpoint context*, where they provide new insight into the role information interaction plays in view changes.

4.3.1. Active Search. Nearly all participants described searching for information as part of their change of view. While view changes were never initiated by search, actively searching for specific information was important for nearly every participant's view change.

When an information need was surfaced by a change in view, participants often used search to fulfill—or begin fulfilling- that need. These needs could be simple, as with P1, who described pausing a YouTube video so she could *'Google'* information the religious teacher in the video suggested. They could also be more complex, as with P10 who '*did a Google search actually trying to find articles or stories where people became vegetarian, so then I can implement it in my life*'. Some searches were for known items. For example P12 described searching for a documentary he had seen part of '*on the Al Jazeera website and watching 'til the end*'. Other searches was more exploratory. P11, for example, searched for data on knife crime, commenting '*I looked for statistics on knife crime…I realized how hard it was to find exact figures. What I wanted to do is…compare the knife crime per capita in the US over 30 years to knife crime per capita in the UK*'.

4.3.2. Passive Information Encountering. Many participants described information experiences that echo existing definitions of information encountering [21; 40] and serendipity more broadly [26; 37; 38]; P10 clicked on a TED talk on the role animals play in different cultures while '*just browsing Facebook'* and commented that while not the turning point in her view change (eating lamb with sheep grazing close by was), it *'played a really big part'* as it made her question why humans consider some animals as pets and others as food. Similarly, P5 was deeply influenced by documentaries '*just randomly there*' on Netflix, such as 'Trembling Before G-d', which focused on the issue of reconciling one's sexuality with one's faith. Based on what we know about serendipity, these participants had to be open to receiving and examining this information, but they were not specifically looking for it [39]. This openness is illustrated by P1, who stated she was '*looking for a sign*' of who to vote for in an upcoming election. Perhaps the most striking example of serendipity was P16, who met the person who introduced him to activism at a Labour party meeting: *'I met this guy, and he didn't seem like an eco-crazy guy.'* He regarded this meeting as a *'jumping board,'* which accelerated his decision to become an activist.

The vast majority of interviewees began their view change with an information encounter. For example, P1 found a religious teacher through YouTube recommendations, P3 and P5 watched movies recommended by Netflix (on climate change and reconciling religion and sexuality respectively), P4 found out about a documentary on allegations against Michael Jackson on

social media and P6, P7 and P10 saw videos in their social media feeds, prompting a change. Encountering played a key role in most view changes, as both an information trigger and catalyst.

4.3.3. Monitoring. Many participants mentioned actively keeping up-to-date on people, organizations or topic areas (e.g. by regularly reading particular information sources, such as P11 who *'read the Guardian before bed'*). This is akin to the monitoring in McKenzie's [45] and Ellis' models [20]. Some sources participants actively monitored were specific (e.g. P1 regularly looked at a feed from an app that curated news from her home country). Others were more general, such as P12 looking through his Google News feed, which presented articles on a variety of topics related to his interests. Some monitoring was of information from participants' social circles. For example, P4 mentioned seeing Tweets from people he knew personally, prompting him to watch the '*Leaving Neverland'* documentary.

Some monitoring was more passive, akin to Bates's 'awareness' which involves being *'conscious and sentient*' in one's environment [9]. For example, P6 described *'follow[ing] the University I intended to study at on Twitter'* without regularly browsing the account. In contrast, P2 deliberately did *not* follow Labour or Liberal Democrat politicians on Twitter, as *'they're really annoying'*, but *'I see their Tweets…I don't need to look for them I guess because of the kinds of accounts that come up on my feed.'* Whether active or passive, monitoring led to many of the information encounters that triggered view changes.

4.3.4. Conversation and Discussion. Several participants mentioned engaging in conversation or discussion about a change of view. This conversational approach was the key driver for P14's change of view on how best to advocate for a centre ground in British politics, which was facilitated almost entirely by a closed WhatsApp group. It was also a key element for P7 becoming anti-Brexit; she described '*talking to [her] young ones*' and realising that leaving Europe would deprive them of many opportunities.

Some discussions happened in person, as with P7 above, others facilitated by technology. For example, P8 described '*a lot of back and forth messaging*' on WhatsApp with a pharmacist friend about maintaining her iron stores after giving up beef, or P10 who described commenting on social media posts. She said she *'couldn't help'* but comment on a Facebook post shared by someone in her network, which she considered to be misinformation. This post was written by a doctor, who claimed children whose parents had raised them on a vegetarian diet were at risk of several health issues.

A key form of discussion was questioning, where participants asked other people for information that would be difficult to acquire via search, because it was highly personalized. Examples of this include P6, who reached out to several people on LinkedIn after she started to question her choice of university, and *'ask[ed their] experience at [their] university'* and P8 who *'just post[ed] a couple of questions online, just to ask people [what their experience of treatment was]'*.

4.3.5. Fact Checking. Many participants mentioned fact checking as part of their view change, a behaviour akin to that seen in journalists, and in a revision to Bloom's taxonomy [5; 33]. It took two forms: having read something in the media and wanting to know more about the underlying statistics or data, or trying to find source information for something they had seen.

P11 conducted a particularly extensive fact checking exercise, looking for statistics on knife crime to try to understand the extent of the problem. He searched in several places, including police and health statistics, and could not readily find the information he wanted. P17 also conducted thorough fact-checking, viewing videos of the moon landing (some frame-by-frame) and comparing the stories of astronauts as to whether they could see stars in space, saying '*they've all got different answers to that question*'. He also noticed an astronaut turning his head in a spacesuit in one of the videos and '*did a little bit of research on the suits*'. He looked at data from Wikipedia and NASA archival footage, and ultimately concluded it was unlikely the moon landing happened, because the suits were a key inconsistency. P7 also did some fact-checking after she heard people saying the 2017 Westminster terrorist vehicle-ramming and stabbing attack was committed by 'foreigners'. She '*went into Google…and I read a few articles and was able to find out that this guy [Khalid Masood, born in Britain as Adrian Russell Elms]…was British'.* In each of these cases, fact-checking involved numerous information behaviours, including search, reading and triage. So it can be considered as a *process*, comprising several information interaction behaviors.

The other form of fact checking we saw was more akin to Ellis's chaining behaviour. This was where a participant had seen a reference to a piece of information, but wanted to view the primary source themselves. P4 described this quite clearly in wanting to see '*Leaving Neverland*' to form his own view: '*I'd always known that if I was going to make a judgement, I'd have to watch it myself.* P12 also mentions looking for source data when he saw something about a Trump tweet in his Chrome newsfeed '*like in the New York Times or the Guardian, and then I went to Twitter and started following it and read it…I usually want to see the source, to see what was actually written*'.

This level of fact-checking is perhaps surprising given the rhetoric around the Google Generation [14] and the promulgation of mis- and disinformation [25]. It is clear from our data though that fact-checking may not always lead to generally accepted facts; inherent information bias will always play a role in interpreting the data that is found.

4.3.6. Seeking Alternative Viewpoints. Many participants described seeking alternative viewpoints as an integral part of their information interactions. P17 said he wanted to '*see information that specifically wasn't from [flat earth believers]*', and so went out and sought alternative viewpoints. P15 described being so shocked after the Brexit referendum that she '*Googled…why people vote Brexit*' because she '*just wanted to understand more'*. The concept of understanding better was echoed by P5, who said she was '*seeking to understand the other and their experience* better'.

Some participants also mentioned monitoring sources they did not necessarily feel comfortable or agree with; P11 described '*starting to broaden the news sources I looked at and open my mind a bit more. So being a bit less polarised in views*'. P8 described reading the economist because she wanted '*a slightly broader perspective in something that challenges my views*' and '*to keep an eye on what they are saying*'. One reason for this was to *'get out of the echo chamber*' (P11).

Even when interviewees deliberately avoided alternative viewpoints, there was sometimes a recognition of this, with P14 saying she did not want to discuss her politics with people with vastly different views because '*it sounds quite bad, but I just feel it's a waste of my life*'. She did not, however '*feel like she was in an echo chamber here, so much, because we were able to discuss nuances*', so even though overall views were shared, she was seeking alternative nuanced perspectives.

Seeking alternative viewpoints allowed participants to be *'flexible'* and *'open minded'* (P12), preconditions of the serendipitous information encounters participants often experienced. Participants also used alternative viewpoints to '*test…like understand [their] own view[s]*' (P9), to determine whether other views resonated more with them. Whether or not it is true that most people live in an echo chamber, in our sample of people who had changed views, seeking alternative viewpoints was an important part of their change.

4.3.7. Overload and Disengagement. Several interviewees described specifically disengaging with information sources. P7 said she '*passes by*' anything to do with Brexit on Twitter '*because I was like, I don't really want to know anymore*'. Similarly, P14 said she '*normally ignores most of what she sees on Twitter'*. These participants disengaged because they considered the information they consumed *'really annoying*' (P2) or '*not very interesting*' (P14). P3 described disengaging with graphic image-based animal rights content because he found it distressing and offensive. Because he had already gone vegetarian and is '*already trying to do his part'*, being exposed to graphic content '*isn't actually making me informed, so I just hide those*'. Graphic content also affected the interactions P10 had with social media; before she was interested in vegetarianism she would '*just scroll past*' graphic slaughterhouse images, but once she began to consider vegetarianism, she stopped to look at these posts.

P11 described disengaging with an entire platform (Twitter): *'Facebook's better for a discussion. I kind of always avoid Twitter… it's essentially a shouting platform. There's a million voices all shouting at once'*. This disengagement can be partly attributed to the way interactions on the different platforms work, and partly overwhelm. P2 considered it important to *'make a conscious choice to look for information you want because it's so easy to get overwhelmed'*. P7 said similar things about WhatsApp: *'I get a load of spam. I call it spam. Because people send you every video in the book that they've seen'*. This overload stopped P7 from engaging in monitoring.

Disengagement was a strategy for managing information overload, but might also prevent a wanted or needed change of view. Our participants were disengaged either prior to a view change, when they were not interested in a topic, or afterwards, when they did not need to know more. Thus, it seems likely that engagement in a topic is a sign of some information need, however unrecognised or undemanded [4].

4.4 Summary of Findings

Participants described a range of online and offline information *types*, *sources* and *interaction behaviours* when discussing their changes of view. Every participant mentioned more than one item from each theme, demonstrating that view change is informationally and behaviourally complex. The prevalence of online information interactions in our data is a clear demonstration that digital information plays an important role in view change.

5. Discussion

Did our participants seek change, or did it find them? We now relate our findings to the existing literature on information-seeking, echo chambers, and persuasive computing. We conclude with design speculations about the role of information interaction in forming viewpoints.

5.1 Complex Information Behaviour

We have presented the information types, sources and interaction behaviours our participants engaged in during view change discretely. However there was complex interplay between these aspects of information interaction. To take a particularly simple example, P4 first saw discussion of the '*Leaving Neverland'* documentary, which features interviews with two men who allege they were sexually abused as children by Michael Jackson, on Facebook. He then read more on Twitter, after seeing the hashtag #LeavingNeverland in his feed. He began to question Jackson's innocence at that point, but also happened to see the Jackson family on TV claiming his innocence. He searched for the documentary and watched it on the train. He was particularly moved by the honesty of the men and shifted his view to the position that Jackson may have committed child sex abuse. After this shift, he searched for and read more online discussions about the allegations and discussed the documentary with colleagues.

This one view change involves text and video-based information types, social information sources, topic-specific websites and online communities and behaviours including active search and monitoring, information encountering, fact-checking and seeking alternative viewpoints. Each participant had a story of similar or greater complexity.

No change of view began with search—a key initial behaviour in most information-seeking models [20; 34; 42]. Instead, the view changes predominantly began with monitoring and encountering: search came later to look for specific information to support making the decision to change views. This supports the hypothesis that many view changes begin with information needs that are 'unrecognized,' 'undemanded' or both [4]. While some of the behaviours and sources seen in our data are well supported online (such as search and text), unrecognized and/or undemanded needs are notoriously poorly supported [12; 44]. This may be an inhibitor to online support for view change.

It is clear that view change does not fit traditional information-seeking models [20; 34; 42; 61], and that digital information environments are not overtly designed to support it. What the overarching process of view change is, the role information plays in it and how best to design to support it (in ways that support productive, rather than destructive changes) remains a future research challenge.

There was also considerable evidence of social information-seeking: a less-recognised but important form of information acquisition. Participants wanted to seek information from people because they needed a personalized answer—they wanted to hear personal experience, or get tailored advice. The conversations they had often extended beyond obtaining factual information—to explore other viewpoints with someone who held them.

5.2 Echo Chambers and Filter Bubbles

Interviewees often recognized they might be in an echo chamber or filter bubble. They expressed this in terms of the online technology. For example P17 stated '*this bubble was small, and it had partly been manufactured because [Google] are not allowing you to find [flat earth materials]*', demonstrating an awareness of the underlying algorithms and tools. They also understood their social groups could result in echo chambers: '*I can't just go and look for friends that disagree with me… because I'm young, I live in London, I come from out of the country, then I have specific friends around me that just happen to agree with my views*' (P2).

The prevalence of social information-seeking means echo chambers are a key concern. However, our participants also expressed a clear willingness, and indeed interest in stepping outside their own social networks. While we might be seeing homophily—a preference for connection with like-minded individuals—the fears about echo chambers may be overstated in a world of heterogeneous *'hybrid media ecology…that cannot usually prevent its participants…encountering a range of information'* [17]. This should allay our worst fears about echo chambers, and supports research such as [23; 27; 30], who have found the negative impact of filter bubbles and echo chambers is unlikely to be as strong as initially feared.

While our participants frequently used (and valued) personalized news, social feeds and recommendations, many also recognised the importance of consuming a diverse range of information sources to challenge their own existing viewpoints (by 'bursting their filter bubbles'). While our findings provide evidence that at least some people want to avoid filter bubbles, and that doing so can facilitate changes of view, they also present a contradiction; participants valued both relevance *and* diversity in a view change context. This suggests the need for *flexible* personalization features that allow users to receive personalized information when they want it, but also to explore beyond personalized content at will. This might involve providing users with an indication of information available beyond their filter, particularly pertaining to alternative viewpoints, and allowing them to explore this information freely—without directly confronting them with alternative views they may not want to engage with.

5.3 Support, Don't Persuade

Our participants were acutely aware of technology and information being used to influence, them; P10 referred to this as '*tricky psychological things*' and many interviewees spoke of '*algorithms*' (P2, P3, P16) determining what information they got to see. Our participants also expressed a clear preference for making up their own mind, free from the influence of others and machines—as P4 said, he wanted to '*judge for himself*.'

There is a risk that design recommendations from this research could be used against users' wishes for autonomy (e.g. to promote extremist or antisocial changes of view). Therefore, rather than designing to *change* views, we suggest designing to support people in becoming and staying informed. This should be achieved in ways that encourage *reflection*. This may be reflection on where their views sit within a landscape of other views; this system [36], for example, shows where a political viewpoint falls within a political spectrum and may facilitate more thoughtful changes of view. This finding has been supported that shows that social media can be an agent for political view change [24]. Encountering a range of views from trusted friends can promote reflection. But there is the potential for future systems to go beyond this by encouraging reflection—not only on own and others' views and their evidence base, but also the credibility and potential bias of the information used as evidence and, where possible, the *values* that underpin their views and approach to assessing evidence. Above all, systems should support users in making free choices—choices that are both their own, and free of unconscious influence or persuasion. How best to achieve this is an empirical question.

6 Conclusions and Future Work

This was a study of the role information plays during a change of view, focusing on the information types, sources and interaction behaviours at play. It is the first to examine view change from a human information interaction perspective—one that is user- rather than techno-centric or psychological.

A key finding is the complexity of the information ecology surrounding view change—there is no clear division between seeking change and being found by it. Participants leveraged many information types, sources and interaction behaviours when changing views. Of note is the prevalence of active monitoring and passive (serendipitous) information encountering; these were often an initial trigger or catalyst for the view change, with search following later. This is in stark contrast to traditional models of information-seeking, in which active search (not passive encountering) is often dominant. It is perhaps unsurprising that information interaction during a view change leverages many information types, sources and interaction behaviours from the literature; there has, after all, been decades of research of Human Information Interaction on the Web and social media. However, this study provides evidence that information interaction in a view change context is very different to traditional information-seeking. Explaining the view change process from an information perspective remains a challenge for future work.

In contrast to previous concerns over the impact of echo chambers and filter bubbles, our participants actively sought alternative viewpoints, often by deliberately exposing themselves to a diverse range of information sources. While they valued diversity, they also valued relevance—a contradiction suggesting the need for flexible personalization features that provide harmonious opportunity for and ideally seamless movement between both, controlled by users. Our findings also suggest that when designing systems to support view changes, we should provide users with autonomy to make free, informed choices without unconscious influence or persuasion and encourage them to reflect on those choices, the information used to support them and the values underpinning them. How best to do this remains future work.

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