Enhancing Awareness of Filter Bubbles and Echo Chambers: The Role of Information Consumption Patterns and Political Orientation

Stefana Ioana Pasca

S2597229

Supervisor: Dr. Shenja van der Graaf

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Bachelor Communication Science

The University of Twente, The Netherlands

Abstract

Tailored content delivery shaped the way individuals consume news and information. Personalized algorithms used by search engines and social media platforms filter out information based on users' recent searches and profiling. On one hand, this made it easier for users to seek information while avoiding cognitive overload. On the other hand, this encourages individuals to expose themselves predominantly to information that aligns with their pre-existing beliefs. This has an impact on an individual level and on a societal level, as it leads to digital polarization and the creation of filter bubbles and echo chambers. While it is known that awareness is an important factor in reducing polarization, filter bubbles, and echo chambers, there is not much information in the existing literature regarding what factors influence awareness. Thus, the goal of this study is to fill in this gap in research by exploring the influence of information consumption patterns, political orientation, and culture on awareness. A cross-sectional survey was created and distributed, which led to 178 responses that were analyzed in this research. The data collected was analyzed by performing regression models and ANOVA tests. The findings of this study show that information consumption patterns have an effect on general awareness. Political orientation only had an effect on the awareness of digital polarization, and cultural aspects did not influence either. This has academic implications as it helps to fill in the research gap regarding the factors that influence awareness. Moreover, it had practical implications, as the findings can help policymakers develop strategies to increase the general level of awareness of individuals. This study also had limitations which include self-reported biases, and a potential bias of the sampling distribution, as a personal network was used. To improve further research, it is recommended that also other factors that could have an influence be explored, and different approaches could be used, such as qualitative studies to get a deeper understanding of the concepts.

Keywords: Digital polarization, filter bubbles, echo chambers, information consumption patterns, political orientation, awareness.

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1. Introduction

In the digital age, social media platforms and search engines have become prominent tools for information dissemination and communication, shaping the way individuals engage with political content (Krafft et al. 2019). In the past individuals gained information through traditional media channels such as TV and newspapers, because of this, exposure to diverse perspectives on political topics of interest was limited, as everyone consumed news from similar sources. Today, the rise of the Internet offers unlimited access to news and information through social media platforms and search engines. Social media platforms have transformed the landscape of political communication, providing individuals with unprecedented access to a vast variety of information, opinions, and news sources (Spohr 2017). These platforms offer users the opportunity to engage in discussions, share political content, and connect with like-minded individuals (Hallikainen 2014). In a similar way, search engines changed the way information is consumed, placing individuals one search away from what the information they seek out (Seymour & Kumar 2011). Moreover, search engines play a pivotal role in shaping online information consumption (Ludwig et al. 2023). Search engine algorithms determine the order in which results are presented to users, influencing the visibility and accessibility of political content (Cho et al 2020). These algorithms are designed to prioritize content based on relevance and popularity, but their inherent biases can inadvertently exacerbate political polarization (Möller 2018).

While this development offers a handful of positive aspects, the extensive use of these online platforms has raised concerns regarding two important issues. The first issue is their impact on political polarization (Garcia Bernando et al. 2018), a phenomenon characterized by the growing divide between individuals with divergent political beliefs, where ideological differences become more rooted (Prior 2013; Ludwig et al. 2023). This represents an issue for our society and a focus of this research as a high level of digital polarization has a negative effect on democracy by dividing society into extreme groups (Bruun et al. 2021) and contributing to the construction of filter bubbles and echo chambers. The second issue is the impact social media platforms and search engines have on filter bubbles and echo chambers, wherein users are primarily exposed to information that aligns with their pre-existing values and beliefs (Bruns 2021; Nguyen 2020). Similar to digital polarization, these represent an issue to our society as they limit exposure to diverse perspectives, reinforce individuals' biases, and contribute to spreading misinformation and fake news.

While digital polarization, filter bubbles, and echo chambers can present peril to society, there are factors that can diminish this, and one of them is awareness. Being aware that one is a bubble, primarily exposed to information and content that reinforces their belief, and engaging predominantly in dialogues with individuals that share their values and beliefs, can help one burst the bubble and break the chamber, as it is a first step to start looking for diverse perspectives and information. While there is a considerable amount of research on the negative consequences of filter bubbles and echo chambers, and how awareness can decrease them, there is a gap in research that needs to be filled in, regarding what factors influence the awareness of filter bubbles, echo chambers, and digital polarization, and how does the way individuals use social media and search engines (information consumption patterns) influence awareness. Based on past research chrome extensions were created that notified individuals of their level of polarized content in order to increase their awareness, however, not everyone is willing to use that extension, thus it is relevant to understand what other factors can increase awareness. Consequently, the main aim of this research is to respond to the question "To what extent do individuals' information consumption patterns influence the awareness of filter bubbles and echo chambers?". This study is relevant in research as it fills in the knowledge gap between the problem of filter bubbles and echo chambers and one of the solutions, awareness. Moreover, the findings from this research have practical relevance as well, as they can help policymakers in developing strategies to fight the issues raised by these concepts.

RQ1: To what extent do individuals' information consumption patterns influence the awareness of filter bubbles and echo chambers?

RQ2: To what extent do individuals' information consumption patterns influence the awareness of digital polarization?

RQ3: To what extent do individuals' political orientation influence the awareness of filter bubbles and echo chambers?

RQ4: To what extent do individuals' political orientation influence the awareness of digital polarization?

2. Theoretical Framework

2.1. Awareness of Filter Bubbles and Echo Chambers

Filter bubbles refer to personalized information environments resulting from algorithmic filtering, where individuals are exposed predominantly to content that aligns with their beliefs, values, and preferences (Bruns 2019). This phenomenon raises critical concerns about the potential consequences for individuals' information exposure, perception of reality (Krafft et al 2019), and the broader implications for democracy and public discourse (Michiels et al 2022). In the online world, individuals are surrounded by a vast sea of information, but their access to it is increasingly mediated by complex algorithms that shape their digital experiences (McKay et al 2022; Krafft 2019). Personalized algorithms, fueled by extensive data collection and profiling, curate content tailored to individual users (Hobbs 2020), creating a unique information ecosystem for each person (Garcia Bernardo et al. 2018). This process leads to the formation of filter bubbles, wherein individuals are often confined to an echo chamber of like-minded perspectives (Tabrizi Shakery 2019), reinforcing their existing beliefs (Cardinal et al. 2019) and limiting exposure to diverse viewpoints (Bruns 2019). Filter bubbles have significant implications for individuals and society at large. Limited exposure to diverse perspectives can result in a narrowing of worldviews, increased polarization, and the entrenchment of preexisting biases (Cardinal et al. 2019). As individuals are exposed primarily to content that aligns with their preferences, they may experience a distorted reality that fails to encompass alternative viewpoints, leading to potential information overload and fragmentation within these self-reinforcing bubbles (Barker 2018). Furthermore, the implications for democratic processes and public discourse are profound, as filter bubbles may contribute to the formation of isolated communities with divergent sets of facts and values (Davies 2018). Understanding the mechanisms and consequences of filter bubbles is essential for addressing the challenges they pose. By examining the various factors that contribute to the formation of filter bubbles, such as algorithmic filtering, echo chambers, homophily, and social network structures (Tabrizi Shakery 2019), we can gain insights into the dynamics of information flow and the subsequent impact on individuals' beliefs and behaviors. Moreover, exploring the dynamic between personal factors, technological influences, and social dynamics can shed light

on the complex nature of filter bubbles. Filter bubbles have been closely associated with the phenomenon of political polarization (Prior 2013). As individuals are exposed predominantly to content that aligns with their existing political beliefs and values, filter bubbles can intensify and reinforce societal division. The selective exposure to like-minded viewpoints, coupled with the limited exposure to alternative perspectives, can create an echo chamber effect, where individuals become increasingly entrenched in their own ideological bubbles (Prior 2013). This can lead to a lack of empathy and understanding for opposing viewpoints, which hinders constructive dialogue and compromise (McKay et al 2022). Consequently, filter bubbles have the potential to exacerbate political polarization, making it more challenging to find common ground and work toward collective solutions to societal issues (McKey 2022). Understanding the role of filter bubbles in political polarization is crucial for addressing the fragmentation of public discourse and promoting more inclusive and informed political conversations.

The rise of personalized algorithmic filtering and tailored content delivery has given birth to another significant phenomenon known as "echo chambers." Echo chambers, closely related to filter bubbles, play a crucial role in shaping individuals' online information environments and contributing to the fragmentation of public discourse (Tabrizi Shakery 2019). While filter bubbles primarily refer to personalized information ecosystems that reinforce individuals' existing beliefs (Cardinal et al. 2019), echo chambers delve deeper into the social dynamics within these environments. Within an echo chamber, individuals are not only exposed predominantly to content aligned with their preferences, but they also engage in interactions and discussions primarily with like-minded individuals (McKay et al 2022). This reinforcement of shared beliefs, values, and perspectives within a closed social circle further solidifies individuals' ideological bubbles and can intensify political polarization (Bruns 2019). Moreover, the formation of echo chambers can reinforce individuals' existing beliefs and contribute to the polarization of public discourse, as they often limit exposure to diverse perspectives and hinder the exploration of nuanced ideas (Guess 2018), potentially fostering an environment of division and an adversarial mindset (Garcia-Bernardo et al. 2018). As a result, individuals become more entrenched in their ideological echo chambers, which can have profound implications for democratic processes, public discourse, and social cohesion (Nguyen 2020).

However, a solution to burst the bubble and break the chamber is awareness. According to Plettenberg et al (2020) being aware of filter bubbles and echo chambers can further push individuals to seek diverse information and expose themselves to different beliefs. Moreover, Amrollahi (2021) emphasized in his research the importance of awareness of filter bubbles, however, his focus was more on what tools can be designed in order to increase awareness. The existing literature still holds a gap regarding what factors increase individuals' awareness of filter bubbles, echo chambers, and digital polarization, which is one of the main objectives of this study.

2.2. Awareness of Digital Polarization

Political polarization, both in the digital realm and offline, has become a pressing concern in contemporary societies (Hwang Huh 2014). It manifests as a widening ideological gap between political factions, leading to heightened animosity, decreased trust in institutions, and reduced opportunities for constructive dialogue (Westfall et al 2015). In the context of digital polarization, online platforms, and social media play a significant role in intensifying political divisions (Hong Kim 2016; Hwang Huh 2014). These platforms often employ algorithmic systems that curate and personalize content based on users' preferences, reinforcing their existing beliefs and limiting exposure to diverse viewpoints (Le et al 2019). This algorithmic curation can create echo chambers and filter bubbles, where individuals predominantly engage with like-minded individuals and are shielded from alternative perspectives (Brian et al 2020). As a consequence, people become more entrenched in their ideological positions, viewing opposing views with skepticism or disdain (GarciaBernardo et al. 2018). The highly partisan nature of political discussions online, fueled by anonymity and the absence of face-to-face interaction, further exacerbates polarization. Moreover, this can lead to the spreading of extreme ideologies, and a lack of empathy toward individuals with opposing political beliefs (Cho et al 2020). This can be further used by individuals or organizations with malicious intent to spread false information and manipulate public opinion. Consequently, polarization has an impact both on individuals' attitudes and on society at large, as it can have a significant role in elections and democracy (Bodrunova et al. 2019). Polarization undermines the ability to find common ground, compromises the quality of public discourse, and hinders the pursuit of collaborative and evidence-based policy-making (Hong Kim 2016). The viral nature of social media amplifies this polarization, as polarizing content spreads rapidly, leading to the entrenchment of extreme positions and the erosion of shared realities (Hwang Huh 2014). The anonymity and reduced social cues in digital interactions can also contribute to the escalation of

political polarization, as individuals may engage in more aggressive and confrontational behavior online (Zimmerman Ybara 2016). Digital polarization has significant implications for democratic processes and societal cohesion, as it hinders constructive dialogue, compromises the search for common ground, and fosters an atmosphere of distrust and animosity (Westfall et al. 2015). Lastly, digital polarization is closely related and contributes to the creation of filter bubbles and echo chambers, which will be discussed in the next chapter. There are many factors that reduce political and digital polarization, such as transparency of algorithms, increasing education on political topics, or the promotion of transparent platforms that encourage diverse perspectives, however, this research focuses on the awareness factor. A relevant factor in reducing digital polarization is being aware of this phenomenon (Cardenal et al 2019) because, according to Nisbet & Markowitz (2015), political awareness encourages individuals to engage in public debates, which further enhances critical thinking and balanced information dissemination. Thus, it is relevant to understand what factors influence digital polarization awareness. Past research emphasized that awareness has a positive impact on decreasing digital polarization, however, there is still a gap regarding what factors influence awareness, which is one of the aims of this study.

2.3. Social media platforms and search engines

In the past, news consumption was very different from how it is today, for a handful of reasons. When only traditional media was used, such as television and newspaper, individuals had access to a limited amount of news sources, since there was not a large number of news television channels or many news gazettes. Thus, Su et al (2019) argue in their research that the existing sources had a large impact on information consumption. Traditional media channels used only a one-way communication model (Hermida, 2010), which is further argued by Alexander et al. (2019) that this did not offer a platform where individuals can give feedback or engage in debates regarding the news they have seen. Moreover, traditional media channels were standard to a large extent, as it was lacking personalized content and individuals were receiving content that would fit a broader audience (Näsi, 2021). These characteristics also enhance gatekeeping, as editors and journalists had a crucial role in deciding what news to the public, what to prioritize, and what to gatekeep (Nechushtai & Lewis 2019). When the transition was made to new media channels, such as social media platforms and search engines, the dynamic changed completely. Compared to traditional media channels, new media offered access to an unlimited amount of information (Bennett et al. 2004). Furthermore, Matthee (2011) describes in his research how new media used

a two-way communication model and users now had a platform where they can easily share feedback or engage in debates about the topics they discover. Moreover, today news outlets are not the main news sharer, as today every user can generate content and share certain news with his community of followers (Luca, 2015).

Both search engines and social media platforms play a pivotal role in reshaping information and news consumption. According to Kobayashi & Takeda (2000) search engines are the central actor of the Internet as they help users search and find information based on their search queries describes also Tene (2008) in her research. Compared to traditional media, where if one wanted to know more about a certain topic one had to physically search in newspapers or books, now individuals can easily search specific key terms and find their desired information (Jones & Purves 2008). Moreover, search engines enhance access to information, by selecting relevant results for the users and avoiding information overload (Badwen et al. 1999), this is done by personalizing the results based on content-based filtering or on individuals' history searches (Garcia-Bernardo & Pit 2018). However, similar to traditional media, search engines play a crucial role in the way individuals consume information, by only selecting the relevant information, or displaying the results in a certain order, search engines risk gatekeeping information (Nechushtai & Lewis 2019). According to Le et al. (2019) this action can consequently lead to the creation of filter bubbles and echo chambers, which have a negative impact on digital polarization.

Social media platforms play a pivotal role as well, in news and information dissemination nowadays, as individuals use them as sources of news and information (Levy, 2019), because of this Plantin (2019) argues in his research that social platforms have the power to shape political communication and public discourse. Moreover, Nair (2011) explains how these platforms offer users the opportunity to engage in dialogues with like-minded individuals and leave feedback. Social media platforms became so used around the entire world that also the majority of businesses use them to connect with their clients and increase their reputation (Kaul et al. 2015, Dijkmans et al. 2015). Social media platforms enhance in theory exposure to diverse perspectives, as everyone is able to generate and share content, thus the same topic can be covered from different points of view.

However, while social media platforms and search engines enhanced access to information and news, they still serve as tools that can contribute to digital polarization and the creation of filter

bubbles and echo chambers (Cinelli et al. 2021). This happens for multiple reasons, one of them being individuals' tendency to seek and engage with content that reinforces their values and beliefs, this action is called selective exposure, which will be further discussed in the next section.

2.4. Selective exposure

A contributing factor to digital polarization, filter bubbles, and echo chambers is selective exposure, which Frey (1986) characterized it by individuals' proneness to engage with content that aligns with their values and to seek out information that reinforces their pre-existing beliefs. Previous research blames selective exposure either on individual factors, such as avoiding uncertainty, the perceived usefulness of the information, as individuals tend to seek information, they find valuable in their decision-making process, and rational choices (Smith et al. 2008). Other researchers take a sociological approach, explaining the influence of factors such as social identity, and social comparison on selective exposure (Sears & Freedman 1967). While all these factors play an important role in selective exposure, this concept is particularly relevant when it comes to social media platforms and search engines, as these enhance selective exposure. Individuals are naturally inclined to seek out information that confirms their pre-existing beliefs and values (Smith et al. 2008), search engines offer the perfect environment to do that as they often display information based on the users' history preferences (Weeks et al. 2017).

Moreover, individuals tend to interact with other individuals or groups that share their same beliefs and values (An et al. 2013), social media platforms, such as Facebook provide the necessary conditions to do that, as one is easily able to join online communities with like-minded individuals that share similar beliefs. Consequently, Lueders (2019) describes in his research how this creates a vicious cycle of information consumption, which leads to digital polarization and the creation of filter bubbles and echo chambers (Liao & Fu 2013). This does not only have a negative impact on an individual scale, by reducing critical thinking and balancing information dissemination (Valention et al. 2009), but it also plays an important role in society, as the lack of diverse perspectives and information can affect public discourse, political elections, and democracy (Michiels et al. 2022). As specified before, awareness can be a powerful tool for reducing filter bubbles, echo chambers, and digital polarization (Cardenal et al. 2019), thus it is crucial to understand what factors impact individuals' awareness of these concepts. According to Passe et al. (2019) looking for information that does not always resonate with one's beliefs, and

engaging in constructive dialogue is considered to have a positive impact on awareness. In this research, one of the independent variables is information consumption patterns, which refers to how individuals expose themselves to information, and how they use search engines and social media platforms. Moreover, another factor that influences awareness of polarization is individuals political orientation, which will be discussed in the following section.

H1: *Information consumption patterns have an effect on awareness of filter bubbles and echo chambers.*

H2: *Information consumption patterns have an effect on awareness of digital polarization.*

2.5. Political orientation

Political orientation refers to individuals' position on the political compass. This can range from values such as right-wing to left-wing, or conservative to liberal. Their stance on the political compass usually reflects in their beliefs, attitudes towards society, and overall values. More specifically this includes what they think about social values, views on authority, opinions on government roles, and individual rights (Cohen & Ruths 2013). According to Kandler et al. (2012), political orientation is affected by multiple factors such as personality traits, genetic factors, and cultural transmission. Other research argues that individuals' position on the political compass is influenced by their personal experiences, education, and oftentimes media (Lep & Kirbiš 2022; Dakhan et al 2021). This concept is relevant to this study as being strongly politically oriented, named also as partisan, is considered to be an influential characteristic of digital polarization, increasing the construction of filter bubbles and echo chambers (Ramírez-Dueñas & Vinuesa-Tejero 2021). This partisan exposure is specifically observed during elections, and some researchers argue that extreme political orientation increases selective exposure, which is further enhanced by the vast availability of media that allows individuals to limit their exposure to sources they resonate with (Druckman et al. 2013; Bou-Hamad & Yehya 2020). Thus a focus in this research is how political orientation influences individuals' awareness of filter bubbles and echo chambers, and individuals' awareness of digital polarization. Closely related to political orientation, is the impact of culture itself on polarization, which will be discussed in the next section.

H3: *Political orientation has an effect on awareness of filter bubbles and echo chambers.*

H4: *Political orientation has an effect on awareness of digital polarization.*

2.6. Culture

Another important factor in this study is the role of individuals' culture, in this research measured as country of residence, played on polarization, filter bubbles, and echo chambers. As mentioned beforehand individual factors are not the only ones that contribute to the construction of filter bubbles and echo chambers, this is influenced by societal factors as well (Dutton & Blank 2013). This makes sense, as different countries have different values, norms, beliefs, media, and news consumption, all of these factors play an important role in shaping individuals' political orientation and thus influence polarization and filter bubbles (Davies 2018, Dutton et al. 2017). In the existing literature, there is a gap that fails to explain the exact effect culture has on the creation of filter bubbles and echo chambers, thus one of the aims of this study is to discover if culture has a significant impact on awareness of filter bubbles and echo chambers. This research is specifically focused on the comparison of Romania, a post-communist country, and The Netherlands, a constitutional monarchy country. According to Molnar (2011), economic inequality in Romania has a significant impact on the level of polarization in Romania, Jucu (2015) further explains how the different levels of education between small-sized Romanian cities, and larges-size Romanian cities also have an impact on polarization. Research on polarization was done also in The Netherlands, Albada et al. (2021) discovered a significant level of polarized attitudes toward refugees and immigrants in The Netherlands. On the other hand, Trilling et al. (2017) argue in their research that the Dutch media landscape is not too polarized. Consequently, these countries were chosen as they have a diverse media landscape, different cultural values, and somewhat different political systems, thus the comparison would help to fill in the research gap regarding what are the differences between different cultures on the awareness of filter bubbles and digital polarization and this is tested in relation with how individuals consume news and information in online environments.

H5: *Culture has an effect on awareness of filter bubbles and echo chambers.*

H6: *Culture has an effect on awareness of digital polarization.*

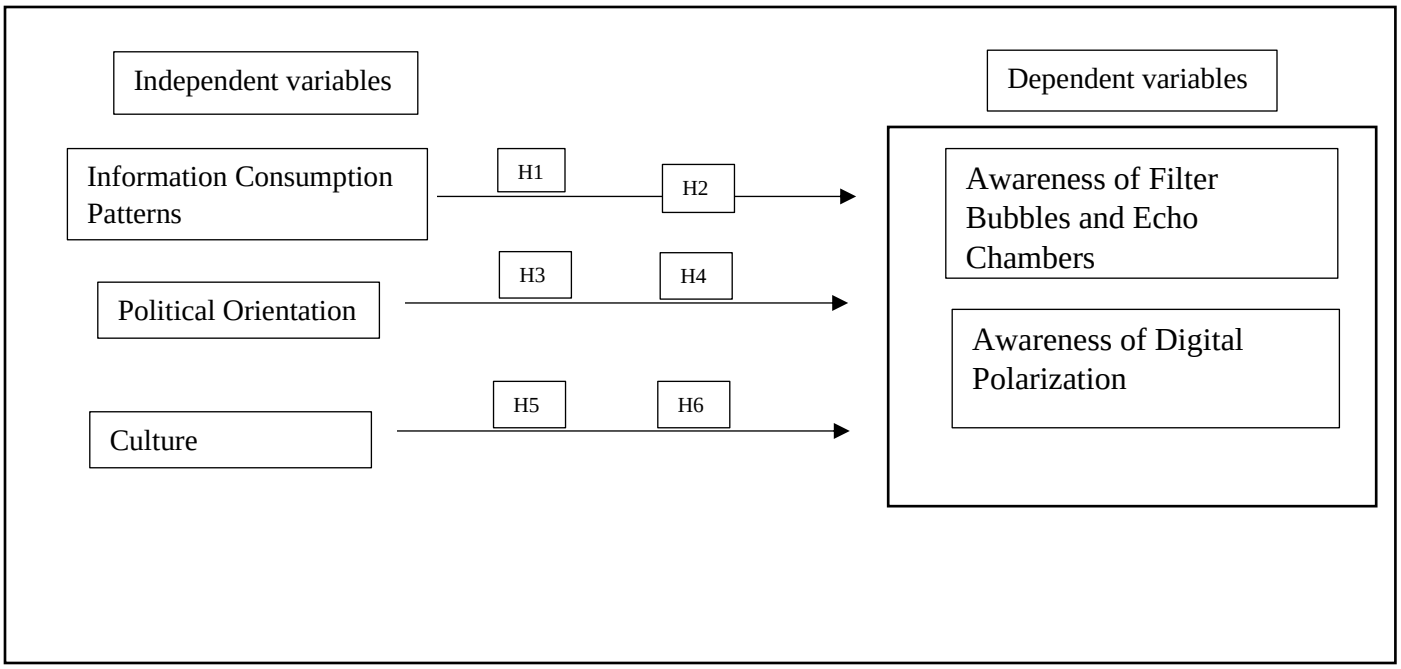
2.7. Hypotheses and conceptual model

The hypotheses described in this theoretical framework are presented in Table 1. and conceptualized in a conceptual model in Figure 1.

Table 1. Research Hypotheses

Number	*Hypotheses*
H1	*Information consumption patterns have an effect on awareness of filter bubbles and echo chambers.*
H2	*Information consumption patterns have an effect on awareness of filter bubbles and echo chambers.*
H3	*Political orientation has an effect on awareness of filter bubbles and echo chambers.*
H4	*Political orientation has an effect on awareness of digital polarization.*
H5	*Culture has an effect on awareness of filter bubbles and echo chambers.*
H6	*Culture has an effect on awareness of digital polarization.*

Figure 1. Conceptual model of the hypotheses.



3. Methods

In the following section, the methodology used in this study is described, including the design of the study, procedure, respondents' sample, participants' recruitment process, data collection, and the plan for data analysis. The research aimed to examine what factors influenced awareness of filter bubbles and echo chambers, and what factors influenced awareness of digital polarization. The possible factors tested in this study were information consumption patterns, political orientation, and cultural aspects.

3.1. Study design

In order to collect data a cross-sectional survey was created, where participants are asked to answer the questions of the survey at a single point in time. This method was chosen for multiple reasons. Firstly, a cross-sectional study is suitable for this research as it follows the associations and relations between multiple variables, in this case, the relation between information consumption patterns and filter bubbles, echo chambers, and digital polarization, this is easy to analyze with the help of a cross-sectional study, as this makes it feasible to perform the needed statistical analysis, in this case, regression, multiple regression, and ANOVA, which help us understand associations between variables and identify patterns. Moreover, Levin (2006) describes in his research that some of the benefits of cross-sectional studies are that they are time and cost-efficient, as individuals do not need to take a long time to fill them in, which further makes it easier to collect more responses. In this case, making the survey was completely free, the only small cost involved was printing flyers to distribute the survey, which will be discussed later. Furthermore, cross-sectional studies are valuable for policymakers as they can help them draw significant conclusions in designing policies. Secondly, this research it was aimed to make a comparison between the countries Romania and The Netherlands and explore the differences between filter bubbles, echo chambers, and digital polarization awareness. A cross-sectional study design represents a suitable method to explore this comparison as it makes it easy to generate participants' locations.

3.2. Study distribution

This section describes how the survey was distributed to gather a large number of participants and reach a diverse audience. In order to gather as many respondents as possible, multiple ways of sharing the survey were used, specifically social media platforms, word of mouth, and flyers.

3.2.1. Social media platforms

The survey was posted, on the 2nd of June, 2023, on multiple social media platforms, more specifically Instagram stories, Reddit, and Facebook. This was done both because it was a suitable way to reach a larger audience and because individuals who used social media were favorable to the study, as half of the questions related to social media. On Instagram, multiple people reposted the survey on their stories in order to reach a broader audience. On Facebook, the survey was posted in around 20 groups related to science and questionnaires, similar to Reddit where the survey was posted in three subreddits related to education and surveys.

3.2.2. Word of mouth

In order to reach a diverse audience, and have participants from different age groups, different political orientations, and different cultural backgrounds. The survey was spread to a handful of different individuals, such as students, parents, employees, citizens of different countries, and people with a higher level of education. These individuals were further asked to share the survey with people in their network. Thus, resulting in gathering participants of various ages, educational backgrounds, cultural backgrounds, and political views.

3.2.3. Flyers

Lastly, the design platform Canva was used in order to design some colorful flyers, presenting a message to encourage individuals to complete the survey, and a QR code to the survey. The flyers were printed and distributed to people on The University of Twente campus, and in the city center of Enschede, as well as hung on the walls of crowded buildings, such as the university library. This method was chosen as it offered individuals easy access to the survey over a longer period.

Consequently, by using these three methods of distribution, the survey gathered 178 respondents over the course of five days.

3.3. Procedure

The first step in creating the study was to make sure that ethical standards were met. Thus, before preparing anything an ethical approval request, which contained the design of the study and sample information, was sent to the Behavioral, Management, and Social Science Ethics Committee of the University of Twente for revision. The research design was approved, and from there the entire survey was created. The survey was created on the Qualtrics platform and was made neither long nor short so that participants do not lose interest during the survey but also that all the right questions are asked. This resulted in the average time of completing the survey of around 6 minutes. In this study, participants had to fill out a cross-sectional survey that started with informed consent that outlined the procedure, risks and benefits, confidentiality, contact persons, and most importantly voluntary participation. After being informed that their data will be kept confidential, deleted after the stud,y and that their participation is strictly voluntary, participants had to respond to different questions regarding their demographics, political views, information consumption pattern, filter bubbles, echo chambers, and digital polarization.

3.4. Respondents

This study aimed to collect 150 participants, however, a number somewhat higher was collected n=178. While there were no specific sample characteristics that participants had to meet, there was one important rule that all participants must be above the age of 18. Moreover, there was a special interest for individuals living in The Netherlands or Romania, as a comparison was intended between these two countries and the level of awareness of Filter Bubbles, Echo Chambers, and Digital Polarization, thus the survey was predominantly spread in these countries. After gathering all the respondents, the demographics showed variability within participants, this can also be noticed in Table 2. For the gender variable, participants had the option to choose between Male, Female, Non-binary/Third gender, or Prefer not to say, this was the automatic response option from Qualtrics, however, nobody choose the last two options so they were excluded from the analysis. There was a majority of females, n=102 (57.30%), and the rest were males n=76 (42.70%). For age no intervals were used, as participants had to type in their age as a response option. As specified before, all participants had to be over 18 so their age was between 18 and 61 with the age mean of M = 27.46 (SD=9.86). For measuring the education level, automatic response options were chosen from Qualtrics, as they fitted the research, these included Less Than High School, High School, Bachelor, Master, Ph.D. From these options nobody chose

Less Than High School or Ph.D., thus they were excluded from the analysis. For the variable country participants had the option to choose their country of residence from a table that included all countries. As intended, the majority of participants were from The Netherlands n=70 (39.33%) and Romania n=69 (38.76%) followed by other countries n=39 (21.91%). Another demographic relevant to this study was participants' political views, measured on a bipolar scale from strongly right-wing to strongly left-wing, measured on a 7-point Likert scale, the mean score for political orientation was M=4.63 (SD=1.53).

Table 2. Full sample demographics

Category	*Full sample*	
	n	*%*
Gender	*178*	*100*
Male	*76*	*42.70*
Female	*102*	*57.30*
Country of residence	*178*	*100*
The Netherlands	*70*	*39.33*
Romania	*69*	*38.76*
Other	*39*	*21.91*
Political view	*148*	*100*
Strongly right-wing	*3*	*1.69*
Moderately right-wing	*19*	*10.67*
Slightly right-wing	*17*	*9.55*
Neutral	*43*	*24.16*
Slightly left-wing	*30*	*16.85*
Moderately left-wing	*51*	*28.65*
Strongly left-wing	*15*	*8.42*

Note. N=150. Participants average age m=27.46 (SD=9.86)
Participants' average political view M=4.63 (SD=1.53)

3.5. Pre-test

Two pre-tests of the cross-sectional survey were conducted, in order to assess the clarity, understandability, and feasibility of the questions and overall survey. The primary aim of the first pre-test was to gather feedback from a small group of individuals (n=5) that still represent the sample characteristics. Participants were selected on a convenient sample, as this was only for the pre-test. During the first pre-test phase, participants were asked to complete the survey and provide feedback on various aspects. The feedback given was regarding the clarity of the questions, the length of the survey, and any difficulties encountered while responding. In the first pre-test run the majority of the participants stated that the survey is too long, and they lose concentration while filling it in. Based on this remark, some items were combined, some items were deleted, and a smaller number of questions was displayed per page to give the impression it takes a shorter time to make it, as this was a suggestion from a participant.

The second pre-test run was done on a smaller sample size (n=3), as it was assumed most errors were discovered. Similar to the first pre-test run, in the second pre-test run it was used a convenience sample to gather participants. This time it was pointed out that some individuals might need a definition to understand concepts discussed in the survey such as left-wing or right-wing. Based on the feedback of both runs, multiple adjustments were made to enhance the clarity, understanding, and flow of the survey questions, such as using appropriate language to explain the terms to the participants, making sure that individuals understand what they are asked to increase the validity of the scales, and adding clarifying definitions of the concepts so participants do not have unclarities while doing the survey. While the pre-test improved the clarity, feasibility, and understandability of the survey to a great extent, it did not assess the items' validity. Thus, this is something that should be taken into account and improved in further research.

3.6. Measurements

In the following section the construction of the variables is described, this section is focused only on the relevant variables for this study, which were previously described in the theoretical framework. The variables are the level of awareness of filter bubbles and echo chambers as the

first dependent variable, the level of awareness of digital polarization as the second dependent variable, information consumption patterns as the main independent variable, political orientation as an independent variable, and culture as an independent variable.

3.6.1. Awareness of filter bubbles and echo chambers

The first aim of this study was to explore to what extent participants were aware of the existence of filter bubbles and echo chambers in digital environments such as social media platforms and search engines. In order to assure that participants have a comprehensive understanding of these concepts, before the question a simple definition of both concepts was presented.

This scale, which represented a dependent variable, was developed specifically for this study, and while existing scales were not used, the example of Plettenberg et al. (2020) research, as they also measure filter bubbles awareness, was used in the creation of the scale. Four items were created related to the awareness of filter bubbles and echo chambers in digital environments, with statements such as *"To what extent do you believe search engine use creates filter bubbles?"*. Participants were asked to rate their answers on a 5-point Likert scale, ranging from "To no extent" to " To a very large extent". In order to assess the internal consistency of the scale Cronbach's alpha was computed ($\alpha = .78$), indicating that the scale is reliable.

3.6.2. Awareness of digital polarization

The second aim of this study was to explore to what extent participants were aware of the existence of digital polarization in digital environments such as social media platforms and search engines. In order to assure that participants have a comprehensive understanding of these concepts, before the question a simple definition of the concepts was presented.

This scale was a dependent variable and in order to keep the structure of the survey, the scale for digital polarization was developed similarly to the scale of filter bubbles and echo chambers awareness with some small changes, as it used items such as *"In your opinion, how likely are social media platforms to reinforce digital polarization?"*. Participants were asked to rate their answers on a 5-point Likert scale, ranging from "Extremely unlikely" to "Extremely likely". In order to assess the internal consistency of the scale Cronbach's alpha was computed ($\alpha = .64$) indicating that, while lower, the scale is reliable (Hair & Wolfinbarger 2015). However, in further research, this scale could be improved to assess a higher internal consistency.

3.6.3. Information consumption patterns

The goal of this research was to see how information consumption patterns, the independent variable, influence the level of awareness of filter bubbles and echo chambers and the level of awareness of digital polarization. In order to measure this concept a scale, out of 12, was constructed measuring different aspects of information consumption patterns. Because different aspects of the concepts were measured, this scale was somewhat difficult to make, and diverse questions were asked such as "*How often do you feel search engine results align with your views or beliefs*?" or "*How often have you unfollowed or blocked someone on social media due to political disagreements*?". The majority of the answer options were measured on a 5 points Likert scale with the answer options "*Never*", "*Rarely*", "*Sometimes*", "*Often*", and "*Always*". However, there was an item "*In your opinion, how likely are social media platforms to change someone's political beliefs?*" which was also measured on a 5-point Likert scale but with the choices ranging from "*not likely at all"* to "*extremely likely*". Two factors were taken into account when the decision to include this item was made. The first factor was that this was an important item to measure information consumption patterns, and the second factor was the length of the survey, as the goal was to keep it practical and on point so that participants don't lose concentration while filling it in. However, this is not recommended in further research as it can affect the validity of the scale. In this case, after erasing one item to increase internal consistency leaving the scale with 11 items, the Cronbach's alpha was ($\alpha = .61$), while lower than ($\alpha = .70$) this scale can still be considered reliable (Hair & Wolfinbarger 2015), with the note that in further research a better reliability of scales is encouraged.

3.6.4. Political orientation

In order to measure individuals' position on the political compass a pre-tested bipolar scale was adapted and used in order to discover participants' political compass. However, to assess political orientation, this study did not use a scale, but rather one item in the demographic section *"How would you describe your political views?"*. In the initial study, the political view was measured on an 11-point Likert scale. However, in this specific study, it was considered that a 7-point Likert scale was enough in order to assess individuals' political views. This scale ranged from 1 = strongly right-wing to 7 = strongly left-wing, with a middle point of 4 = neutral. Before the question was addressed, participants were shown a short definition explaining both concepts.

3.6.5. Culture

In order to discover participants' culture a question was asked in the demographic section *"In which country do you currently reside?*". The answer option to this question was a list including all the countries and participants had to click on one. Moreover, as a comparison between Romania and The Netherlands is intended, this variable was broken into two dummies, dummy Romania (Romania = 1, Other = 0) and dummy Netherlands (Netherlands = 1, Other = 0).

To conclude, multiple scales were created in order to measure different aspects of individuals, while the scales showed reliability this was still somewhat low, this should be taken into account in the results section, and moreover it should be taken into account in further research as validity and reliability is a crucial aspect when conducting research.

Table 3. Scales validity and reliability measures

Factor analysis			
	Factors		
Statements	1	2	3
Fe_1 To what extent do you believe search engine use creates filter bubbles?	0,80		
Fe_2 To what extent do you believe search engine use creates echo chambers?	0,68		
Fe_3 To what extent do you believe Social Media platforms can create filter bubbles and echo chambers?	0,49		
Fe_4 To what extent do you believe Social Media platforms can create filter bubbles and echo chambers?	0,74		
Dp_1 In your opinion, how likely are search engines to reinforce digital polarization?		0,46	
Dp_2 In your opinion, how likely are social media platforms to reinforce digital polarization?		0,64	
Dp_3 Do you feel that your political beliefs have become more polarized as a result of using search engines?		0,83	
Dp_4 Do you feel that your political beliefs have become more polarized as a result of using social media?		0,71	
Icp_1 How often do you encounter viewpoints that differ from your own on search engines?			0,40
Icp_2 How often do you encounter viewpoints that differ from your own on social media platforms?			0.32
Icp_3 In your opinion, how likely are social media platforms to change someone's political beliefs?			0,18
Icp_4 How often do you feel search engine results align with your views or beliefs?			0,10
Icp_5 How often do you feel social media content aligns with your views or beliefs?			0,15
Icp_6 How frequently do you search political content on search engines?			0,24
Icp_7 How frequently do you engage with political content on social media?			0,36

Icp_8 Have you ever noticed different agendas for politically related topics when scrolling through different social media platforms?			0,21
Icp_9 How often have you unfollowed or blocked someone on social media due to political disagreements?			0,30
Icp_10 How often do you come across misleading or false information related to politics on search engines?			0,63
Icp_11 How often do you come across misleading or false information related to politics on social media platforms?			0,64
Cronbach's alpha:	0.78	0.64	0.61
Explained variance:	47,9%	40,1%	14,5%
Eigenvalues:	2.42	1.96	2.40

4. Results

In the following sections the results of this research are presented, the research questions presented in the introduction are answered, and the hypotheses addressed in the theoretical framework are rejected or accepted. In order to test the relationship between all the variables the statistical software R was used, and different analysis were performed, such as descriptive statistics, regression analysis and ANOVA.

4.1. Descriptive statistics

The first part of the results section is focused on the describing the descriptive statistics of the variable used in this research.

The first variable analyzed was the dependent variable awareness of filter bubbles and echo chambers, measured on a 5-point Likert scale, M=3.70 (SD=0.75), the mean is rather high, with a somewhat small standard deviation. The second dependent variable of this study was the awareness of digital polarization, this was also measured on a 5-point Likert scale, M=3.54 (SD=0.73), the mean is somewhat high, with a small standard deviation. This indicates that individual's level of awareness is somewhat higher than average.

The independent variable information consumption patterns, was measured on a 5 point Likert-scale, M=3.11 (SD=0.41) , the mean is close to average and the standard deviation in somewhat small. The other independent variable, political orientation, was measured on a 7-point Likert-scale, M=4.63 (SD=1.54) the mean is above average, but with a higher standard deviation. This could indicate that the participants of this study leaned towards the left-wing orientation.

The correlation between variables was not very high. For example, information consumption patterns and political orientation had the lowest correlation (r = .09). Political orientation correlated low with awareness of filter bubbles and echo chambers (r = .13), and with awareness of digital polarization (r = .18) as well. However, information consumption patterns had a somewhat higher correlation with awareness of filter bubbles and echo chambers (r = .27) and even higher with awareness of digital polarization (r = .40), this was also the highest from the entire table. While information consumption patterns showed higher numbers, this still does not represent very high correlations.

Moreover, in order to have some descriptive information about the culture effect on awareness of filter bubbles and echo chambers. The variable country of residence was broken into 2 dummies, dummyRomania (Romania = 1, Other = 0) and dummyNetherlands (The Netherlands = 1, Other 0). The mean of the awareness was then calculated per country, showing that Romania M=3.48 (SD=0.84) had a somewhat lower mean both compared to The Netherlands M=3.85 (SD=0.62) and Other M=3.80 (SD = 0.70).

The same thing was done in order to get more descriptive information about the influence of culture on awareness of digital polarization. This showed a small difference between Romania M=3.50 (SD=0.85) and The Netherlands M=3.51 (SD=0.66), and the other countries scoring the higher M=3.67 (SD=0.60).

Table 4. Descriptive statistics and Pearson's correlation of variables

	Mean	SD	*Awareness of filter bubbles and echo chambers*	*Awareness of digital polarization*	*Information consumption patterns*	*Political orientation*
Variables						
Awareness of filter bubbles and echo chambers	3.70	0.75	1			
Awareness of digital polarization	3.54	0.73	.37	1		

Information consumption patterns	3.11	0.41	.27	.40	1	
Political orientation	4.63	1.53	.13	.18	.09	1

4.2. Regression analyses

4.2.1. Hypothesis 1

The first hypothesis was that information consumption patterns have an effect on awareness of filter bubble and echo chambers. In order to test this hypothesis a simple regression analysis was performed with awareness as dependent variable and information consumption patterns as independent variable, results are shown in Table 5. We found support for our expectations as the effect of information consumption patterns was significant, b = 0.50, SE = 0.13, t(177) = 5.76, p= < .01, with R^2 = .07. Indicating that the explained variance of the model is 7%, which is low. These results suggest that every unit individuals increase their information consumption patterns, such as engaging in constructive dialogues or exposing themselves to diverse sources, the awareness of filter bubbles and echo chambers increases by 0.50. It is important to note that while the effect is positive and significant, the explained variance of the model is still low, meaning other factors should be taken into account as well.

Table 5. Regression model between information consumption patterns and awareness of filter bubbles and echo chamber.

Predictor	b	SE	t	p	Lower 95% C.I.	Upper 95% C.I.	F
Intercept	2.15	0.41	5.20	< .01	1.34	2.97	14.13
Information consumption patterns	0.50	0.13	5.76	< .01	0.24	0.76	14.13

Note: *R^2adjusted = 0.16*

4.2.2. Hypothesis 2

The second hypothesis was that information consumption patterns have an effect on awareness of digital polarization. In order to test this hypothesis a regression analysis was performed with awareness as dependent variable and information consumption patterns as independent variable, results are shown in table 6. We found support for our expectations, as the effect of information

consumption patterns on digital polarization awareness was significant, b = 0.72, SE = 0.12, t(177) = 5.83, p= < .01, with R^2 = .16. Indicating that the explained variance of the model is 16%.

Table 6. Regression model between information consumption patterns and awareness of digital polarization.

Predictor	b	SE	t	p	Lower 95% C.I.	Upper 95% C.I.	F
Intercept	1.32	0.38	3.43	< .01	0.56	2.07	34.09
Information consumption patterns	0.72	0.12	5.83	< .01	0.47	0.95	34.09

Note: *R^2adjusted = 0.16*

4.2.3. Hypothesis 3

The third hypothesis was that political orientation has an effect on awareness of filter bubble and echo chambers. In order to test this hypothesis a simple regression analysis was performed with awareness as dependent variable and political orientation as independent variable, results are shown in table 7. We did not found support for our expectations, as the effect of political orientation on filter bubbles and echo chambers awareness was not significant, b = 0.07, SE = 0.04, t(177) = 1.80, p= .07, with R^2 = .01. Indicating that the explained variance of the model is 1%, which is very low.

Table 7. Regression model between political orientation and awareness of filter bubbles and echo chambers.

Predictor	b	SE	t	p	Lower 95% C.I.	Upper 95% C.I.	F
Intercept	3.39	0.18	19.16	< .01	3.04	3.74	3.25
Political orientation	0.07	0.04	1.80	.07	-0.01	0.14	3.25

Note: *R^2adjusted = 0.01*

4.2.4. Hypothesis 4

The fourth hypothesis was that political orientation has an effect on awareness of digital polarization. In order to test this hypothesis a regression analysis was performed with awareness as the dependent variable and political orientation as the independent variable, results are shown in table 8. We found support for our expectations, as the effect of political orientation on digital

polarisation awareness was significant, b = 0.07, SE = 0.04, t(177) = 1.80, p= .07, with R^2 = .03, indicating that the explained variance of the model is 3%, which is very low.

Table 8. Regression model between political orientation and awareness of digital polarization.

Predictor	b	SE	t	p	Lower 95% C.I.	Upper 95% C.I.	F
Intercept	3.14	0.17	18.32	< .01	2.80	3.47	6.12
Political orientation	0.09	0.04	2.47	.01	0.02	0.14	6.12

Note: *R^2adjusted = 0.03*

4.2.5. Hypothesis 5

The fifth hypothesis was that culture has an effect on awareness of filter bubbles and echo chambers. In order to test this hypothesis an ANOVA was performed with awareness as the dependent variable, information consumption patterns as an independent variable, dummy Romania as an independent variable, and dummy Netherlands as an independent variable, results shown in table 9. The model showed no support for our hypothesis that culture has an impact on awareness of filter bubbles and echo chambers. The effect for residing in The Netherlands was not significant b = 0.07, SE = 0.14, t(177) = 0.51, p=.60. Neither was the effect for residing in Romania b = -0.27, SE = 0.14, t(177) = -1.93, p= .05. Moreover, the explained variance of the model was only 11%, R^2 = 0.11.

Table 9. ANOVA Information consumption patterns and country on filter bubbles and echo chambers awareness.

Predictor	b	SE	t	p	Lower 95% C.I.	Upper 95% C.I.
Intercept	2.31	0.43	5.40	< .01	1.47	3.16
Dutch	0.07	0.14	0.51	.60	-0.20	0.35
Romanian	-0.27	0.14	-1.93	.05	-0.55	0.01
Icp	0.71	0.12	5.74	< .01	0.47	0.95

Note: *R^2adjusted = 0.11*

4.2.6. Hypothesis 6

The sixth hypothesis was that culture has an effect on awareness of digital polarization. In order to test this hypothesis an ANOVA was performed with awareness as the dependent variable, information consumption patterns as an independent variable, dummy Romania as an independent variable, and dummy Netherlands as an independent variable. The model showed no support for our hypothesis that culture has an impact on awareness of filter bubbles and echo chambers. The effect for residing in The Netherlands was negative and not significant b = -0.13, SE = 0.13, t(177) = -0.98, p= .60. Neither was the effect for residing in Romania b = -0.10, SE = 0.14, t(177) = -0.75, p= .05. In this case, the explained variance of the model was a bit higher, accounting for 16% of the model, R^2 = 0.16. From this model only information consumption patterns had an effect, however this was discussed before. Because

Table 10. ANOVA Information consumption patterns and country on digital polarization awareness

Predictor	b	SE	t	p	Lower 95% C.I.	Upper 95% C.I.
Intercept	1.43	0.41	3.51	< .01	0.63	2.23
Dutch	-0.13	0.13	-0.98	.60	-0.40	0.13
Romanian	-0.10	0.14	-0.75	.05	-0.38	0.17
Icp	0.71	0.12	5.74	< .01	0.47	0.95

Note: *R^2adjusted = 0.16*

Table 11. Hypotheses acceptance/rejection summary.

Number	Hypotheses	Result
H1	*Information consumption patterns have an effect on awareness of filter bubbles and echo chambers.*	*Accepted*
H2	*Information consumption patterns have an effect on awareness of filter bubbles and echo chambers.*	*Accepted*
H3	*Political orientation has an effect on awareness of filter bubbles and echo chambers.*	*Rejected*

H4	*Political orientation has an effect on awareness of digital polarization.*	*Accepted*
H5	*Culture has an effect on awareness of filter bubbles and echo chambers.*	*Rejected*
H6	*Culture has an effect on awareness of digital polarization.*	*Rejected*

5. Discussion

The aim of this section is to offer a reflection of this study and draw conclusions of the statistical analyses. This section is going to reflect on the findings of this study, as well as specify what academic and practical implications those findings have. It's going to follow up with possible directions for further research, as well as describe what were the limitations of this particular study, and what could be improved in the studies to come. It is going to end with the main conclusions of this study.

5.1. Discussion of the findings

The first part of this section is going to focus on the findings from this study. Starting from the first hypothesis of this study "H1: *Information consumption patterns have an effect on awareness of filter bubbles and echo chambers.*", in order to test this a simple regression model was used. The model showed that the independent variable information consumption patterns had a positive effect on the dependent variable awareness of filter bubbles and echo chambers. In this study, the variable information consumption patterns measured aspects such as how often individuals engage in constructive dialogue or expose themselves to diverse information. This model showed that increasing information consumption patterns results in an increase of awareness of filter bubbles and echo chambers, because of this hypothesis 1 was accepted. However, it is important to note that the explained variance of the model was low, which indicates that the independent variable might not have been the best predictor for the dependent variable. Moreover, the correlation between information consumption patterns and awareness of filter bubbles and echo chambers was not very high. This hypothesis also represented RQ1. "To what extent do individuals' information consumption patterns influence the awareness of filter bubbles and echo chambers?". From the results it can be noticed, that while information

consumption patterns had a significant effect on awareness of filter bubbles and echo chambers, it was not to a large extent.

The second hypothesis of this research was “H2: *Information consumption patterns have an effect on awareness of filter bubbles and echo chambers.”* To test this a simple regression model was used again. The model showed that the independent variable information consumption patterns had a positive effect on the dependent variable awareness of digital polarization. This means that the more individuals engage themselves in constructive dialogue the higher their level of awareness of digital polarization is. Giving the significant results of the model, hypothesis 2 was accepted. Compared to the model for hypothesis 1, in this model the explained variance was higher, but could still be improved, which indicated that the independent variable could be a significant predictor of the dependent variable. The correlation between information consumption patterns and awareness of digital polarization was higher than in the model for hypothesis 1, being in fact, the highest correlation of them all. This hypothesis also represented RQ2. “To what extent do individuals’ information consumption patterns influence the awareness of digital polarization?”. Based on the results information consumption patterns had an effect on awareness of digital polarization to a large extent.

The third hypothesis of this research was “H3: *Political orientation has an effect on awareness of filter bubbles and echo chambers.* “in order to test this, once again, a simple linear regression model was used between the independent variable political orientation and the dependent variable, awareness of filter bubbles and echo chambers. The results did not show support for the hypothesis, as none of the values were significant, because of this hypothesis 3 was rejected. Moreover, the correlation between the variables was quite low, as was the explained variance of the model. This could indicate that individuals political orientation does not have an effect on their level of awareness of filter bubbles and echo chambers, contrary to past research. This hypothesis also represented RQ3. “To what extent do individuals’ political orientation influence the awareness of filter bubbles and echo chamber?”. Based on the results political orientation did not had an effect on awareness of filter bubbles and echo chambers.

The fourth hypothesis of this study was “H4: *Political orientation has an effect on awareness of digital polarization.*” to test this hypothesis a simple regression model was used between the independent variable political orientation and the dependent variable awareness of digital

polarization. The results of the model showed support for the hypothesis as they were positive and significant, because of this hypothesis 4 was accepted. However, the explained variance of the model was low, which could indicate that there might be other variables that better explain awareness of digital polarization. Interesting enough, the results show that political orientation has an effect on awareness of digital polarization, but not an effect on awareness of filter bubbles and echo chambers. This hypothesis also represented RQ4. “To what extent do individuals’ political orientation influence the awareness of digital polarization?”. Based on the results political orientation did not had an effect on awareness of filter bubbles and echo chambers.

The fifth hypothesis of this study was “H5: *Culture has an effect on awareness of filter bubbles and echo chambers.”* In order to test this hypothesis an ANOVA test was conducted between the independent variables, dummyRomania, dummyNetherlands, and information consumption pattern, and the dependent variable awareness of filter bubbles and echo chambers. The results of the test did not show support for hypothesis 4, as neither residing in Romania, nor residing in The Netherlands had an effect on the awareness of filter bubbles and echo chambers. Moreover, the explained variance of the model was quite low, because of the not significant results hypothesis five was rejected. However, the overall mean of filter bubble and echo chambers awareness was calculated per country showing that The Netherlands have a higher level of awareness, compared to Romania.

The sixth hypothesis of this research was “H6: *Culture has an effect on awareness of digital polarization.”* In order to test this hypothesis an ANOVA test was conducted between the independent variables, dummyRomania, dummyNetherlands, and information consumption pattern, and the dependent variable awareness of filter bubbles and echo chambers. The results of the test did not show support for hypothesis 4, as neither residing in Romania, nor residing in The Netherlands had an effect on the awareness of filter bubbles and echo chambers. Moreover, the explained variance of the model was quite low, because of the not significant results hypothesis five was rejected. Furthermore, the overall mean of digital polarization awareness was calculated per country showing that Romania and The Netherlands have a very similar level of awareness.

5.2. Academic and practical implications

Overall, the findings of this research had both academic and practical implications. From an academical point of view, this study contributed to fill in the gap in existing knowledge regarding what factors influence awareness of filter bubbles and echo chambers, and what factors influence the awareness of digital polarization. Firstly, the significant results of hypothesis 1, helped answer RQ1, and confirmed past research that information consumption patterns contribute to the awareness of filter bubbles and echo chambers. Furthermore, the positive significant relationship of information consumption pattern on awareness of digital polarization further reinforced past research stating that indeed it has an effect. However, political orientation did not have a significant effect on the awareness of filter bubbles and echo chambers, leading to the rejection of hypothesis 3, and gave an answer to RQ3. On the other hand, the significant result between political orientation and awareness of digital polarization, further confirms past research that argued that being a partisan has an impact on the awareness of digital polarization, however it is important to remember that while the results were significant, they were still not quite strong. The effect of culture was tested as well but did not show significant results on neither the awareness of filter bubbles, nor the awareness of digital polarization. This disagreed with the past research findings stating that cultural differences have an effect on the individual's level of awareness.

This study also contains practical implications. The first implication would be that the positive results of information consumption patterns and awareness of filter bubbles and echo chambers could help policymakers develop strategies related to filter bubble and echo chambers awareness. Moreover, information consumptions patterns impacted awareness of digital polarization to a great extent. This shows that the way individuals consume media, and engage in debates has an impact on their overall awareness. Thus, policymakers should develop strategies to encourage people engage in constructive debates. Moreover, this could help create or improve awareness programs that teach individuals about the danger of being exposed predominantly to information that reinforces their beliefs, and more about the importance of awareness on filter bubbles, echo chambers, and digital polarization. Finally, this results highlight the need for media literacy education, as learning from a young age to consume media in a balanced way, staying exposed to diverse perspectives, and engaging in constructive dialogue, can lead to the

reduction of filter bubbles, echo chambers, and digital polarization, which consequently leads to a better democratic society.

5.3. Further research

Based on the findings of this study some recommendation for further research can be made. First, the study employed a quantitative method. This method offered an understanding of how the variables relate and influence each other. However, qualitative methods can get an in-depth understanding of what individuals understand from concepts such as filter bubbles, echo chambers, and digital polarization, and how awareness impact them. Thus, qualitative methods could also be employed in further research to get a deeper understanding of the concepts.

Furthermore, a cross-sectional study was used in this research, which measured individuals at on point in time. It could be useful to see in further studies what are the effects of increasing information consumption patterns over time and measure awareness at two or multiple points in time. This could better show the extent to which information consumption patterns actually impacts the awareness of filter bubbles and echo chambers, and the awareness of digital polarization.

The cultural aspect could be further explored, as different media landscapes and political parties among countries could have an impact on the awareness of filter bubbles and echo chambers and the awareness of digital polarization, in further research more countries could be included and compared.

These recommendations are not only addressed the social science researcher, but technological sciences could also explore these phenomena and the creation of diverse tools that help user increase their awareness of filter bubbles and echo chambers, and the awareness of digital polarization. Moreover, it would be interesting to explore stakeholders perspectives, for example how do individuals in charge of the good and ethical function of social media platforms and search engines feel about this impact and their contribution on it. While this research was rather focused on the individual solution, it could be approached from a different perspective and explore what big companies could do to contribute to a solution.

5.4. Limitations

As any other research, this study had its' limitations. The limitations of this study concerned the measurement of some concepts, for example in the research the cultural aspect was addressed. However, to measure that individuals were asked in which countries they reside. This leaves room for interpretation, as individuals could reside in a country only for a year, without actually being aware or exposed to all the cultural aspect of that country, this could be better addressed in further research. Moreover, the scale for awareness of digital polarization and for information consumption had an alpha a bit higher than .6, while there is research that argues this is still reliable, an alpha of over .7 is desired when constructing scales.

Moreover, while trying to be aware and avoid potential biases, the sample of this study also involved personal network to some extent, which could result in a bias. This can further affect the generalizability of the results, as it is possible that if a different sample was selected it could differently impact the results, however this was kept mind when sampling.

A personal self-biased could possibly be present as well. Individuals had to self-report their level of awareness of filter bubbles and echo chambers, and their level of awareness of digital polarization. Individuals could report untruthfully or to the level they think they are aware but this might not be their actual level of awareness.

5.5. Conclusion

To conclude, the aim of this research was to discover the extent to which information consumption patterns impact the level of awareness of filter bubbles and echo chambers, and the level of awareness of digital polarization. Information consumption patterns have an effect on the level of awareness of filter bubbles and echo chambers, and the level of awareness of digital polarization. Political orientation did have an effect on the level of awareness of digital polarization but not on the level of awareness of filter bubbles and echo chambers. Cultural aspects did not have an effect on neither of the levels of awareness.

This research had both academic implications for filling in the knowledge gap in research, and practical implications for policymakers, as the findings could help policymakers develop new strategies to increase the awareness. The findings also showed the need for media literacy, this could be more adapted in school, as learning from a young age to consume media in

a balanced way and engage in constructive dialogues could enhance their critical thinking skills, awareness of filter bubbles and echo chambers, and awareness of digital polarization. This research included some limitations as well, as it risked self-reported biased, and sample bias, which could affect the generalizability of the results. The findings of this study confirm past research that information consumption patterns affects the awareness of filter bubbles and echo chambers, and the awareness of digital polarization. However, it also denies past findings that political orientation has an effect on the level of awareness of filter bubbles and echo chambers. For further research, other factors that could influence awareness should be explored, and different approaches of the study could be taken, for example performing qualitative studies, or doing it from a technological perspective to develop tools that let individuals know their filter bubble, echo chamber, or polarization level. To be noted, that the scales of measurements could be improved, and it is advised to do so in further studies.

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Appendix

Appendix 1. Survey

Survey
Digital Polarisation

Start of Block: Informed Consent

Informed consent **Introduction and purpose:** Dear participant, you are being invited to participate in a study conducted by Stefana Pasca at the University of Twente, with the purpose of exploring the dynamic between search engine algorithms and digital polarization and how they can lead to the construction of filter bubbles and echo chambers.

Procedure: If you agree to participate, you will be asked to complete an online survey that will take approximately 5-10 minutes to complete. Most of the questions relate to search engine behaviours, diverse exposure perspectives, and political topics like climate change, abortion and so on.

Risks and Benefits: There are no anticipated risks associated with participating in this study. However, you are free to withdraw at any time without providing a reason.

Confidentiality: Your participation in this study is confidential. The information you provide will be kept strictly confidential and will only be used for research purposes. After the research is concluded all of your answers will be deleted. Your responses will not be linked to your identity and will be analysed.

Voluntary Participation and Withdrawal: Participation in this study is voluntary. You may refuse to participate or withdraw from the study at any time without providing a reason. If you choose to withdraw there will be no penalties or negative consequences.

Contact Information: If you have any questions or concerns about this study, please contact:
Stefana Pasca: s.i.pasca@student.utwente.nl
Dr. Shenja van der Graaf: shenja.vandergraaf@utwente.nl

After reading the information above, do you understand and agree to participate in this study?

- ○ Yes, I understand and wish to participate (1)
- ○ No, I do not wish to participate (2)

Skip To: End of Survey If Introduction and purpose: Dear participant, you are being invited to participate in a study conducte = No, I do not wish to participate

Page Break

dg1 What is your age in years?

_____

Skip To: End of Survey If Condition: What is your age in years? Is Less Than 18. Skip To: End of Survey.

dg2 What gender do you identify as?

- Male (1)
- Female (2)
- Non-binary / third gender (3)
- Prefer not to say (4)

country In which country do you currently reside?

▼ Afghanistan (1) ... Zimbabwe (1357)

dg4 What is the level of education you completed or are that you are currently enrolled in?

- Less than high school (1)
- High school (2)
- Bachelor's degree (University) (4)
- Master's degree (5)
- Phd/doctorate (6)

Page Break

text The next question is about your political affiliation, here are two short definitions:

Left-wing: usually advocate for individual rights, equality, social justice, and government intervention to address societal issues. They often support progressive policies, such as advocating for diversity and inclusivity.

Right-wing: typically prioritize traditional values, limited government intervention, personal responsibility, and free-market principles. They often emphasize the importance of preserving established institutions and traditions, maintaining law and order, and promoting individual liberty and economic freedom.

Please note that these are simplified definitions and political ideologies can vary across different context and countries.

---

dg6 How would you describe your political views?

- ○ Strongly right-wing (1)
- ○ Moderately right-wing (2)
- ○ Slightly right-wing (3)
- ○ Neutral (4)
- ○ Slightly left-wing (5)
- ○ Moderately left-wing (6)
- ○ Strongly left-wing (7)

End of Block: Informed Consent

Start of Block: Social Media Platfrom use

se1 Which search engine do you frequently use? (select all that apply)

- [ ] Google (1)
- [ ] Bing (2)
- [ ] Yahoo (3)
- [ ] Other (please specify) (4) _____

---

sm1 Which social media platforms do you actively use? (select all that apply)

- [ ] Facebook (1)
- [ ] Twitter (2)
- [ ] Instagram (3)
- [ ] Reddit (4)
- [ ] Snapchat (5)
- [ ] TikTok (6)
- [ ] YouTube (8)
- [ ] Other (please specify) (7) _____

End of Block: Social Media Platfrom use

Start of Block: filter bubbles and echo chambers

text 1 In this section you will be asked about filter bubbles and echo chambers which can be defined as follows:

Filter Bubble can be defined as the phenomenon where algorithms and personalization techniques used by search engines such as Google and social media platforms like TikTok, present content that aligns with an individuals' pre-existing beliefs, and viewpoints, while minimizing exposure to different or opposite viewpoints. This can result in the individual being closed in a "bubble" of information that reinforces their pre-existing beliefs, potentially limiting exposure to diverse perspectives.

Similar to filter bubbles, in **Echo Chambers** individuals tend to interact and engage with other individuals who share similar beliefs and viewpoints, creating a reinforcement feedback loop, this can lead to reinforcement of existing biases, and narrowed down perspectives because of the limited exposure to different point of views.

---

se2 To what extent do you believe search engine use creates filter bubbles and echo chambers?

	To no extent (1)	To little extent (2)	To some extent (3)	To a large extent (4)	To a very large extent (5)
Filter Bubbles (1)	○	○	○	○	○
Echo Chambers (6)	○	○	○	○	○

---

sm2 To what extent do you believe Social Media platforms can create filter bubbles and echo chambers?

	To no extent (1)	To little extent (2)	To some extent (3)	To a large extent (4)	To a very large extent (5)
Filter Bubbles (1)	○	○	○	○	○
Echo Chambers (4)	○	○	○	○	○

End of Block: filter bubbles and echo chambers

Start of Block: Viewpoints

sesm3 How often do you encounter viewpoints that differ from your own on search engines and social media platforms?

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
Search engine (1)	○	○	○	○	○
Social media platforms (2)	○	○	○	○	○

Page Break

End of Block: Viewpoints

Start of Block: Beliefs

sesm4 In your opinion, how likely are search engines and social media platforms to change someone's political beliefs (this can also include controversial topics, such as climate change, abortion etc.)?

	Extremely unlikely (1)	Somewhat unlikely (2)	Neither likely nor unlikely (3)	Somewhat likely (4)	Extremely likely (5)
Search engines (6)	○	○	○	○	○
Social media platforms (7)	○	○	○	○	○

Page Break

Q48 Take a deep breath, you are halfway done! :)

sesm5 How often do you feel search engine results and social media content align with your views or beliefs?

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
Search engine results (1)	○	○	○	○	○
Social media content (2)	○	○	○	○	○

End of Block: Beliefs

Start of Block: political engagement

se6 How frequently do you search political content (this can also include controversial topics, such as climate change, abortion etc.) on search engine?

- ○ Never (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)
- ○ Always (5)

sm6 How frequently do you engage with political content (this can also include controversial topics, such as climate change, abortion etc.) on social media?

- Never (1)
- Rarely (2)
- Sometimes (3)
- Often (4)
- Always (5)

---

sm0 Have you ever noticed different agendas for politically related topics (this can also include controversial topics, such as climate change, abortion etc.) when scrolling through different social media platforms?

- Definitely not (1)
- Probably not (2)
- Might or might not (3)
- Probably yes (4)
- Definitely yes (5)

End of Block: political engagement

Start of Block: Digital Polartisation

Q27 In this section you will be asked about digital polarization, which can be defined as follows:

Digital polarization refers to the division or polarization of individuals or groups in the digital environment. It occurs when people are separated into distinct ideological or cultural sides, with little interaction or understanding between them.

---

sesm7 In your opinion, how likely are search engine and social media platforms to reinforce digital polarization ?

	Extremely unlikely (6)	Somewhat unlikely (7)	Neither likely nor unlikely (8)	Somewhat likely (9)	Extremely likely (10)
Search engine (4)	○	○	○	○	○
Social media platforms (5)	○	○	○	○	○

sesm8 16. Do you feel that your political beliefs (this can also include controversial topics, such as climate change, abortion etc.) have become more polarized as a result of using search engines and social media?

	Extremely unlikely (1)	Somewhat unlikely (2)	Neither likely or unlikely (3)	Somewhat likely (4)	Extremely likely (5)
Search engine (6)	○	○	○	○	○
Social media platforms (7)	○	○	○	○	○

Page Break

sm9 How often have you unfollowed or blocked someone on social media due to political disagreements (this can also include controversial topics, such as climate change, abortion etc.)?

- ○ Never (1)
- ○ Rarely (2)
- ○ Sometimes (3)
- ○ Often (4)
- ○ Always (5)

Page Break

sesm10 How often do you come across misleading or false information related to politics (this can include controversial topics as well, such as climate change, pregnancy etc.) on search engines or social media platforms?

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
Search engine (2)	○	○	○	○	○
Social media platforms (3)	○	○	○	○	○

Page Break

sm 11 In your opinion, which platforms show the most polarized content? (Please rank them in order 1-most polarized 7-least polarized)

_____ Facebook (1)
_____ Instagram (2)
_____ YouTube (3)
_____ Twitter (4)
_____ TikTok (5)
_____ Reddit (6)
_____ Snapchat (7)

se11 In your opinion, which search engine shows the most polarized content? (Please rank them in order 1-most polarized 3-least polarized)

_____ Google (1)
_____ Bing (2)
_____ Yahoo! (3)

End of Block: Digital Polartisation

Appendix 2. Literature log

date	Key words	Hits	Useful for research
12-4-23	"digital polirisation" AND "echo chambers"	1	0
12-4-23	"digital polirisation"	63	3
13-4-23	"social media" AND "echo chambers"	450	1
15-4-23	"filter bubbles" AND "echo chambers"	162	4
18-4-23	"filter bubbles" OR "echo chambers"	1548	2
25-4-23	"filter bubbles" OR "search engines"	83562	1
25-4-23	"filter bubbles" OR "social media"	158349	3
25-4-23	"echo chambers" OR "social media"	158637	2
28-4-23	"echo chambers" AND "social media" OR “search engines”	457	0
29-4-23	"echo chambers" AND "awareness"	26	3
1-5-23	"echo chambers" AND "digital polarisation"	1	0
1-5-23	"echo chambers" OR "awareness"	515464	2
1-5-23	"echo chambers" AND "romania"	2	1
2-5-23	"echo chambers" AND "netherlands"	5	1
3-5-23	"romania" AND "netherlands" OR "digital polarisation"	954	5
3-5-23	"search engines" AND "social media"	2207	2
13-6-23	“Political”AND “orientation”	14779	1

Note: All articles were from Scopus