Realizing the Bubble: Young adults' Awareness and Control over Algorithmic

Information Filtering in Social Media

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Abstract

The pervasive use of social media among Dutch adolescents has raised concerns since the implementation of algorithmic content filtering on platforms like Instagram and X in 2016. Building on De Groot et al. (2023), this study examines the awareness and control of algorithms among Dutch students in higher education aged 18 to 22. Using qualitative methods, including walk-throughs and semi-structured interviews with 20 adolescents, this research explores their algorithmic awareness, imagination, power and critical evaluation. Results reveal that, while these adolescents are aware of algorithms and options to exert power, they often do not actively modify their content. Despite recognizing the negative consequences of algorithms, such as polarization and excessive screentime, many of these adolescents continue to consume content filtered by it, due to the greatest positive outcome, which is entertainment. This study also explored whether adolescents feel they are in filter bubbles, using Dutch political elections as an example. Although they primarily search for political information outside social media platforms, they also rely on social media for political information and form their expectations of election results based on personalized content. This reliance of algorithmic-filtered content highlights a gap between awareness and actions, suggesting a need for future research into underlying motivations and behaviors regarding algorithmic engagement. The results highlights questions of the sufficiency of user autonomy in content regulation, suggesting that policy might be necessary. This study contributes to understanding adolescents' interactions with algorithmic-driven platforms and can inform strategies to enhance critical media literacy.

Key words: algorithms, adolescents, social media, filter bubble, algorithmic awareness, algorithmic imagination, algorithmic power, media literacy

Het alledaagse gebruik van sociale media onder Nederlandse adolescenten heeft sinds de invoering van algoritmische contentfiltering op platforms zoals Instagram en X in 2016 zorgen gewekt. Voortbouwend op De Groot et al. (2023) onderzoekt deze studie het bewustzijn en de controle over algoritmes onder Nederlandse studenten in het hoger onderwijs van 18 tot 22 jaar. Met behulp van kwalitatieve methoden, waaronder walk-throughs en semigestructureerde interviews met 20 adolescenten, wordt algoritmisch bewustzijn, verbeelding, macht en kritische evaluatie onderzocht. De resultaten tonen aan dat, hoewel deze adolescenten zich bewust zijn van algoritmes en opties om macht uit te oefenen, ze hun content vaak niet actief aanpassen. Ondanks erkenning van negatieve gevolgen van algoritmes, zoals polarisatie en overmatig schermgebruik, blijven veel van deze adolescenten gefilterde content consumeren vanwege het grootste positieve resultaat: entertainment. Deze studie onderzocht ook of adolescenten zich in een filterbubbel voelen, met als voorbeeld de Nederlandse politieke verkiezingen. Hoewel ze voornamelijk buiten social mediaplatforms naar politieke informatie zoeken, vertrouwen ze ook op social media voor informatie en baseren ze hun verwachtingen van verkiezingsuitslagen op gepersonaliseerde content. Deze afhankelijkheid van algoritmisch gefilterde content benadrukt een kloof tussen bewustzijn en acties, wat suggereert dat verder onderzoek nodig is naar onderliggende motivaties en gedragingen met betrekking tot algoritmische betrokkenheid. De resultaten roepen vragen op over de toereikendheid van gebruikersautonomie en contentregulering, wat suggereert dat beleid nodig zou kunnen zijn. Dit onderzoek draagt bij aan het begrip van interacties van adolescenten met algoritmisch gedreven platforms en kan strategieën informeren om kritische mediageletterdheid te verbeteren.

Sleutelwoorden: algoritmen, adolescenten, sociale media, filterbubbel, algoritmisch bewustzijn, algoritmische verbeelding, algoritmische macht, mediageletterdheid

Realizing the Bubble: Young Adults' Awareness and Control over Algorithmic

Information Filtering in Social Media

A substantial majority of Dutch adolescents and young adults aged 12 to 25 engage in daily internet usage. Of these adolescents, 97% is active on one or more social media platforms (CBS, 2020a). Dutch adolescents between de ages of 18 and 25 spend an average of 166 minutes a day on social media (Jonker et al., 2024), causing them to be exposed to algorithms on a daily basis. The frequency and intensity of social media use is much higher among this age group compared to all other age groups (CBS, 2020b). Social media platforms make use of an algorithmic-based working since 2016. Since then, the order of which content is showed in one's 'feed' is determined based on users' preferences, interspersed with recommended accounts and advertisements (NOS, 2022).

Algorithmic Information Filtering

These incorporated personalized algorithms in social media affect the type of content users are presented with on their feed, together with the way this content is presented. An algorithm is "any well-defined computational procedure that takes some value, or set of values, as input and produces some value, or set of values, as output. An algorithm is thus a sequence of computational steps that transform the input into the output" (Cormen et al., 2009). A certain type of social media usage (input) creates a certain type of social media content representation (output). In addition to input due to usage of social media platforms, demographic information is another form of input: users' social media profiles often reveal their demographic information including age, gender and education (Zhao et al., 2015). To summarize, social media algorithms primarily present users with content aligned with their personal interests and demographics, based on their online behavior and what is generally suitable for others in similar demographic groups (Zhao et al., 2015).

These algorithms work in various ways. The three most common algorithms on social media platforms are the *more of the same* algorithm, the *novelty* algorithm and the *wisdom of the crowd* algorithm. The *more of the same* algorithm makes that users are presented with content similar to what they have already seen and liked before. Thus, this algorithm provides content that matches a users' interests and opinions (Dahlgren, 2021). The *novelty* algorithm ensures that social media users are shown content that is new to them and does not necessarily include their existing opinions or interests (Dumitrescu & Santini, 2015). Lastly, the *wisdom of the crowd* algorithm provides content that is considered fun or interesting among other social media users (Ratner et al., 2023).

Consequences of Algorithms

There are several potential negative consequences of using algorithmic-driven platforms. Multiple studies, such as Harriger et al. (2022), claim that social media use causes polarization. That is, differences in opinions between social media users are becoming more extreme due to exposure primarily to content that matches users' interests and opinions. This selective exposure to like-minded information can result in polarization (Cho et al., 2020; Harriger et al., 2022). This polarization-forming is supported by Mummolo (2016), which states that people are highly motivated to find and consume information that matches their interests and social identities, which leads to matching content on their social media. A consequence of identity-conforming information is that all users receive their news in different, personalized ways (Caplan & Boyd, 2016), which can result in polarization (Cho et al., 2020; Harriger et al., 2022).

Another consequence is getting stuck in so-called echo chambers. *Echo chambers –* defined as environments characterized by the sharing of specific opinion-conforming ideas, information and beliefs (Jamieson & Capella, 2008; Sunstein, 2007) – can lead to a limited exposure to diverse perspectives (Colleoni et al., 2014; Ku et al., 2019; Theophilou et al.,

2023). This concept aligns with the *filter bubble* theory, which suggests that users are systematically directed toward content that makes direct satisfaction, prolonging their time spend on that platform at the expense of other, more diverse opinions (Yeung, 2016).

This prolonged time spend on social media platforms is another consequence of using algorithmic-driven platforms. That is, algorithmic-driven platforms offers *dopamine loops*: the short videos offered by platforms such as TikTok and Instagram release short-term dopamine, causing users to keep seeking this dopamine (Yang et al., 2022). This makes it easy to lose time and fall into a vicious cycle, increasing the duration of using these platforms (Zhang, 2022).

Lastly, a possible consequence is a loss of reality. Social media users may become unaware of the dissonance between the information presented on their social media and the real state of the world (De Groot et al., 2023). This unconscious disconnect can distort their perception of reality.

Despite these negative consequences of algorithms, making use of algorithmic-driven platforms can also be perceived as positive by users. That is, due to algorithms, social media platforms offers benefits such as only seeing preferred content, resulting in a limited information overload (De Groot et al., 2023; Swart, 2021). Although previously mentioned studies state that social media causes polarization, other studies argue the opposite. Namely, because of the open access to participation of social media platforms, usage of social media forces people to gain a wide range of opinions and views (Bruns, 2019; Dubois & Blank, 2018).

News Consumption through Algorithms

The awareness of algorithmic workings is becoming increasingly important as there is a shift from gathering news from traditional news sources (e.g., newspapers or news on television) to social platforms. Adolescents regularly consume news on social media, which is

their preferred source (Notley et al., 2017). Therefore, news gathering is brought up in this study as an example to understand how young people perceive algorithms, by exploring how adolescents gather news in times of political elections. This example is chosen because social media plays a significant role during elections. For instance, in the 2016 American election, Trump and Clinton strategically utilized social media to directly influence voters (Enli, 2017). This phenomenon is also observable in The Netherlands. In the 2021 elections, political parties increased their presence on social media platforms. Parties such as FVD and CDA spend approximately 115.000 to 150.000 euros for ads on social media (De Goede & Hankel, 2021; Kasteleijn, 2021). Consequently, since ads are tailored to the personal algorithm, each social media user sees different ads from political parties, which can influence their opinion forming (Dubois & Blank, 2018). This idea of influence of algorithms on opinion forming is confirmed by the study from Levy (2021) in which it is concluded that algorithms on social media may limit exposure to counter-attitudinal news and thus increase polarization. In addition, the constant opinion-confirming content can come at the expense of social media users' critical views, allowing fake news content to continue around elections and enabling social media users to gather political misinformation (Rhodes, 2021).

Key Concepts

To explore adolescents' awareness of the existence, workings and consequences of algorithms, De Groot et al. (2023) studied algorithmic information filtering among Dutch students aged 12 to 16. Involving eighteen students, the study revealed that, while adolescents are aware of the presence of algorithms on social media, their understanding remains limited. This current study builds on the work of De Groot et al. (2023), which is why we chose to use the same key concepts.

Firstly, *algorithmic awareness* is formulated as "knowing that a dynamic system is in place that can personalize and customize the information that a user sees or hears" (Hargittai

et al. 2020, p. 771). Algorithmic awareness is often experiential and context-specific: it is constructed and understood through using social media contexts (Cotter & Reisdorf, 2020; DeVito et al., 2018). Secondly, *algorithmic imagination* is defined as "the way in which people imagine, perceive and experience algorithms and what these imaginations make possible" (Bucher 2017, p. 31). Thirdly, *algorithmic power* is the active influence social media users have on their personal algorithm, in other words, how they 'game the system' (Cotter, 2018). For example, by personalizing settings in a platform manually or by adjusting browsing behavior (Haim et al., 2017; Min, 2019; Thurman & Schifferes, 2012). By deliberately not clicking on a post, not fully watching a video or marking posts with 'not interested', the algorithm can be fine-tuned (Swart, 2021). Lastly, *critical evaluation* goes beyond the basic understanding of algorithms, but also understanding the impact of algorithmically-driven platforms on, for example, privacy or polarization (Butcher, 2018; Flaxman et al., 2016).

Current Study

For the aforementioned negative consequences associated with the use of algorithmic-driven platforms, namely polarization, echo-chambering and loss of reality, it is important for adolescents to remain critical when using social media platforms. As Buckingham (2021) states, being able to critically assess media and grasp the broader social, political and economic contexts of communication is undoubtedly fundamental to being an informed citizen. This study aims to investigate the awareness and opinions among students about algorithms employed by their social media platforms. While several studies have researched the impact of algorithms on everyday life among adults (Beer, 2016; Diakopoulos, 2014; Willson, 2019) or young adolescents (12 to 16; De Groot et al., 2023), less is known about the awareness and handling of algorithmic-driven social media platforms by young adults aged 18 to 22 years in higher education. This is what we set out to research in the current study.

As described, possible outcomes of algorithmic filtering can become apparent when it comes to the gathering of political information on social media platforms. Therefore, it is interesting to address political opinion forming and expectations to find out how aware adolescents are of algorithmic information filtering in this field. For this reason, the study includes questions about reactions to the results of the political elections to determine if there was a *bursting bubble* moment. Focusing on an older age group than the study from De Groot et al. (2023) provides the opportunity to use the topic of political issues, as this group is allowed to vote. Also, adolescents who are already further along in their academic careers have stronger and more critical opinions than the younger age group (Hunter et al., 2014). People in the age group 18 to 22 are either first-time voters or have participated in only two elections, occurring in a time where political parties extensively use social media platforms (De Goede & Hankel, 2021; Kasteleijn, 2021). In addition, occurring in a time where youngsters predominantly rely on social media for their news consumption (Kalogeropoulos, 2020), potentially shaping their political opinions and therefore voting behaviors (Witschge et al., 2016).

Research Questions

This study uses the following research question: "To what extend are Dutch students in higher education aged 18 to 22 aware of the existence and workings of personalized algorithms?". To answer this question, the following sub-questions are defined: "Are students in high education aware of the algorithmic workings of their social media, and how do they imagine such workings?" (algorithmic awareness and algorithmic imagination), "How did they learn – or not learn – about algorithms?", "What do they do to influence, resist or work around such algorithmic workings?" (algorithmic power), "How do they evaluate and reflect upon the (ethical) effect of such algorithmic workings?" (critical evaluation and algorithmic awareness), and lastly "Are they willing to look beyond their bubble?" (bursting the bubble).

Methods

A qualitative research was conducted to gain knowledge about the awareness and control of adolescents regarding algorithms. Interviews with students in higher education aged 18 to 22 were conducted. Researching this topic in a qualitative way leads to in-depth information, with the opportunity to explore context and motivation (Rich & Ginsburg, 1999).

Sample

Data collection took place in March and April 2024, either at Utrecht University, a respondents home or another neutral place, as was convenient for the respondent. Conducting interviews in a way that is convenient for respondents increased their willingness to participate. Respondents were 18 years or older on November 22, 2023, so they had the opportunity to vote at least once during the Dutch elections. The collection of respondents was done through convenience and snowball sampling. People from personal circles were approached to either participate or help finding respondents. Respondents were also collected through posts on social media platforms. Lastly, interviewed respondents gave contact information of other potential respondents. By using a convenience sampling method, we could quickly reach a certain amount of respondents without extensive time or resource. Also, snowball sampling helped to reach respondents who might not were easily accessible through direct approaches or social media, thereby broadening our sample. Finally, a number of 20 interviews with Dutch students in higher education aged 18 to 22 took place. Whether a respondent was more left- or right oriented, was decided by using the "kieskompas" (Het Politieke Landschap 2023, 2023). Respondents reported which party they had voted for in the 2023 Dutch elections. The party they reported was then placed on the electoral compass. This compass then indicated whether that party was more right, left or center oriented. This political orientation division is shown in Table 1.

Table 1

*Gender, Age, Study, Year of Study and Political Orientation of the Respondents*

Name	M/F	Age	Study, year of study	Political orientation
1. Abel	M	18	HBO Logistic Management, 1	No vote
2. Annabel	F	21	M Social, Health & Organization Psychology, 4	Right
3. Anne	F	22	B Pedagogical Sciences, 5	Left
4. Bart	M	22	M Social, Health & Organization Psychology, 5	Left
5. Dennis	M	19	B Commercial Economics, 1	No vote
6. Dunya	F	22	M Clinical Child, Family & Education Studies, 5	Left
7. Eleanor	F	21	B Psychology, 1	Left
8. Enya	F	19	HBO Chemics, 1	Center
9. Floortje	F	20	B Interdisciplinary Social Sciences, 3	Left
10. Gijs	M	19	B Economics and Business Economics, 1	Right
11. James	M	18	B Sociology, 1	No vote
12. Joris	M	22	M Youth, Education and Society, 1	Left
13. Lily	F	22	B Pedagogical Sciences, 3	Left
14. Lisa	F	22	B Pedagogical Sciences, 5	Left
15. Luna	F	22	HBO Art and Economics, 4	Left
16. Mason	M	20	B Technical Mathematics, 2	Right
17. Maud	F	21	HBO Biology, 4	Right
18. Olivia	F	20	B Psychology, 3	Left
19. Ruby	F	22	B Media and Culture, 4	Left
20. Zoë	F	22	B Psychology, 2	Left

Note. Political orientation is based on the respondents' votes by placing the party they voted

for on the electoral compass (Het Politieke Landschap 2023, 2023).

Table 1 shows the respondents along with their gender, age, study, year of study and political orientation. The distribution of political orientations of the respondents during the 2023 elections is shown in Figure 1.

Figure 1.

Distribution of Political Orientations of Respondents during the 2023 Elections
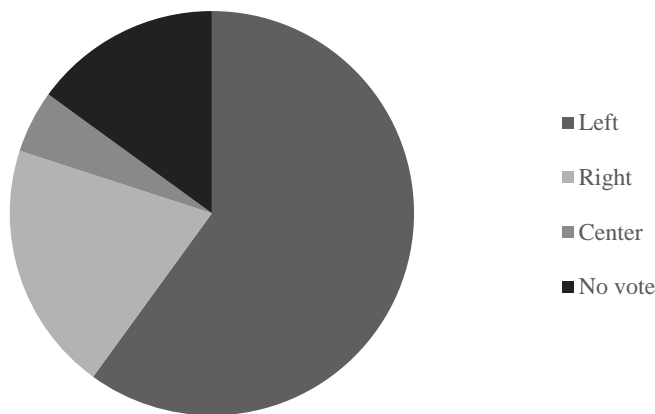
Note: Political orientation is based on the respondents' votes by placing the party they voted for on the electoral compass (Het Politieke Landschap 2023, 2023).

Figure 1 shows the respondents' political orientations devided between left, right, center and no vote. It shows that there were more respondents who voted left (12), followed by respondents who voted right (4), then followed by no vote (3) and lastly center vote (1).

Measurement Instrument and Procedure

The framework of this research is adapted from the study from De Groot et al. (2023), consisting of a walk-through (assignment one) followed by an interview (assignment two). These two research methods took place at the same time in the same setting with the same

respondent. Assignment one and two had an average time of 30 minutes in total. Assignment

one consisted of a 'walk-through' the respondents' social media platform. By using this

method (watching the respondents' social media app as it is being used), it is found out in

what ways technical mechanisms and embedded cultural references influence users'

experiences (Light et al., 2016). Respondents were first asked which platform they use the

most. The stated most used platform was then used for the walk-through. This method brought

consciousness to users' concrete interactions with algorithms, which they might normally do

not notice (Hamilton et al., 2014). It helped the respondents not only tell, but also show their

algorithm experiences, which was useful for those who found it difficult to reflect or

vocabulary articulate this topic (Light et al., 2016).

During the walk-through, the concepts algorithmic awareness, algorithmic imagination

and algorithmic power were addressed. An example of a question that addressed algorithmic

awareness and algorithmic imagination during the walk-through was "Why do you think you

see this specific – photo, video, text – ?" To cover the term algorithmic power, respondents

were asked to navigate through their platform as usual, to see how they influenced their

content. Examples of questions during this act were "Why are you doing this?" and "Why are

you not doing/skipping this?" The walk-through took approximately 10 minutes.

Following the walk-through, individual, semi-structured, in-depth interviews were

conducted. The interview consisted of four parts. During the first part of the interview, the

concepts algorithmic imagination and algorithmic power were addressed. Examples of

questions covering algorithmic imagination were "How does the platform/app do this [give

you personalized content]" and "How does – social media platform – know what you do and

do not want to see?" To address the concept algorithmic power, questions such as "If you

notice the filtering in your content, what do you do to react to this?" were asked. In the second

part of the interview, the concept of critical evaluation was addressed. An example of a

question regarding this concept was "What is your opinion about content filtering in social media?" In the third part, the concept of content filtering and political opinions were addressed. Examples of questions were "Do you think you are influenced by content filtering in making your political choice?" and "If and how did you use social media to inform yourself to make political choices?" In the fourth and last part of the interview, the concept of bursting the bubble was addressed. Examples of questions in this part were: "Did you think about filter bubbles after the election results?", "Are there other moments you realized that you were in a bubble?" and "Do you want to act on filter bubbles?" The interview ended by asking demographic data, which were gender, age, study and the political party voted for in the last Dutch election.

Data Analysis

The interviews were transcribed, followed by thematic coding using NVivo14. During the analyses, texts that concerned the themes algorithmic awareness, algorithmic imagination, algorithmic power, critical evaluation, influences on political preferences and the opinions of the working of algorithms were coded.

Ethical Review Procedure

Ethical approval was provided by the Ethical Board of the Faculty of Social and Behavioral Sciences of Utrecht University (reference number 24-0624). Prior to the interviews, respondents were asked to sign the informed consent form, which consisted of the purpose of the research together with its noncommittal and anonymous nature. That is, respondents were given fictious names which they were aware of. By signing, respondents agreed with audio recording through a recording app on the researchers' phone and using the data for this study and possibly further studies. The observations were only voice-recorded due to privacy policies. For this reason, no screenshots or videos were saved. However, the

recordings were saved on a local folder of Utrecht University and deleted from researchers'
phone.

Results

Algorithmic Awareness

During the interviews, it became clear that all 20 respondents were aware of the existence of content filtering on social media. That is, 17 respondents literally used the word 'algorithm' in their answer (without interviewer asking about algorithms), which made clear that they knew of its existence. In addition, regardless of whether they named the word algorithm, each respondent talked about how they imagine the workings of content filtering and how they might have power over this filtering. All respondents used either one or more social media platforms. That is, 18 respondents reported Instagram and two respondents reported TikTok as their most used social media platform. All respondents had comments about content filtering, indicating that they were aware of the existence of algorithms.

Algorithmic Imagination

To find out how respondents imagine, perceive and experience algorithms (Bucher, 2018), questions were asked about why and how respondents imagine they are being shown certain content on their social media platform. While watching content on respondents' social media platforms during the walk-through, questions were asked about why they are presented with certain content.

It appears that all 20 respondents see the effects of algorithmic working through their actions on social media very clearly. For instance, Zoë said: *"Yes, I do notice that quite often, that I like one thing, something specific, and then suddenly I get lots of other things from that subject."* Like Zoë, 15 respondents see the impact of liking on algorithmic modification. For example, Anne explained: *"You start liking things you like, you click on things you like, you start following things you like. Then you roll into it [interesting content]. And, and so I think it*

[content] does get more and more specific.” Next to liking content, watching posts for a longer period of time was also mentioned as influencing the type of content in users' feeds by 15 respondents. Dennis explained this: *“So if you skip that one quickly and you go to the next one, it knows you don't want that one and more of that other.”* In addition, 12 respondents mentioned they got certain content because they made use of other platforms. For example, when one uses Google, Netflix or other streaming platforms, then similar type of content can be seen back on the social media platform. Another factor that causes certain content in users' feeds, stated by 11 respondents, is following accounts existing of that same type of content. Like Lily: *“Um, I follow headscarf companies and things like that. So then I get very often … Headscarf um, content on my feed.”* It was also mentioned by 10 respondents that interacting through content (by sending and receiving posts via Direct Message influences the type of content they are presented with as well. Annabel gave an example: *“And my roommate and I have the same type … these kind of pictures [of half-naked men], I'm forwarding them all to him, so I see all kind of that things [content].”* Lastly, it was stated by eight respondents that they get certain content because they belong to certain offline groups, like living in a certain city, being a student or being of a certain age and gender.

When respondents were asked about how they knew about the workings of algorithms, 11 said they learned about it through using social media platforms themselves and seeing the effects of their social media behavior. It was also mentioned by six respondents that they saw content posted on social media that explained the workings of algorithms. In addition, five respondents mentioned that they find algorithms an interesting topic to talk about with friends and that they learned from those conversations as well.

Algorithmic Power

To gain more insight into how respondents use their algorithmic imagination to influence algorithmic filtering through algorithmic power (Cotter, 2018), respondents were

asked about what they might do to see or not see certain content. When asked about reasons for scrolling through content quickly or using the 'not interested' button (i.e., actions that make certain content less frequent), it appears that respondents are not particularly engaged in influencing their algorithm. That is, to avoid unwanted content, 15 respondents explained they scroll past the content quickly. It was not mentioned that this fast-scrolling is used as a way to influence the algorithmic filtering, but more about not seeing the content at that moment. Five respondents mentioned that they were 'too lazy' to use the 'not interested' option. However, nine respondents told that they sometimes – but rarely – use the 'not interested' option, but use the fast-scrolling method more often when they are not interested in the content.

When asked about reasons for liking, commenting, forwarding or saving a post (i.e., actions that make certain content more frequent), no response indicated respondents did so to influence the algorithm. No respondent said they do so with influencing the algorithm in mind. Instead, 11 respondents said that the reason to like or comment is because they generally like the post or know the person of the post personally. The reason behind forwarding is for nine respondents to show friends or family what they saw. Lastly, saving posts is never mentioned to be a strategy to have power over algorithms, but more to be able to look at it again, according to five respondents. Luna explained her actions:

"I do that somewhat less consciously: if I find something funny, I like it, if I like something or someone I grant it to, I like it. If I want to share something with my friends, I forward it. If I just want to see something again later, I save it. And if I find something funny, I just watch it longer."

Critical Evaluation

To find out about the opinions and understanding of the impact of algorithmically-driven platforms (Butcher, 2018; Flaxman et al., 2016), respondents were asked to talk about their experiences. When asked about respondents' feelings about algorithms, 15 respondents mentioned they had mixed feelings. That is, seven respondents literary said they experienced algorithms positive as well as negative. Like Ruby: *"I really have a love-hate relationship with that [algorithm]."* The other eight respondents made their mixed feelings clear by mentioning positive and negative effects of algorithms during different parts of the interview. Negative and positive opinions will be explained separate.

Negative Sides of Algorithms

When asked about personal consequences due to algorithms, 15 respondents mentioned that it is very easy to stay on the platform too long because of the exposure to personalized content. This is considered by the respondents as being a negative effect of algorithms. Joris explained:

Interviewer

"And for you, what could be a consequence for you?"

Joris

"For me? Well I think the main consequence of algorithm is staying on the apps for too long I think. That the apps kind of suck you in and then you stay in that vacuum or something like that."

Interviewer

"And what do you find negative about that?"

Joris

"Well, I can better spend my time on more fun and useful things."

According to six respondents, this keep-scrolling behavior is the reason behind the algorithm: because users see more advertorials on the platform. Bart explained this way of generating profit through algorithms: *"The longer you are on the platform and the longer you look ... the more ads they can sell. So they just want you to keep looking. And keep scrolling more and then they can throw more ads in between."* Interestingly, TikTok is perceived differently than Instagram, sometimes as more 'addictive', according to 10 respondents. Like Floortje:

Interviewer

"Why did you delete TikTok??

Floortje

"Because I found it very addictive. I lost track of time. But with reels (Instagram) I'm more likely to get bored because I just ... relate less to the content. With TikTok, they know exactly what I want to see, it just was so accurate. With Instagram I don't have that as much."

Next to personal consequences of algorithms, it was asked about possible consequences of algorithms for the society. Among the respondents, 13 of them indicated that they were concerned about the impact of algorithms on society. Respondents mentioned they think opinions can get more extreme due to constant confirmation of one's own opinion, creating more difference between people. Like Mason:

Mason

"... You're seeing that more now that there's more and more extreme left and more and more extreme right."

Interviewer

"Would you say that algorithm is contributing to that?"

Mason

"Yes, sometimes it does, I guess ... those people [who comment very different opinions on a post], have very different For-You pages than I have."

Nine respondents mentioned that a negative consequence of algorithms is unconscious bubble formation. On an interesting note, when they talk about unconscious bubble formation, they are talking about other people being unaware. In doing so, they consider themselves to actually be conscious of this bubble formation. Next to this idea of polarization due to algorithms, 10 respondents expressed that they find the algorithm scary or get a bad feeling about its existence because the algorithm knows so much about them. Like Joris: *"That advertisement is also very scary actually ... just that they know so much about you ... Maybe they know more about you than you do. That's kind of scary."* In addition, five respondents even reported thinking that offline conversations are recorded by their mobile device. Another negative consequence that was mentioned by eight respondents is that because of their content being specifically catered to their taste, they missed out on other content due to algorithms. Like Maud mentioned: *"Sometimes I was told ... "you're living under a rock", because maybe it's influenced by the fact that my content is almost only horses, that I don't get anything from the rest of what's going on."* Interestingly, two respondents actually acted on this awareness of the consequences of opinion amplification and information-missing through algorithms. For example, Joris felt that he did not want to manipulate Instagram too much, because otherwise he would get too much into his *"own little world"*. Despite his concerns, he mentioned that also his content is much focused on his opinion.

Positive Sides of Algorithms

It was asked if respondents would turn of their algorithm. Interestingly, 14 respondents expressed no interest in turning it off, despite seeing negative consequences of the existence

of algorithms. The other six respondents expressed an interest in giving turning off the algorithm a try. This possibility to turn off the algorithm on Instagram and Facebook is available since 2023. A user can now manually turn off the algorithm and will no longer receive personalized recommendations. The feed will be in chronological order and no more content will be shown from accounts you do not follow. Also, search results will then be based only on what you type (Vischjager, 2023). The 14 respondents mentioned that they did not want the personalized recommendations gone, because the platforms will be less attractive to be on. Like Eleanor:

"No. No. No. Although then I might have a little more peace of mind that I know that they don't save anything [personal information]. But then I think … why should I be on it? If they're not going to show me what I like … the point of the app is gone for me then."

Respondents were aware of the fact that algorithmic-driven platforms makes that users' input creates a certain output. Lisa, for example, made the conscious decision of not following the news intensively on social media and therefore gets little to no news on her social media platform: *"Because otherwise I'm going to be very sad about that news."* Also Bart told his positive experience with algorithms: *"Hip mobility … I find that interesting … I get quite a lot of that now. I really like that. Because every now and then I find a new exercise … And the algorithm makes sure you see that."*

Two respondents also talked about the positive consequences of algorithms for the society as a whole. They explained that through the algorithm, minority groups can better meet each other and create their own *"little thing"*. For example, it can provide support, namely the fact that you can meet people you otherwise would not talk to.

Bursting the Bubble

We were interested to learn if, through algorithmic filtering, respondents had the experience to be in a bubble and also to reflect on moments in which they realized they were in a bubble. When talking about so-called 'filter bubbles' and 'bubbles' in general, it is important to know how respondents view this term, so that there is alignment on this term and the answers are valid. Respondents explained filter bubbles in similar ways, summarized as that a filter bubble is content filtered for you personally, where you only encounter certain content and that it makes information outside the bubble difficult to access. This is the same explanation of (filter)bubbles in current research. To find out how respondents experience and see these bubbles in general, they were asked if they could name an example in which, outside of algorithms, they realized they were in a bubble. Respondents indicated or showed they had to think about this for a while, but 19 respondents eventually gave an answer. Remarkably, seven respondents mentioned a somewhat same answer, which is that they indicated a big difference between where they grew up and where they now live and study, hereby naming differences between a (small) village and the city. Like Ruby: *"I'm in a friend group where certain things are much more normal than where I'm from. And when I then go from that group of friends [from hometown] to them, I feel … that I can have very different behavior."*

Bubbles and Politics

Now that there was consensus on the concept of filter bubbles, we were curious to know if respondents believed they themselves were in a filter bubble. To find out, the topic of politics was brought up as an example. Respondents were asked if they felt surprised at the election results or whether they saw the results coming. Noticeable was that all 12 of the more left-leaning respondents indicated that they did not see the results coming and realized they were in a 'left-wing filter bubble', like Bart: *"I think you do realize very much that you're in a left-wing student bubble. That you do feel like, oh, there are really so many people who are*

right-wing [after election results]." The eight more right-leaning or center/no voting

respondents, did not indicate that they were surprised by – or actually expected – the results.

      However, respondents were sufficiently aware that social media presents information

in a certain way, leading them to seek political information outside of social media. Like

Maud: *"I did that voter guide. Really completely without being influenced by others. I also*

read all the election programs that I felt somewhat interested in. I made my choice based on

that." Lisa also said: *"... I trust those sources [voting guides] more."* In addition to Maud and

Lisa, 13 other respondents indicated that they used a voter guide ('kies/stemwijzer'),

independent of social media, to make their political voting decision. Although respondents

indicated that they did not specifically search for information on political elections on social

media, 11 respondents mentioned that they followed accounts on Instagram to gather political

information. For example @checkjestem. This account posts motions with an overview which

parties are pro and which parties are against these motions. For example the motion "Royal

family must also pay income tax" (Check je stem, 2024).

      Although these respondents explained that they see these pages as neutral without

influences of algorithms, nine respondents stated that they probably were – sometimes

mentioned 'unknowingly' – influenced by algorithms when it came to having political

opinions. That is, seven of these respondents mentioned that they come across more

information on their social media accounts that fits their political orientation than seeing

opinions contrasting to theirs. Like Gijs: *"They wouldn't be able to see the different parties. If*

you only liked GroenLinks, then you only get to see ... left-wing parties, which actually puts

you in a ... thinking corner. And the same goes for the right." Using the example of the

elections, it became clear that 12 respondents realized they mostly saw content that matched

their opinions on social media and existed in a filter bubble.

Discussion

In this section, we will discuss the meaning of the results and suggestions for future research. The results are used in order to answer the main question: "To what extend are Dutch students in higher education aged 18 to 22 aware of the existence and workings of personalized algorithms?"

Algorithmic Awareness, Algorithmic Imagination and Algorithmic Power

The results show that all these adolescents have some degree of *algorithmic awareness* (Hargittai et al. 2020) and are able to *imagine* (Bucher, 2016) the workings of algorithms. According to these adolescents, liking content impacts their feed the most, followed by viewing time, then searching behavior and lastly following certain accounts. Performing these actions on social media platforms, according to them, generates the same kind of content as they saw before. This aligns with the *more of the same* algorithm (Dahlgren, 2021). Additionally, these adolescents recognize that they receive content popular among their demographic, consistent with the *wisdom of the crowd* algorithm (Ratner et al., 2023). When it comes to *algorithmic power* (Cotter, 2018), the results show that these adolescents are not actively modifying their algorithm. Interestingly, unlike the younger users of De Groot et al. (2023), they do not engage in liking, forwarding or watching content longer to influence the algorithm. When encountering unwanted content, they are quicker to scroll through than to actively click 'not interested', despite knowing this option exists. This lack of effort to shape their algorithms connects to Yang et al. (2022) and Zhang (2022): the quick dopamine hits from short content on social media platforms may make indicating preferences feel too time-consuming.

These adolescents primarily gained information about algorithms through using algorithmic-driven platforms, aligning with Cotter & Reisdorf (2020) and DeVito et al. (2018). Similar to the young users of De Groot et al. (2023), their knowledge comes from social media use. However, unlike the young users from De Groot et al. (2023), these

adolescents also learn through discussions with friends, recognizing the impact of social media and critically discussing its functions and consequences. This aligns with Hunter et al. (2014), which found that that adolescents further along in their academic careers exhibit more advanced critical thinking skills compared to those who are earlier in their academic journeys.

Interesting is that despite these adolescents' awareness and understanding of algorithms and how to have power over it, they choose not to take active steps to modify their content. This suggests a gap between knowledge and action. Given that users of this study are aware of certain options to influence the algorithm, it is important to understand why they refrain from taking these actions. It would be valuable for future research to explore users' motivations and behaviors regarding algorithmic engagement.

Critical Evaluation

In terms of *critical evaluation* (Butcher, 2018; Flaxman et al., 2016), the results indicate that these adolescents have mixed feelings about algorithms, both negative and positive. A negative side of algorithms, according to them, is that algorithm makes them spend too much time on social media, aligning with Zhang (2022). Most of these adolescents understand that algorithmic-driven platforms aims to maximize user time for advertising. Yet, they continue using these platforms despite disliking this profit model. Another factor that is perceived as negative by these adolescents is the feeling that algorithms cause polarization and sometimes make them miss information by only seeing what interests them. This aligns with studies by Levy (2021) and Rhodes (2021). Additionally, some of these adolescents find it unsettling to notice that platforms know so much about them by showing content tailored exactly to their preferences. The main positive aspect to algorithms, according to these adolescents, is that it is it pleasing to see content that they find enjoyable, entertaining and interesting. It is seen by them as a form of entertainment.

Interestingly to notice is that this one positive side of algorithms stand out over the negative sides if it is up to these adolescents. In fact, while some adolescents do think it can be interesting to see other content than solely opinion- and interest conforming content on social media, most of them are not willing to turn off their algorithm. This raises a fundamental question: why do adolescents persist in using algorithmic-based platforms despite their desire to reduce screentime and awareness of its potential negative outcomes? Future research could focus on underlying motivations that drive adolescents to continue using algorithmic-driven platforms, regardless of their critical views of negative outcomes. By examining these motivations, we can gain a deeper understanding of adolescents' social media behavior. Strategies could then be developed aimed at promoting healthier digital habits and decisions.

Bursting the Bubble

To gain a deeper understanding about how adolescents perceive and navigate algorithmic filter bubbles, we examine their perspectives using the Dutch political elections as an example. The results show that these adolescents were aware of the potential bubble-formation on social media, especially in political contexts. In fact, some even acknowledged being in a bubble, as they were unaware of the significant presence of people with different voting behaviors than their own. That is, left-leaning adolescents were surprised by the election results in which the right prevailed. This highlights their limited exposure to differing viewpoints on social media, consistent with findings form several studies (Caplan & Boyd, 2016; Colleoni et al., 2014; Ku et al., 2019; Theophilou et al., 2023).

Because of these adolescents' awareness of algorithms on social media, most of them deliberately sought political information from sources outside of social media to mitigate algorithmic influences. This awareness shows that these adolescents are mindful of the consequences of algorithm, namely polarization, falling into echo chambers and missing

information (Cho et al., 2020; Colleoni et al., 2014; Harriger et al., 2022; Theophilou et al., 2023). Interestingly, despite their awareness, the majority of these adolescents still use social media to gather political information, namely comparing parties when it comes to motions and even unconsciously forming expectations about election results. This behavior shows a kind of unconsciousness, even though they know that algorithms ensures a certain way of placing content in the users' feed. Future research would benefit from investigating the factors that lead adolescents to trust and rely on social media for information gathering, despite their awareness of algorithmic biases and limitations in exposure to diverse viewpoints. This is especially interesting given the fact that these adolescents do have critical views on the influence of algorithms on information gathering. Also, the fact that these adolescents are aware of algorithmic consequences yet continue to use them, raises the question of whether user autonomy is sufficient.

To summarize, the results reveal that Dutch adolescents in higher education aged 18 to 22 are 'aware of the unconscious': they try not to be influenced by algorithms, yet know that they are, in fact, probably being influenced. Despite recognizing negative consequences of algorithms – mainly polarization and excessive screentime – these adolescents still also rely on social media for information and expectations. They do so without exerting power over the algorithm, revealing a gap between awareness and action. These results highlight the need for future research. That is, research is necessary to find out why adolescents do not take action to have power over the algorithm, despite knowing about the options to do so. Also, it should be explored what factors lead adolescents to trust social media. Understanding what motivates adolescents to continue using algorithmic-based platforms despite negative consequences is crucial for creating strategies for healthier habits and decisions. Moreover, the infrequent use of options to influence or partially disable algorithms raises a question: should autonomy in content regulation solely depend on users, or is policy intervention needed? In addition, it is

intriguing to explore if being in filter bubbles is inherently negative, or whether mere awareness of their existence, as seen in these adolescents, can reduce the potential negative impacts of algorithms.

Limitations

We should be aware that this study recruited respondents through convenience and snowball sampling, which possibly created a sample bias: individuals might already were interested in or knowledgeable about algorithmic information filtering. Moreover, because this study has a qualitative design and used audio-recording, respondents' answers might be influenced by socially accepted behavior or expectations. In addition, this study focused on a specific population group in the Netherlands. Because of these limitations, findings may not be representative of the broader population. However, despite these limitations, this study fills a gap in the literature on finding the opinions of Dutch adolescents in higher education on algorithmic information filtering. This allows for follow-up research that builds on the valuable information found in this study.

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