News for you!

News consumption in the digital society

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Chapter 3

Online news consumption

The interplay between consumer, content, and context features

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Abstract

The complexity and diversity of today's media landscape provides many challenges for scholars studying online news consumption. Yet it is unclear how news consumers navigate online. Moving forward, we used a custom-built browser plug-in—passively tracking Dutch online news consumers 24/7—to examine how context features (website) and content features (news topic) affect patterns of online news consumption. This resulted in a data set containing more than 1 million Web pages, from 175 websites (news websites, search engines, social media), collected over 8 months in 2017/18. We used automated content analysis to retrieve news topics, and estimated Markov chains to detect consumption patterns. Our findings indicate that news consumers often directly visit their favorite (typically mainstream) news outlet, and continue browsing within that outlet. We also found a strong preference for entertainment news over any other topic. Although social media often offer entertainment news, they are not necessarily the starting point to such news.

Introduction

Being informed about important and relevant public issues is essential for a well-functioning democracy. News media play a crucial role in providing people with diverse, multifaceted perspectives on political and public issues (Eveland & Schmitt, 2015). Recently, the very nature of news consumption has changed drastically as people increasingly use the Internet as their primary news source (Newman, Levy, & Nielsen, 2019). The Internet offers an enormous amount of available information sources and channels, as well as greater opportunities for interaction and co-creation among news consumers. As a consequence, people increasingly find and access online news not only directly via news media organizations' own websites, but also via a great range of other pathways, including search engines and social media (Nielsen & Schrøder, 2014). People actively combine these different websites into complex patterns of media use. More importantly, patterns of news consumption also vary depending on the topic people are informed about (Kleppe & Otte, 2017; Nielsen & Schrøder, 2014). Scholars are concerned that people may predominantly consume entertainment news while neglecting political information online (see e.g., Pearson & Knobloch-Westerwick, 2018).

The shift toward online news consumption has not only had a fundamental impact on consumption patterns, the multitude of different pathways and topics also represents many challenges for researchers studying news use today. Previously, most research methods analyzing online news consumption focus on recalled user behavior by survey, diary, or interview methods (e.g., Taneja, Webster, Malthouse, & Ksiazek, 2012; Tewksbury, 2003). Self-reports may, however, be less accurate as some people tend to over-report news usage, because it is socially desirable or it is hard to recall content they consumed (Prior, 2009). Recently, more accurate avenues for studying online news consumption have opened up. Such approaches include analyses of log files (i.e., visit records) provided by website owners (e.g., Menchen-Trevino & Karr, 2012) or passive tracking through third-party panels (e.g., Glenski, Pennycuff, & Weninger, 2017). However, these approaches do not always provide insights into the actual individually encountered information and the access to information via different media (for a detailed overview, see Haim & Nienierza, 2019).

To overcome this limitation, we deployed a custom-built browser plug-in (collecting Web activities 24/7 of a group of Dutch respondents), to (1) passively track online media use, and (2) analyze the way news consumers find and act upon a wide range of online news outlets, search engines as well as social media, and news topics, and (3) retrieve a more detailed picture of online news consumption. We focus on browsing behavior on desktop and laptop computers. By means of this innovative research method, we aim to better understand how people navigate today's media landscape; also, whether it makes selection of particular news topics (e.g., politics, business, entertainment) more likely. More specifically, we focus on the following question: To what extent do *context* features (i.e., the type of website) and *content* features (i.e., the news topic) affect patterns of online news consumption? In the remainder of this article, we consider the *type of website* in which the news item was encountered (news website, search engine, social media) as a context feature, whereas content features refer to the *actual topic* of encountered news items (e.g., politics, entertainment).

To make sense of the patterns of news use online, we applied Markov models to passively tracked user data. Markov chains allow us to examine the sequence of news-related pages a user is visiting. We already know from television-viewing behavior, for example, that it is at least partly shaped by lead-in and lead-out effects: watching a given television show can make it more likely to watch the show prior and subsequently on the same channel (Wonneberger et al., 2012). Previous work by Moeller, van de Velde, Merten, and Puschmann (2020) has illustrated that Web users can also be distinguished based on certain modes of news use online (e.g., using search engines to access news online). Despite this, there are several gaps in our knowledge about the complex patterns of media use, particularly the interrelation between

news websites and topics. Using a Web mining approach, this study fills this gap with an in-depth understanding of the sequentiality of online news consumption, by focusing on the following: (1) online user behavior, (2) context features (i.e., the type of website), as well as (3) content features (i.e., the news topic).

This study contributes to the literature in two important ways. First, our findings improve our understanding of gatekeeping processes in an online news environment. As people are less restricted by traditional gatekeepers, news users have to find their way through a complex world of information as they navigate online (Pearson & Kosicki, 2017)—a challenge they increasingly solve by relying on algorithmic agents (Thurman, Moeller, Helberger, & Trilling, 2019). In the current study, we examine whether people use social media and/or alternative media outlets to access more news online. Second, this study offers an empirical confirmation of how content and context features of online media interact in affecting how people consume news.

Theory

The Internet has brought various changes to the way people consume news, as it (1) allows people to have increased control over the news they select; (2) provides a wide variety of sources to keep informed about public issues; and, (3) changes the gatekeeping process so that it is less controlled by traditional media (see Majó-Vázquez, Cardenal, & González-Bailón, 2017). According to gatekeeping theory, gatekeepers "facilitate or constrain the diffusion of information as they decide which messages to allow past the gates" (Shoemaker & Vos, 2009, p. 21). For decades, traditional gatekeepers (e.g., journalists, print and broadcast media organizations) exercised control over what information reached society and how social reality was framed (Shoemaker & Vos, 2009). In recent years, however, gatekeeping tasks are increasingly carried out by non-journalistic actors and platforms (Wallace, 2018). For example, individuals contribute to news coverage on social media (e.g., uploading media) and alternative news outlets (e.g., BuzzFeed, The Huffington Post) compete successfully against traditional news outlets for power over the public agenda (Fletcher & Park, 2017). Additionally, news users increasingly rely on algorithmic agents (Thurman et al., 2019): Google's algorithm compiles our search results, news websites recommend us certain news content, and Facebook's news feed algorithm compiles our daily dose of news. In this way, algorithmic selection can increase personalization, individualization, and customization (Shin & Park, 2019). Welbers and Opgenhaffen (2018) indeed found that news organizations'

Facebook pages can have a strong influence on the diffusion of news items on Facebook. All in all, algorithmically driven technology is drastically revolutionizing society and becoming an integral part of everyday life.

As a result, news is mostly free to access and people consume individual news items from a number of different outlets, accessed via a variety of pathways (Pearson & Kosicki, 2017). Hence, the Internet has resulted in a complex labyrinth of information, in which the options for news consumption are almost infinite (Pearson & Knobloch-Westerwick, 2018).

With the rise of online news consumption, various scholars have proposed alternative frameworks and metaphors to supplement gatekeeping theory. Bruns (2005) introduced the concept of *gatewatching*: "the observation of the output gates of news publications and other sources, in order to identify important material as it becomes available" (Bruns, 2005, p. 17). In other words, *gatewatchers*, for example on social media, monitor the content coming through the gates from journalism and share it with specific audiences.

To make sense of the patterns of news use online, Thorson and Wells (2016) developed a framework for mapping information exposure. Using the concept of curated flows, they outline how news flows are curated by various actors, such as social networks and algorithms. Although every user's experience is unique—given the complexity of the information environment today—it is important to discover trends and patterns within algorithmically curated media environments (Thorson & Wells, 2016).

To retrieve a more detailed understanding of these trends and patterns, Pearson and Kosicki (2017) sought to supply a way-finding framework. They describe the online news process as a news users' journey from the moment they arrive on the Internet through the necessary choices they undertake to arrive at the news content they want. One key assumption of the way-finding framework is that news consumption is increasingly passive (Pearson & Kosicki, 2017), as people are simply wandering or browsing through the Internet and can be incidentally exposed to news (e.g., via social media, see Gil de Zúñiga, Weeks, & Ardèvol-Abreu, 2017). Additionally, news users encounter and consume news items from multiple news outlets, not because they have not found one they are satisfied with, instead they desire and appreciate the ability to gather information from a variety of news outlets depending on the topic and occasion (Pearson & Kosicki, 2017).

A high-choice media environment: Cause for concern?

The availability of a wide variety of news outlets has raised concerns about the democratic implications of such a high-choice media environment. According to Prior (2007), people's

preferences have become more important predictors of news outlets and content they expose themselves to. "The greater media choice there is, the more selective people have to be; and the more selective people have to be, the more important their preferences become" (Strömbäck et al., 2018, p. 2). It has never been as easy for people highly interested in politics to decide when, where, and through which outlet(s) they consume political news. For people less interested in politics, however, it has become easier to decide—either intentionally or incidentally—whether they want to expose themselves to political news. In this way, increased media choice enables some to easily avoid (political) news content all together (Prior, 2007). Another concern is that commercialized news media increasingly seek to grab attention with entertainment news to capture the attention of news readers (Tandoc, 2014). Hence, the growing offer of (and interest in) entertainment news seems to precede the offer of (and interest in) political news (de Waal & Schoenbach, 2010).

Although such concerns exist, theoretical and empirical assumptions about online news consumption and its implications often ignore the combined influence of two important components which are of decisive influence online: context features and content features (Orellana-Rodriguez & Keane, 2018). We argue that these two main categories of features should be explored in understanding patterns of online news consumption. Context features can relate to *how* the news is accessed (e.g., search engines, social media). Content features concern *what* is written in a news item; for instance the topic of the news item (e.g., politics, business, entertainment). In the following, we discuss the existing literature before drawing hypotheses to test to what extent context features and content features interact in today's media ecosystem.

Context features

First, the context in which online news is consumed is of great importance as our media system is becoming increasingly hybrid (Chadwick, 2013). Previous studies elaborated on the notion of context in many different ways, ranging from different popularity cues (Haim, Kümpel, & Brosius, 2018) to different accompanying user comments (Anderson, Brossard, Scheufele, Xenos, & Ladwig, 2014). In a recent study, Orellana-Rodriguez and Keane (2018) capture the context surrounding the posting of a news-tweet. In this way, context features relate to the conditions in which the tweet is posted, such as time and day of publication, location of the author, or geographical focus of the tweet. In line with recent work by Haim and Nienierza (2019), we address context as the way in which users encounter news. More specifically, we consider the type of website in which the news was encountered (e.g., news website, search engine, social media) as a context feature.

Using a gatekeeping model, a news user arrives at a news websites' home page and subsequently selects a news item of interest from those available. The gatekeeper, in this case the journalist, editor, or recommender system (Moeller, Trilling, Helberger, & van Es, 2018), selects the news items a news consumer can choose from online (i.e., the headlines on the news website). On the contrary, Pearson and Kosicki (2017) suggest that a news user can also read news via a search engine or social media platform, and browse through stories based on their interests, searched keywords, or network. For instance, by searching and subsequently selecting a certain news item in a search engine, the news user can be redirected to a news website. In this way, the user is directed straight to the news article, and does not visit the website's home page. Thus, rather than choosing from a collection of news articles made by a journalist (the gatekeeper on the news website), a news user selects from a compilation of news items from a variety of sources pulled together by a search engine.

To understand this process, Newman et al. (2019) examined how citizens encounter online news. Overall, online news consumers are most likely to access news by going directly to a news website or app (29 percent), and to a somewhat lesser extent through search engines (25 percent) and social media (23 percent; Newman et al., 2019). However, they found very significant country differences (e.g., due to market size, competition, and regulation). The results indicate that online news consumers in countries like the United States and Canada use many different routes to online news content. Interestingly, online news consumers in countries, such as Finland, Norway, Sweden, and the Netherlands, were far more likely to access news by going directly to a news website or app, and to a lesser extent through search engines and social media. This is in line with results by Kleppe and Otte (2017), who explored online behavior in the Netherlands, and found that 59 percent of the news items that were read on news websites were accessed via a news website's home page, indicating that this is still the main driver of traffic to news items. Particularly, traffic to mainstream news websites from, for example, search engines accounts for a very small fraction of their total traffic. Recent work exploring users' pathways to online news indicate that—despite the rise of search engines and social media—direct access to a news website (i.e., the homepage) remains the most important gateway to online news. All in all, there is evidence that most online news consumption results from individuals visiting a news website's homepage (Flaxman, Goel, & Rao, 2016).

Yet, most previous studies, as the Digital News Report (Newman et al., 2019), relied on respondents' self-reported measures in retrieving survey, diary, or interview data (see also Tewksbury, Weaver, & Maddex, 2001), while various scholars asserted that media use is often overestimated (Prior, 2009). The shift toward online news consumption has not only had a fundamental impact on consumption patterns, the multitude of different pathways and topics

also represents many challenges for researchers studying news use today. Since users encounter news in many different ways, it is more challenging for respondents to reliably self-assess exposure to news online. Hence, we expect that news consumers' actual online behavior may show a more accurate picture. Based on previous work, we expect the following:

H1: *News websites are more likely to serve as an entry-point to access news online compared to search engines or social media.*

Another critical issue facing online news consumption is defining which news experiences tend to inspire follow-up actions, such as searching for additional information (Nielsen & Schrøder, 2014). Online information is more immediate, as information can be consumed at any time and in an interactive way; for example by finding more information via hyperlinks (Strömbäck et al., 2018).

As news users increasingly shift their attention to online news and traditional circulation declines (Franklin, 2008), it is increasingly important to understand what websites news users access throughout their journey. Following the uses and gratifications tradition, news users actively select among news outlets based on their ability to gratify their needs for information, entertainment, social interaction, and self-expression (Diddi & LaRose, 2006; Lee, 2013; Ruggiero, 2000). Different news consumption *motivations* lead to different news consumption *choices*. News users seeking social interaction are more likely to use Facebook and Twitter, whereas opinion validation is motivational to consume news from national newspapers and broadcasters (Lee, 2013).

Recent work has demonstrated that news content differs considerably between tabloid, broadsheet, regional, and financial newspapers (Boukes & Vliegenthart, 2020). Broadsheets and tabloids, for example, often not have a divergent news agenda, different journalistic values and styles, and a specific target audience. Besides a diverging identity, Richardson and Stanyer (2011) found that tabloid and broadsheet online newspapers differ in the way that news users use the interactive opportunities (e.g., message boards, polls, chat rooms) to express themselves.

Although previous work has focused on what type of websites have been accessed (as filling out surveys can be very labor-intensive; Newman et al., 2019), it remains unclear how likely it is for people to change from one particular website to another website (e.g., changing from a search engine to a specific news outlet). By deploying a custom-built system, we aim to understand how people combine different websites into complex patterns of media use, and how social media and search engines affect this process. This allows us to depict a

comprehensive picture of citizens' media use and news consumption rather than focusing on one specific outlet at a time. By exploring this process as a *news user journey*, which according to Pearson and Kosicki (2017, p. 1090) can be defined as: "guiding the news user from the moment they arrive on the Internet through the necessary choices they undertake to arrive at the content they want", allows us formulate the following research question:

RQ1: *How do news consumers combine different outlets (e.g., news websites, search engines, social media) while browsing online?*

Content features

Beyond *how* news is accessed online, the online news experience also varies depending on *what* type of news is accessed (i.e., news topics; Nielsen & Schrøder, 2014). In a high-choice media environment, politics constantly competes with entertainment (Prior, 2005); as many people generally prefer the latter (Prior, 2007). Entertainment news—as opposed to political news—refers to news that lacks a policy component; rather it includes subject matters such as crime, disaster, celebrities, and sports (Baum, 2002). Tewksbury (2003) conducted a survey in the U.S. to examine the topics people select at online news websites. The results indeed indicate that online news users choose to read about politics and public issues less frequently, compared to news about sports, arts, and entertainment. Since both entertainment and political news are available on numerous websites, people's content preferences become key to understanding online news consumption (Prior, 2005). For example, politically interested people are able to access more information and increase their political knowledge, and those who prefer non-political content can easily escape the news, pick up less political information, and opt for more entertaining options (Sunstein, 2007).

Gatekeepers (e.g., news organizations, journalists) have a strong impact on citizens' awareness of political and public issues, as they decide which events are covered and how these events are described in news messages (Chong & Druckman, 2007; Welbers et al., 2018). In our current high-choice media environment, self-selection of news become more prominent. In other words, citizens are less guided in their news consumption by traditional gatekeepers. Self-selection of news has been often discussed by previous work and shows that self-selection is particularly important for selecting specific topics (Bennett & Iyengar, 2008; Iyengar & Hahn, 2009; Pearson & Knobloch-Westerwick, 2018). This strand of research notes that politics constantly competes with entertainment news (Prior, 2005). More specifically, as a vast amount and almost endless stream of news is provided online, it allows people to consume news content that matches their individual interests and needs, which in turn might increase opportunities to select mainly entertainment content and avoid political

news; thereby leading to a decrease in political news consumption, which may have detrimental effects on political knowledge and political engagement.

However, conversely, people might still inadvertently consume news and information on the Internet when they are not actively seeking it. More self-selection does not always lead to more control (i.e., power over users' news consumption). People can be exposed to information while reading news on other topics or navigating online for non-political purposes (i.e., "people inadvertently consume news and information on the Internet when they are not actively seeking it", Tewksbury et al., 2001, p. 2608), so-called 'incidental exposure'. In the same way that people receive general news and information either intentionally and incidentally (Beaudoin, 2008), it is likely that when people use the Internet they will unintentionally be exposed to news and information about politics. Online news websites offer hyperlinks to related stories and enlightening readers about the interconnection of many news events. Accordingly, when people start a Web session, it is possible they may encounter news items or political information without the motivation to become informed (Y. Kim, Chen, & Gil de Zúñiga, 2013). Tewksbury et al. (2001), using survey data, already indicated that the more frequently people went online, the more likely they were to report incidental news exposure. In turn, incidental exposure is positively associated with both offline and online political participation (Y. Kim et al., 2013), as well as knowledge about counter-attitudinal political information (Lu & Lee, 2019).

It is yet unclear how likely it is for people to change—either intentionally or incidentally—from one particular topic to another topic (e.g., changing from entertainment news to political news). Therefore, we formulate the following research question:

RQ2: *How do news consumers combine various news topics (e.g., politics, business, entertainment news) while browsing online?*

The interplay of context and content features

Besides examining context and content features separately, we also look into their interplay. Research indicates that certain topics in the news are more likely to be accessed through one pathway over another (Pew Research Center, 2017). Then, another question that arises is whether particular pathways to news are able to support exposure to particular news topics, such as political news (Pearson & Kosicki, 2017). Focusing on both context and content features allows to understand how different types of news websites and topics set the boundaries for a media environment (see e.g., Elenbaas, de Vreese, Schuck, & Boomgaarden, 2014).

Exposure to information and news stories increasingly occurs through online social networks (Bakshy et al., 2015). According to a recent study of Newman et al. (2019), Facebook and Twitter are used by many users to discover news, which is eventually discussed via messaging apps such as WhatsApp. Such networks have the potential to expose users to more diverse viewpoints, and at the same time have the potential to limit exposure to attitude-challenging information. The content people encounter on social media, for example, depends on their ties (e.g., friends, acquaintances) and what information those ties share (Bakshy et al., 2015). As Trilling et al. (2017) indicate, topics influence how news is shared on social media. Particularly, news about politics and foreign affairs is poorly shared, whilst entertainment news is more likely to be shared and engaged with on social media. According to Bright (2016), this can be attributed to people's desire to enhance their social status, as the nature of the shared content reflects on the individual's identity.

Pew Research Center (2015) found that 73 percent of Facebook news consumers regularly encounter entertainment news in their news feeds. Political news, on the other hand, is seen by just over half (55 percent). Relatedly, Bakshy et al. (2015) analyzed news feeds of approximately ten million active American Facebook users over a six-month period. They found that merely 13 percent of all news items posted on Facebook contained hard news (i.e., politics, foreign affairs). Taken together, we propose that users are more often exposed to entertainment news than to political news on social media. Using a browser plug-in, we are able to capture individually encountered content through algorithmic gatekeepers (in this case Facebook). We hypothesize the following:

H2a: *Social media are more likely to expose users to entertainment news than to political news.*

Bakshy et al. (2015) found that Facebook users merely clicked on 7 percent of hard news links available in their feeds. Instead, political news is more likely to be discovered by going directly to a news website: about half of the news covering politics occurred through an individual going directly to a news website (46 percent, see Pew Research Center, 2017). Entertainment news, on the other hand, is much more likely to be accessed through social media compared to news websites and search engines. Everything considered, it can be argued that entertainment news emerges as a social online news experience (Pew Research Center, 2017). We hypothesize:

H2b: *Entertainment news is more likely to be accessed via social media than via news websites or search engines.*

Method

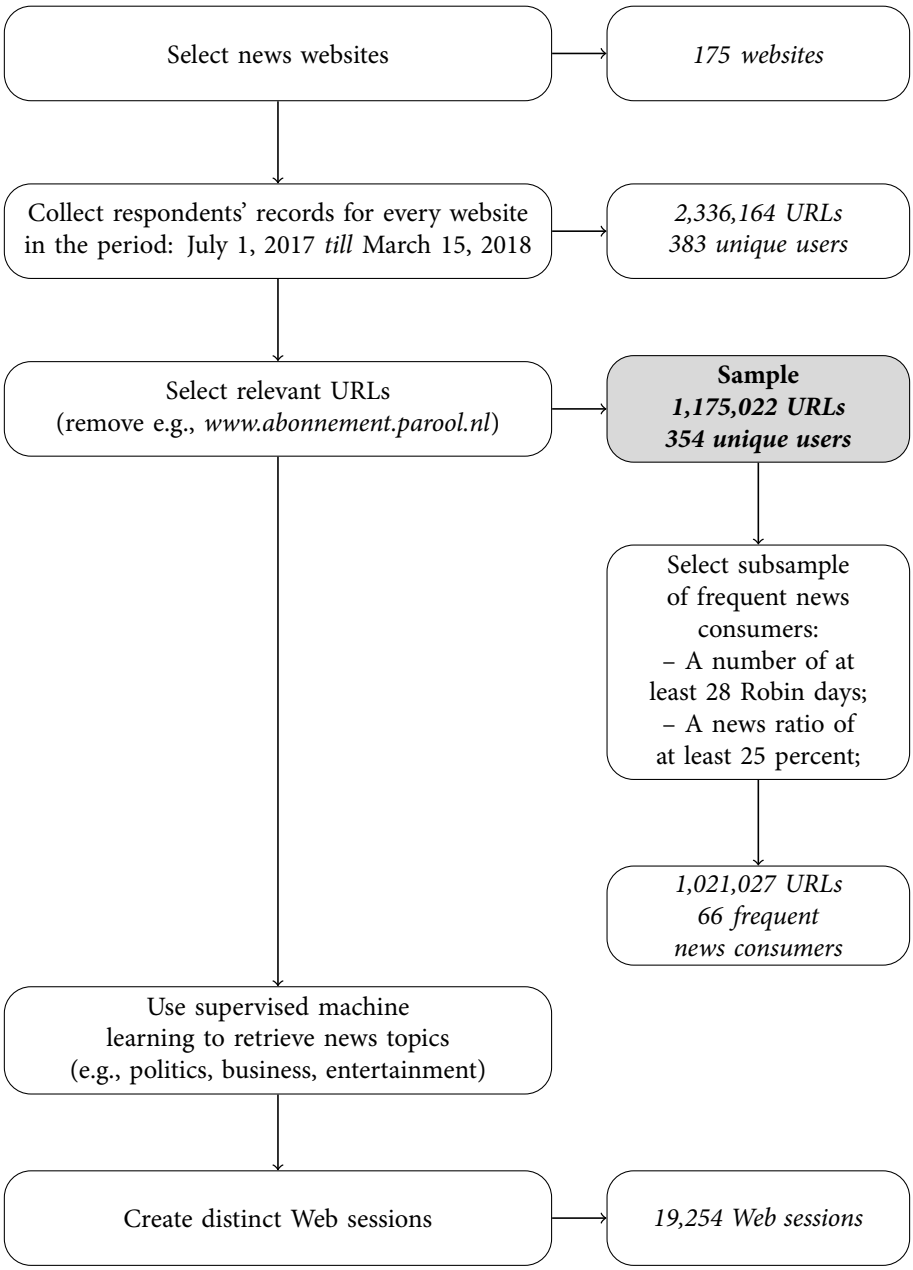
Data

As part of a larger project, we recruited respondents via the LISS (Longitudinal Internet Studies for the Social Sciences) panel of CentERdata, which is based on a true probability sample of the Dutch population (Scherpenzeel, 2011). Panel members were included in our sample if they (1) are aged eighteen years and older, and (2) agreed to install a browser plug-in on their personal computer (the University approved the study under IRB protocol number 2016-PCJ-741). We collected data from our respondents in two ways: having them fill out an online survey and tracking their online media use (for more information see Moeller et al., 2020).

Panel members installed a Google Chrome or Mozilla Firefox plug-in *Robin*, a custom-built system that registers and monitors respondents' Web behavior in the period between 1 July 2017 and 15 March 2018. Our sample is not necessarily representative of all Web behavior (e.g., smartphone browsing, browsing using work computers are not considered). We were unable to include consumption patterns on mobile devices due to limited resources as well as technical constraints. We focus on browsing behavior on desktop or laptop computers. Nonetheless, in 2017, computers (52 percent) were the main access point for online news in the Netherlands compared to smartphones (49 percent) or tablets (26 percent; Newman, Fletcher, Kalogeropoulos, Levy, & Nielsen, 2017).

The plug-in software was compatible with MacOS, Linux, and Windows. Whenever respondents accessed one of the white-listed websites (which includes an exhaustive list of Dutch news websites, as well as social media and search engines, see appendix: Table 14), the plug-in transmitted all Web traffic (HTTP and HTTPs) to our servers. In this way, the system not only collects the URL request (Web page address), but also the date, time, session ID and referrer URL (i.e., the address of the Web page that linked to the resource being requested) for each recorded visit. To guarantee respondents' privacy as much as possible, we filtered the raw data to exclude sensitive information. We stored the data in an Elasticsearch database on a server that is not directly available for the researchers. Instead, *Robout*, a Python library, is made available on another secured server to complement *Robin*. We conducted the analyses using *Robout* and an Elasticsearch database on the second server so no sensitive data would leave the environment (for more information see Moeller et al., 2020).

Figure 10: Phases of data collection and pre-processing



To be able to analyze respondents' online activities, the raw data needs to be captured and transformed into relevant and meaningful information. During the first stage of the pre-processing phase, Web behavior is extracted for 175 news websites (e.g., *www.telegraaf.nl*, *www.volkskrant.nl*). In our study, a news website refers to a Web page whose primary offering is news content. Besides, we included search engines (e.g., *www.google.nl*, *www.yahoo.com*) and social media (e.g., *www.facebook.com*, *www.twitter.com*) to gain a better understanding of online news patterns. Secondly, the raw data is cleaned by removing entries irrelevant for our goals (e.g., advertisements). In the third stage of the pre-processing phase, we determined what we consider a Web session. We implemented the following algorithm: (1) group the tracking data by user ID and time, (2) create a new session if there is a 30-minute gap between records in the data (using the same methodology as Athey & Mobius, 2012), and (3) assign the same session ID to records that are connected.

Respondents

Figure 10 illustrates an overview of the data collection and pre-processing phase. At the end of the process, we have a set of 354 respondents who constitute the user base that we use for further analyses: 48.5 percent were male, mean age was 47.2 (SD = 19.2), and 15.7 percent had a low level of education (e.g., primary school), 38.3 percent had a medium level of education (e.g., college), and 44.6 percent had a high level of education (e.g., university). Compared to the Dutch population as a whole, the sample is slightly older.

Measures

We focus on the following measures:

- *Entry-point*: The first recorded visit of each Web session has a referrer (e.g., search engine, social media or any other website);
- *Context*: (1) Tabloids, (2) Broadsheets, (3) Online-only outlets, (4) International outlets, (5) Broadcasters, (6) Facebook, (7) Twitter, (8) Search engines, (9) Other news outlets, and (10) Other websites;
- *Content*: (1) Politics, (2) Business, (3) Entertainment, and (4) Other.

Analytical strategy

To obtain further insights into the frequency of visits to particular Web pages we explored which websites (*context* features) were accessed. Next, we used automated content analysis

to retrieve the topic of each news item (*content* features). Finally, to detect usage patterns (in terms of *context* and *content* features), we modeled Web sessions using Markov chains.

Automated content analysis

Based on a supervised machine learning method, we determined what topic is covered in each news item. In order to examine news topics, we extracted the raw text (HTML) for every accessed URL. Then, we used the package *jusText* (Pomikálek, 2011) to strip HTML markup or JavaScript code and remove non-textual content, such as navigation links, headers and footers. This resulted in the main content, containing full sentences, of every accessed news item. Eventually, we stored the data in an Elasticsearch database. In order to effectively train our classifier, we could merely use Dutch-language news items (i.e., English, German, French and Frisian websites were excluded when examining the *content* of news websites; $n_{\text{websites}} = 18$). To train the classifier, we used a coding scheme developed by Shoemaker and Cohen (2005) to guide the coding process. We distinguished four news categories: (1) Politics (e.g., *internal politics*, *international politics*, and *military and defense*); (2) Business (e.g., *economy*, and *education*); (3) Entertainment (e.g., *sports*, *culture*, and *human interest*); and (4) Other (e.g., *science and technology*, *environment*, and *religion and beliefs*). If an item would suitably be annotated as being relevant to more than one topic, we annotated the most dominant topic present when merely reading the first five sentences of a news item.

Two human coders independently coded approximately 500 news items. The assignment of news items to these four categories reached a Cohen's kappa score of .88. On this basis, one coder analyzed an additional 3,200 news items in a step-wise approach.

Next, we used the Python *scikit-learn machine learning* library (Pedregosa et al., 2011) to train and test the Passive-Aggressive (PA) algorithm, which is known to perform well in various text classification tasks (Crammer, Dekel, Keshet, Shalev-Shwartz, & Singer, 2006), including Dutch-language news items (Burscher, Vliegenthart, & de Vreese, 2015). We applied a random sampling procedure to split the data set into a training set (80 percent), on which we trained the classifier, and a test set (20 percent), on which we evaluated the classifier (Burscher et al., 2015). We measured its ability to accurately classify unseen items, which computed the following scores: *precision* of .82, *recall* of .83, and *accuracy* of .82. Finally, we used the classifier to predict the topic for all news items outside the training set.

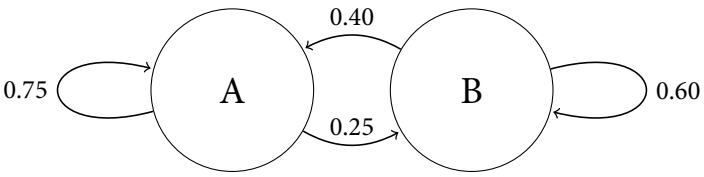
Markov chains

Furthermore, we use Markov chains (absorbing Markov chains, in particular), as described by Vermeer and Trilling (2020) to answer RQ1 and RQ2. Markov chains are mathematical systems that change from one state (i.e., a situation) to another state. All possible states are

listed in a so-called *state space*. A Markov chain provides the likelihood of transitioning from one state to any other state (see Gilks, Richardson, & Spiegelhalter, 1996).

Figure 11 illustrates an exemplary Markov process with two states (A and B) in the state space. In total, there are four possible transitions, as a state can transition back into itself. Each number represents the probability of the Markov process changing from one state to another state, with the direction indicated by the arrow (Gilks et al., 1996). For example, if the Markov process is in state A, then the probability it changes to state B is 0.25, whereas the probability it remains in state A is 0.75.

Figure 11: Example of a two-state *Markov Chain* process



In the context of this study we use two types of Markov chains:

- *Context*: The probability of users changing from one website to another website, using the state space described in the *Measures* section;
- *Content*: The probability of users changing from one news topic to another news topic, using the state space described in the *Measures* section.

The begin state is the first Web page (or first state) of every Web session. Furthermore, we added a final 'absorbing' state (i.e., End of session) to every Web session, representing the exit point (i.e., a state once entered, cannot be left).

Robustness check

To verify the robustness of our findings, we selected a subsample of panel members that we call *frequent news consumers* ($N = 66$): 64.6 percent were male, mean age was 49.7 ($SD = 15.1$), and 18.5 percent had a low level of education, 41.5 percent had a medium level of education, and 40 percent had a high level of education. We used the following measures to select frequent news consumers:

- *Robin days*: The respondent has at least 28 days of Web activity (i.e., the number of days Robin recorded Web activity between the first and last record) during the period under study (i.e., 258 days);

- *News ratio*: The number of news consuming days (i.e., the number of days of recorded visits on news websites); set against *Robin days* (in %) is at least 25 percent.

The main results hold.

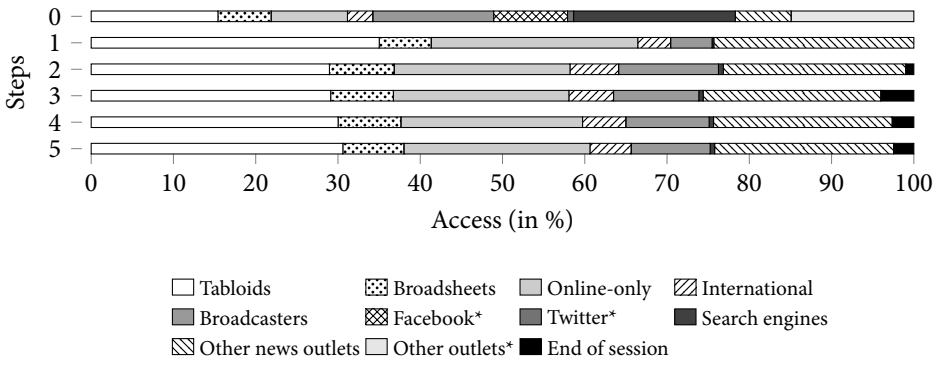
Results

After the pre-processing phase of the collected data, we had 1,175,022 relevant URLs providing us insight in the Web behavior of 354 news consumers.

Context features

First, we indicated whether respondents used a referrer, for example social media, as an entry-point to access news online. Figure 12 presents the first five steps of a Web session, in which step 0 is the entry-point, and 1-5 are follow-up actions. Interestingly, at the entry-level, search engines and Facebook seem to serve as important gateways for tabloids and/or other news outlets. Access to tabloids increased from 15.4 percent at step 0 to 35.0 percent at step 1, and access to other news outlets increased from 6.8 percent to 24.3 percent.

Figure 12: Steps 0 – 5 *(0 = entry-point)*



Note. *Facebook, Twitter and Other websites are merely taken into account as an entry-point.

To examine H1, we examined the entry-point to a Web session. The observed frequencies indicate that online news consumers were most likely to get news by going directly to news

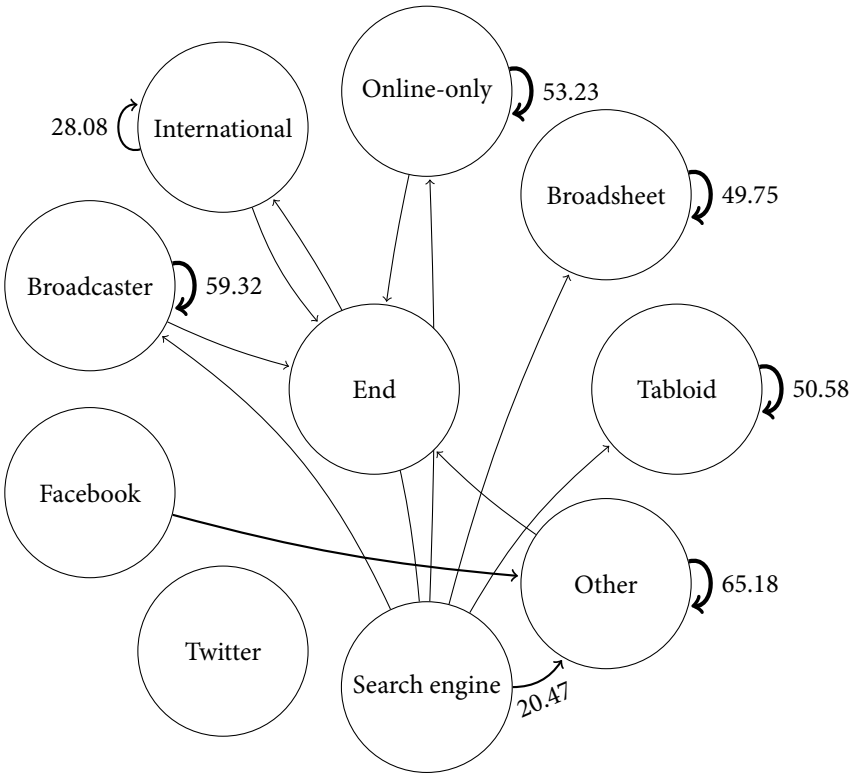
websites (n = 4,611), followed by search engines (n = 1,627), other websites (n = 1,234), and social media (n = 804). To examine whether news websites are more likely to serve as an entry-point to access news online compared to search engines or social media, we used multilevel multinomial logit models (i.e., including a random intercept). In this way, we consider the nested structure of respondents' Web sessions. The results indicate that news consumers are more likely to use news websites as an entry-point to access news, compared to social media ($b = -.98, p < .001$), search engines ($b = -.28, p = .03$), and other websites ($b = -.55, p < .001$; N_{obs} = 8,276, N_{groups} = 331; MLE = −7,665.82). Accordingly, H1—news websites are more likely to serve as an entry-point to access news online compared to search engines or social media—is supported by the data. This means that users have a strong tendency to directly visit the news website's home page when they want to keep up with the news.

To retrieve a closer examination of the data, we estimated Markov chains. This allowed us to capture sequential dependence by modeling users' navigational behaviors. For every existing Web session, we created a pattern of states (e.g., *Facebook* → *tabloid* → *tabloid* → *end of Web session*). To explore the pattern of accessed news outlets, we constructed transition matrices (for every respondent; $N = 354$) representing transition probabilities between all possible states (i.e., news websites). Based on the transition probability matrix, we define the transition paths at an aggregate-level (see appendix: Table 17).

We visualized mean transition probabilities higher than five percent in Figure 13. Mean transition probabilities higher than twenty percent are presented in actual numbers next to the corresponding edge. We argue that the current website is expected to be a good clue to grasp the next website. We assigned weights to the edges to represent the probability of users changing from one news site to another news site. In other words, the thicker the line, the higher the transition probability.

Three patterns are particularly clear in Figure 13. First, the results indicate that search engines are an essential entry-point for any type of news outlet, particularly for other news outlets (20.47), as well as for broadcasters (13.43), online-only outlets (9.30), broadsheets (8.61), and international outlets (8.04). This means that users use search engines to access all types of news websites. Second, we found that particularly other news outlets benefit from Facebook referrals (16.12), compared to, for example, tabloids (4.02) or broadsheets (2.41). Finally, the transition probabilities of interactions within the same outlet: broadcaster, online-only, tabloid, broadsheet, and international, were higher than interactions between different news outlets. This means that online news consumers have a strong tendency to continue browsing within the same news outlet.

Figure 13: The probability of users changing from one website to another website



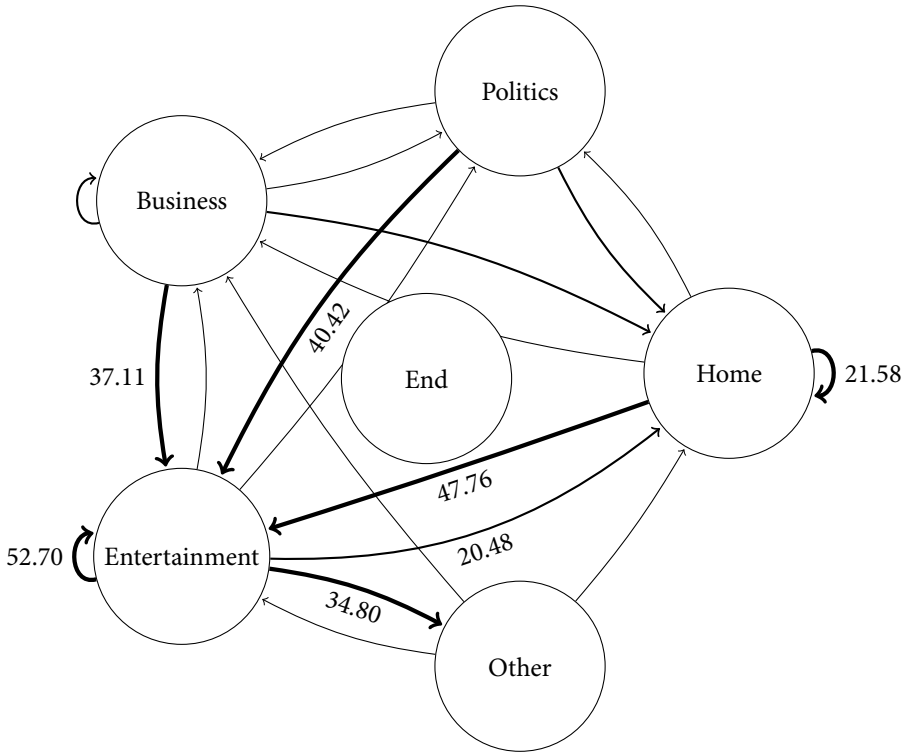
Note. **(i)** The edges present the mean transition probabilities - the thicker the line, the higher the transition probability; **(ii)** As Facebook, Twitter and Other websites are merely taken into account as an entry-point they do not have any incoming edges, and it is impossible to transition from these outlets to the end of a Web session; **(iii)** Mean transition probabilities higher than twenty percent are presented in actual numbers next to the corresponding edge.

We also examined whether respondents who are highly interested in politics (i.e., 6 or 7 on a 7-point scale from *strongly disagree* to *strongly agree*, $n = 81$) show different news consumption patterns. The results indicate that respondents who are more politically interested were more likely to keep browsing within the same news outlet: tabloids (60.80), broadsheets (53.36), online-only outlets (58.35), international outlets (23.39), and broadcasters (62.77). Politically interested respondents were less likely to consume news from other news outlets. They were also less likely to end a Web session.

Content features

We also explored the transitional probabilities with the content identified. Table 18 (see appendix) represents any possible transition in terms of content. Mean transition probabilities higher than five percent are visualized in Figure 14. Mean transition probabilities higher than twenty percent are presented in actual numbers next to the corresponding edge. We can discover two clear navigation patterns.

Figure 14: The probability of users changing from one news topic to another news topic



Note. **(i)** The edges present the mean transition probabilities - the thicker the line, the higher the transition probability; **(ii)** Homepage can also refer to section pages; providing an overview of the news for a specific topic; **(iii)** Mean transition probabilities higher than twenty percent are presented in actual numbers next to the corresponding edge.

First, after reading a news item (about any topic) users frequently return to a homepage or section page and continue browsing from there (i.e., Politics: 16.18, Business: 16.80, Entertainment: 20.48, and Other: 10.34). This means that the homepage is still important, as

pages providing an overview of the news (for a specific topic) help users navigate the wealth of online news.

Second, we found a relative preference for entertainment news over any other news topic. Online news consumers are very likely to transfer to entertainment news during a Web session, and also continue reading entertainment news (see Figure 14). Users are less inclined to read about political issues. Consuming political news, on the other hand, decreases people's desire to continue reading about this topic. Instead, people rather switch to business (11.29) or somewhat less cognitively demanding news items, such as entertainment (40.42). This means that the consumption of entertainment news seems to precede the consumption of any other type of news.

Again, we examined whether respondents who are interested in politics (i.e., 6 or 7 on a 7-point scale from *strongly disagree* to *strongly agree*, $n = 81$) show different news consumption patterns. The results indicate that respondents who are more politically interested were somewhat more likely to read news items covering business and politics.

Context and content features

Turning to the interaction between context and content features in online news consumption, our hypotheses predict that social media are more likely to expose users to entertainment news than to political news (H2a)[7], and in turn entertainment news is more likely to be accessed via social media than via news websites or search engines (H2b). To test H2a, we examined the content of news items on Facebook. In the period July 1, 2017 till March 15, 2018, 203 respondents were exposed to 149,123 different Facebook items. 4,195 Facebook items were news-related. The observing frequencies indicate that social media users were most likely to encounter entertainment news ($n = 3{,}329$), followed by political news ($n = 407$), business news ($n = 350$), and other news ($n = 77$). In order to determine to what extent social media expose users to various news topics, we used multilevel multinomial logit models (i.e., including a random intercept). The results indicate that social media are more likely to expose users to entertainment news, compared to political news ($b = -2.36$, $p < .001$), business news ($b = -2.51$, $p < .001$), and other news ($b = -4.02$, $p < .001$; $N_{obs} = 4{,}195$, $N_{groups} = 59$; MLE = −3,028.77). This means that, when browsing on Facebook, news consumers are more likely to encounter topics such as sports, culture, fashion, and human interest, and less likely to encounter political news. Accordingly, H2a is supported by the data.

[7] We focused on *all* Facebook items that our respondents encountered throughout the period under study (not merely items that have been accessed through a referral). To obtain encountered news items on a Facebook news feed separately, we programmed an additional custom privacy-friendly parser.

Finally, we examined whether entertainment news is accessed more often via social media than via news websites or search engines. The observing frequencies indicate that people, at the first step of a Web session, access entertainment news via news websites (n = 1,131), followed by other websites (n = 562), search engines (n = 513), and social media (n = 319). By using multilevel multinomial logit models, we found that news consumers are more likely to access entertainment news via news websites, compared to social media ($b = -.20$, $p < .001$), and search engines ($b = .28$, $p < .001$; N_{obs} = 2,525, N_{groups} = 239; MLE = −2,535.17). Accordingly, H2b is not supported by the data.

Discussion

The very nature of news consumption has changed drastically as people increasingly use the Internet as their primary news source. Hence, users face greater difficulty navigating the complex wealth of information, and strive to cope with this information overload. In turn, this could draw them toward increasingly consuming entertainment news (Pearson & Kosicki, 2017). To examine such concerns, we aimed to gain a better understanding of online news consumption patterns. Our design enabled us to (1) passively record online browsing behavior, and (2) analyze the way news consumers find and act upon a wide range of online news outlets, search engines, and social media, as well as a variety of news topics (e.g., politics, entertainment).

The results indicate that news websites (compared to search engines or social media) most often serve as an entry-point to a Web session. In line with previous studies (Kleppe & Otte, 2017; Newman et al., 2017), the homepage of a news website can be considered as the main driver of traffic to such outlets. Although social media are not often used as an entry-point to a news item, our results do give an indication on the role of social media in the online news consumption process. When examining the entry-point of a Web session, we found that Facebook is particularly important in generating Web traffic to other, mostly local and regional, news outlets. One could argue that users do not need Facebook to find typically mainstream news outlets, or as argued by Mukerjee, Majó-Vázquez, and González-Bailón (2018), users consume most of their mainstream news directly from their news feed. Based on our outcomes, however, we can only speculate about these dynamics. Search engines, on the other hand, seem to serve any type of news outlet. Furthermore, when news users browse through a news website, they are more likely to continue browsing within that same outlet. The vast majority of online news consumption, thus, resembles offline reading habits, with

individuals directly visiting homepages of their (probably) favorite, typically mainstream, news outlets (Flaxman et al., 2016).

In terms of content, we examined how people combine news topics during a Web session. While previous studies have examined people's selection of entertainment news (e.g., Prior, 2005), such studies did not quantitatively track what people choose to consume, and how they combine different topics into complex patterns of media use. The results of our tracking data certainly confirm previous findings (e.g., Pearson & Knobloch-Westerwick, 2018) that news consumers prefer entertainment news over any other topic (e.g., politics, business). An explanation for this result might be that, due to a commercialized news business, news organizations increasingly seek to grab attention with entertainment news (Tandoc, 2014). As a consequence, the growing offer of (and interest in) entertainment news seems to precede the offer of (and interest in) political news. In this way, people seem to predominantly selecting and consuming entertainment news in an online news environment (Pearson & Knobloch-Westerwick, 2018).

Finally, we looked into the interplay between content and context features, in order to determine whether certain news topics are more likely to be accessed through one pathway over another. Although users particularly encounter entertainment news on Facebook (due to e.g., friends and acquaintances), which is in line with findings by Bakshy et al. (2015), entertainment news is not necessarily accessed via social media.

Our findings help contributing to building new theories of gatekeeping processes and news use in an algorithmically curated media environments. Although news consumers are more empowered and have more control over their information flows online, journalistic gatekeepers still play an important role in online news consumption; as news consumers often rely on websites of traditional news outlets when navigating the complex wealth of online news. Our findings also indicate additional insights in the role of algorithmic curation. Using a promising approach to the observation of users within algorithmically curated media environments, we were able to explore the role of Facebook's news feed algorithm in our daily dose of news.

Furthermore, this study can help inform the debate around selective exposure (see Zuiderveen Borgesius et al., 2016). In a high-choice media environment, news consumers are more empowered and have more control over their news flows online. Our findings indeed suggest that interest in (and consumption of) entertainment news seems to precede interest in (and consumption of) political news (Prior, 2007), which might be in line with a general trend indicating a growing attention for entertaining topics (de Waal & Schoenbach, 2010).

This could have serious consequences for society at large, as being exposed to a diverse set of news (particularly political and societal issues) is essential for a functioning democracy.

Further, this study offers practical implications for news organizations (including journalists and Web developers) to understand how people navigate today's media landscape. Ferrer-Conill and Tandoc (2018) have indicated, for example, to what extent user data can assess the performance of editorial choices. Given the complexity of online news consumption, it is important to understand the differences in news consumption processes contributed by each of the different (news) websites (Kleppe & Otte, 2017). Our findings, for example, indicate that particularly other news outlets (mostly regional news outlets) benefit from Facebook referrals compared to mainstream outlets (e.g., tabloids, broadsheets).

By applying Markov models to a large amount of user behavior data, we were able to provide relevant insights for news organizations seeking to guide users to the relevant content on their website. As journalistic news production is more and more metrics-driven, users' pathways can be a relevant source of support and inspiration for editorial groups (Giomelakis, Sidiropoulos, Gilou, & Veglis, 2019). Utilizing Markov chains could provide relevant insights for news organizations seeking to guide users to relevant content on their website (e.g., enabling personalization, content recommendation). Such insights can, for example, help to determine whether a certain news article should be offered merely to premium members or not. As journalists, editors, and Web developers are the architects of news pathways (Pearson & Kosicki, 2017), our findings can serve as a starting point to help them shape the paths users take.

Methodologically, we demonstrated how to use tracking data to tackle the complexity of studying news use today. Furthermore, we set out to advance a way to construct Markov chains, as these provide a better understanding of which outlets and news topics are combined during a Web session. Setting up this research design of course involved various methodological limitations (more information regarding the challenges of our browser plug-in see Bodo et al., 2017). First among these is the small number of frequent news consumers. The final number of panel members that indeed used our plug-in for an extensive period of time did not meet our expectations. Consequently, we were unable to draw clear conclusion on the effects of consumer characteristics (such as political interest, but also age, gender, political efficacy, and ideological position). Future research needs to obtain a larger sample to take such features into account.

Second, respondents might have adapted their behavior to the fact that they were under observation. To account for the possibility of social desirability, we passively tracked over a relatively long period of time (over more than 8 months).

Moreover, we excluded other websites (unrelated to news) after the first entry-point of a Web session. People, however, receive general news and information either intentionally and incidentally (Beaudoin, 2008); hence it is likely that when people use the Internet they will unintentionally be exposed to, for example, political news and information. Future research that aims to analyze actual news consumption should, therefore, incorporate other websites throughout a Web session to build upon the concept of incidental news exposure (Tewksbury et al., 2001). It would also be worthwhile to gain insight into particular needs and preferences regarding news content, for example by conducting in-depth interviews (see Kleppe & Otte, 2017).

In the current study, the element of time has not been taken into account (i.e., minimum time on a certain Web page). Future studies could clean the data in such a way that allows exploring whether users spend *more* time with political news.

Future work that leverages larger samples would also enable analyses within specific news websites. As media organizations started experimenting with the use of recommender systems to give users personalized recommendation (Moeller, Trilling, et al., 2018), news use in algorithmically curated media environments warrants further exploration.

Finally, when studying online news consumption it is increasingly important to record media use on mobile devices (e.g., Kleppe & Otte, 2017). In the current study, we were unable to include news consumption patterns on mobile devices such as smartphones and tablets (due to limited resources and technical constraints). Recent studies indicate that specifically young news consumers basically always have their smartphones with them, making it their most important device for news consumption (Newman et al., 2019). They often turn to WhatsApp and other direct messaging apps for their news (Newman et al., 2019). Future research on the role of news consumption that aims to track actual news consumption should, thus, take the practice of cross-device news consumption into account. Up until now, only few studies have experimented with monitoring news consumption on smartphones and tablets. Accordingly, for future work, it is clear that the increasing cross-device consumption of news asks for new approaches of monitoring news consumption on all possible websites.

Notwithstanding the exploratory nature of our findings, this study has provided a strong set of findings, relevant to (online) news consumption. By focusing on an online news environment, these findings not only update and advance earlier research about gatekeeping processes, but also provide a further understanding of the role of context and content features in news consumption patterns.

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Supplemental material

More information about using Markov chains see the following Python module: https://github.com/uvacw/df2markov.
More information about our supervised machine learning approach: https://doi.org/10.6084/m9.figshare.7314896.v1.