Algorithmic Audience in the Age of Artificial Intelligence

Tailored Communication, Information Cocoons, Algorithmic Literacy, and News Literacy

Roselyn Du

PETER LANG

Algorithmic Audience in the Age of Artificial Intelligence employs a mix-methods approach to examine and interpret the algorithmic news consumption phenomenon from several inter-related perspectives, including tailored communication, customization, gatekeeping, agenda-resisting, algorithmic literacy, and news literacy. Potential implications for an empowered or rather (information-) cocooned public are explored. The research aims to illuminate the renewed relationship between media and audience and the effects on users of algorithmic processes.

The aim of the book is multifaceted: (1) to describe the phenomenon of AI-based news recommendation; (2) to explore the user experience of consuming recommended news; (3) to analyze the effects that algorithmic news consumption has on the audiences; (4) to raise awareness of the impact of algorithmic news consumption; (5) to inform the public, technocrats, and policy makers of the effects of algorithmic news consumption; and (6) to guide debate on ethical decision-making and possible policy change. Through an empirical investigation process, this volume examines algorithmic news consumption from a user perspective and dissects the complex effects caused by such consumption.

This book is suitable to be a primary text for undergraduate-level courses relating to media literacy issues and graduate-level courses with a particular focus on audience analysis in the age of artificial intelligence. It can also serve as a supplemental text for core courses in media/communication studies, such as Introduction to Communication, Current Issues in Communication, Communication Theory, and Communication Ethics.

Roselyn Du received her PhD from UNC-Chapel Hill. Before joining the faculty at Cal State Fullerton, she spent ten years at Hong Kong Baptist University, where she received the Outstanding Performance Award in Scholarly Work, among other honors. In a previous life, she was an award-winning frontline journalist in China.

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Advance Praise for

Algorithmic Audience in the Age of Artificial Intelligence: Tailored Communication, Information Cocoons, Algorithmic Literacy, and News Literacy

"This comprehensive work uses original research to both focus and expand our understanding about the ways that the growing consumption of algorithmic news will impact both the news media business and participatory democracy. It provides sharp new insights at a critical moment in the evolution of journalism."

—Ryan Thornburg, Associate Professor of Journalism, School of Journalism and Media, University of North Carolina at Chapel Hill

"Roselyn Du's book is a roadmap to understanding how the audience of today's news are grappling with tailored communication, information cocoons, algorithmic literacy, and news literacy. This book is timely, insightful, and methodologically rigorous. This is a must read for students and scholars interested in algorithms and journalism."

—Kerk F Kee, Associate Professor of Media & Communication, Texas Tech University

"Guided by key theoretical considerations, this timely text details comprehensive empirical investigation of the effects of algorithmic news recommendations on news appreciation, news literacy, and public agenda priorities. Findings suggest that algorithmic news consumption may not be as dangerous as presumed and warned. A significant contribution of this work is support for the theoretical development of a renewed conception of the active audience and the redefinition of agenda-setting. A compelling case is made for the importance of research on algorithms and artificial intelligence for understanding the future of journalism and civic society."

—Cynthia King, Professor of Communication, California State University, Fullerton

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Library of Congress Cataloging-in-Publication Control Number: 2022041706

Bibliographic information published by **Die Deutsche Nationalbibliothek**.
Die Deutsche Nationalbibliothek lists this publication in the "Deutsche Nationalbibliografie"; detailed bibliographic data are available on the Internet at http://dnb.d-nb.de/.

ISSN 2373-6976 (print)
ISSN 2373-6984 (online)
ISBN 978-1-4331-7358-5 (hardback)
ISBN 978-1-4331-7359-2 (paperback)
ISBN 978-1-4331-7360-8 (ebook pdf)
ISBN 978-1-4331-7361-5 (epub)
DOI 10.3726/b16102

To Ben Ben and Han Han.

Your arrivals to this world transformed my world.

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Acknowledgments

There it is. College Park, Suite 650. Thank you for the workspace that allowed me to complete most parts of this book project. For more than one year, I stayed there longer than anywhere else.

I am thankful to AEJMC and Peter Lang for selecting my book proposal to be included in the prestigious AEJMC-Peter Lang Scholarsourcing Series. I signed the book contract with Peter Lang while I was in Hong Kong carrying a regular 2-2 teaching load, not knowing that I would be having an intercontinental relocation right after that, moving myself into a 4-4 teaching load job in California. As if this was not challenging enough, soon came COVID-19 while I was in the first year with my new institution. Life and work were turned upside down inopportunely. This book would not have come about but for all the support I have received from organizations and individuals. A sabbatical leave from Hong Kong Baptist University in 2017 allowed me the time to refresh my mind and start musing about the concepts of algorithmic audience and news literacy. When this research reached its critical phase in 2021, AEJMC supported my national survey with a Senior Scholar Grant and California State University Fullerton granted me one course release. My pilot study benefited greatly from colleagues and students across disciplines at Fullerton. These are kindhearted people who I have never met in person but were willing to go out of their way to support my research. Thanks are due to Alfonso Agnew, Jon Bruschke, Julia Chan, Lisa Erwin-Davidson, Tony

Fellow, Zac Johnson, and Mia Sevier, among others, for their generosity with time to help distribute the questionnaire to their students who enrolled in their programs or classes. My deep gratitude also goes to all the reviewers of this manuscript for their comprehensive feedback and their painstaking and meticulous comments.

The bulk of the research and writing took place under the COVID pandemic, concurrent with my first years in the entirely new environment of Cal State Fullerton. It was too unsettled a period for intense concentration required for scholarly contemplation, but thanks to my family, friends, students, and colleagues for the constancy of faith, hope, courage, and perseverance, I knew I would eventually reach this point, right here, sharing my research with a broader audience.

CHAPTER 1

Algorithmic News Audience

> "I don't pretend we have all the answers, but the questions are certainly worth thinking about."
>
> – Sir Arthur C. Clarke, media futurist

Imagine the following scenario: You grab your smart phone to check for messages, and a pop-up notification tells you that "Perseverance rover makes 'completely unexpected' volcanic discovery on Mars." You're interested, as you have been following news about Mars and rovers, but are also left wondering how your mobile service provider knows that this is of interest to you. A few stories later and you suddenly notice an advertisement for your favorite footwear product embedded into the story. How do they know this is your brand? Now, you are a little perturbed.

This scenario is nonfictional; it is currently happening to every one of us. Algorithm-based news recommendation systems are personalizing information by analyzing user interactions with content across platforms. Take for example the revamped "Google News" app, which replaced "Google Play Newsstand" in May 2018. It now features the "For You" section as the first choice, providing a personalized list of news stories which the algorithm decides the user might be interested in. The app is designed to track user data and adapt to user reading interests as well as a dynamic news environment, improving over time.

Algorithms are increasingly shaping our online and offline lives as we are constantly exposed to algorithm-based web search results, targeted advertisements, personalized social media content, and personalized recommendations for consumption. Netflix recommends movies. Pandora recommends music. Amazon recommends books and everything to us. Well, we are probably fine with personalized entertainment and lifestyle products. But news is something is different. News, with its core values, should be fair, objective, impartial, and free of personal opinion and bias. Journalism has an essential role in a democratic society. The basic idea of personalized news recommendation seems to be at odds with this tenet.

The "age of artificial intelligence" has seen a global proliferation of AI-powered, algorithm-based news applications that cater to individual preferences. Such technology advancement for customized news consumption is favorable to news audiences as it allows easy and efficient access to relevant news and information, mitigating the human inability to sift through an enormous online space of existing news stories to reach a point of interest. Around the world, technology entrepreneurs partner with news content producers to make use of algorithms to make news apps. Online news aggregators like *Feedly* and *Flipboard*, as well as traditional independent news media like *The New York Times* and *CNN*, have all developed news apps that have personalized "For You" recommendations based on algorithms since 2018. Some technology reviewers and scholars noticed that AI-based news platforms were in full bloom in both China and the U.S. in 2020. According to a survey by Apple Inc., its news aggregator app, Apple News, had 125 million active users in the second quarter of 2020, which marked an increase of 40 million from the first quarter of 2019 (Figure 1.1). Meanwhile, subscriptions to Apple News+, which is a paid service integrated into Apple News, are also on the rise and could amass 100 million paid subscribers by 2023, according to analysts. The popularity of these algorithmic news apps makes a strong case for studying

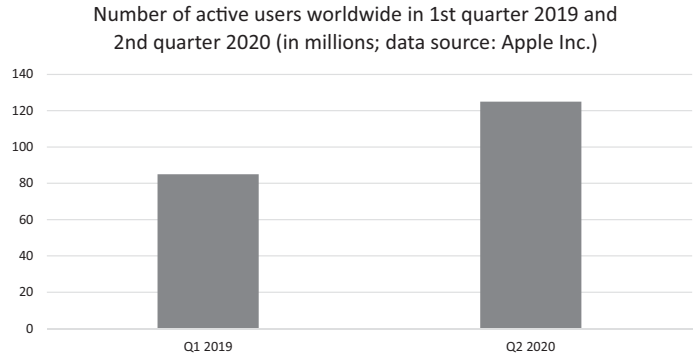

Figure 1.1 Apple News App Active Users

how artificial intelligence is transforming information distribution and news consumption, and therein the relationship between media and their audiences, and the implications for new types of media effects. It is, perhaps, both timely and necessary to examine various aspects of the phenomenon.

AI-powered news apps recommend personalized information to their users by analyzing user interactions with content on the platform. Take for example the aforementioned "Google News" app, which replaced the old "Google Play Newsstand." Its "For You" section, now offered as the first choice among others, provides a personalized list of articles and local news that its algorithm decides the user might be interested in. The app is designed to adapt to a user's profile data, such as personal interests, browsing history, and reading habits, and improve in its algorithm over time based on the activities of the user, which are fed back in the form of user data.

The algorithmic communication model powered by AI which sits behind these apps is revolutionizing its users' news and information consumption behaviors and capsizing the relationship between media and their audiences. Its "algorithmic audience" symbolizes a whole new notion of the information distribution process, in which the wants and desires of individual audience members are no longer buried in and subordinate to professional media organizations' wholesale operations. Instead, individual preferences are being attended to and catered for, becoming a decisive priority in the communication process. The algorithmic news app is representative of a major shift in communication models from a "one-to-many" broadcasting system and subsequently a "many-to-many" conversational one, to a fully personalized "one-to-one." As such, its communication process is customized and tailored, which seems to have contributed to the remarkable popularity of such apps. This is in line with previous research on customization effects, which discovered that tailored communication, in general, is favored over non-tailored.

Meanwhile, such popularity has raised ethical concerns. While a convenient populism is at play, as these technologies allow us to filter news and information in a convenient and efficient way, they also create a risk that users may end up trapped in an "information cocoon." Information cocoons impoverish the marketplace of ideas and reduce the diversity of information and viewpoints. As technologies may empower each one of us to control deliberately what information and perspectives we are exposed to—that is, to custom-build a communicative world to our prior beliefs and interests—it is also considered a threat to a normal and wholesome society. At the societal level, the proliferation of algorithmic news apps may debase public opinion by isolating people from challenging perspectives to such an extent that they are unable to make informed civic decisions. At the individual level, the algorithmic audience may be at risk of becoming partially news-illiterate.

Tailored Communication and Customization Effects

Tailored communication appears to be key to algorithmic media. Its success has been achieved largely by using machine learning to discover and cater to its users' interests, preferences, and tastes, and tailoring its offerings accordingly to attract clicks and views. The increasing popularity of algorithmic news certainly speaks for the positive effects of tailored communication.

In theory, tailored communication can customize the source, message, and channel for a given individual, presumably maximizing the relevance of the communication to that person, and such messages are expected to be more effective to the people they reach (Grier & Brumbaugh, 1999; Li, Kalyanaraman, & Du, 2011). As Kreuter and Skinner (2000) and Kreuter and Wray (2003) suggest, tailored communication assumes that each person possesses some unique characteristics that can be assessed and reflected and that a tailored message can be created specifically for a given person based on his or her unique characteristics. In other words, the defining trait of customization is that the message is individually created and delivered in response to the message recipient's preferences. In the case of algorithmic news, each content item (be it an in-depth investigation by a prestigious newspaper, a transportation announcement by a local government, or a blogger's repost of entertainment tidbits) is coded into a series of variables (such as source, genre, timeliness, views, likes, forwards, and heat index), ready to be matched with user preferences.

As previous studies suggest, customized messages have certain advantages over non-customized ones, such as being more persuasive and memorable, and thus more appreciated (Noar, Benac, & Harris, 2007). Alongside health-related information, on which health communication researchers have extensively examined customization effects, the effects of customization have also been studied with news stories (Beier, 2007) and web portal content (Kalyanaraman & Sundar, 2006), revealing some degree of superiority of customization over non-customization. As Beier (2007) found, people tend to be more attentive to and remember more about customized news stories (as opposed to non-customized ones) because these stories appeared more relevant.

Information Cocoons and News Literacy

Admittedly, the most remarkable feature of algorithmic news apps is personalization, which filters news and information for a news-seeking individual in a very

efficient way. In a world of extreme content abundance and information overflow, these apps play a critical role in assisting audiences navigating an increasingly complex and fragmented media environment, making them desirable for many people and even addictive for some. There is, of course, a certain populism at play here. Should objective newsworthiness become secondary to subjective personal preferences? One major concern regarding algorithms is the existence of systematic biases. The values, biases, or ideologies behind the algorithms can create consequences for the fair provision of information and the formation of public opinion. As the Universal Declaration of Human Rights (UDHR, proclaimed by the United Nations General Assembly in 1948) states, freedom of information is a fundamental human right—are the news recommendation algorithms violating that fundamental right?

Information Cocoons and "The Daily Me"

Personalized news recommendation reminds us of the "information cocoons" concept, which was first coined by Harvard professor Cass Sunstein in his book entitled "republic.com" (2001). It is also reminiscent of "The Daily Me" concept, which was prophesied by MIT professor Nicholas Negroponte in the very early stages of the Internet. In the prophecy, "The Daily Me" was an entirely personalized newspaper in which each individual could select perspectives that he or she liked. Both terms have been cited in warnings about consequences that may ensue at the societal level, such as the threat that the choices made by individuals will transform to a fragmentation of society so pervasive that the public sphere will become nonexistent; and at the individual level, that people are merely exposed to the types of information and opinions that suit their perspectives, and as a result, become uninformed and biased in other respects. It is also suggested that members within subgroups tend to interact only with those who are like-minded and never with those with whom they disagree (Sunstein, 2006; Sunstein, 2007). If this happens, as Sunstein warns, communication technologies can threaten democracy by creating "information cocoons," within which information is filtered and tailored to personal tastes and favored opinions. In other words, algorithmic media can create an echo chamber and lock their users into comfortable isolation, and generate inert or addicted consumers who are unaware of the cocoons of ignorance that they may have unintentionally chosen to weave for themselves. In fact, some research has found that the use of a personalized news recommender system has a negative direct effect on knowledge gain (Beam, 2014).

Media Literacy and News Literacy

Media literacy centers on the idea that media representations of reality are "socially constructed," and therefore, often incomplete, inaccurate, or even distorted. The definition of media literacy in previous research tends to commonly center on critical thinking, analysis, and evaluation, and conscious processing of mediated messages (Potter, 2004; Potter & Christ, 2007). News literacy, in particular, concerns how and why people use news media, how they make sense of what they consume, and how individuals are affected by their own news consumption (Fleming, 2014; Maksl, Ashley, & Craft, 2015). News exposure and knowledge have been linked in previous research with ample empirical evidence, particularly concerning youth.

Aspects of News Literacy

Potter's (2004) theory of media literacy has shed much light on news literacy research. Potter's cognitive approach model proposes that media literate individuals tend to think deeply about their media consumption experiences, have confidence in control of the influence of the media, and are knowledgeable about media content, the media industries, and media effects. Adapting this model to address news literacy specifically, research in this line has commonly focused on several main components of the model, including the need for cognition and orientation, knowledge of the self and of the "real world," motivations and control, news access and skepticism, news evaluation, and news appreciation (e.g., Ashley, Maksl, & Craft, 2013; Maksl, Ashley, & Craft, 2015; Maksl, Craft, Ashley, & Miller, 2017).

Algorithm Literacy and News Literacy

As Powers (2017) found, most people, even college-educated, are largely unaware of whether and how news sources track user data and apply editorial judgments to deliver personalized results. Living in a media landscape that is becoming increasingly algorithmic with growing numbers of AI-based personalized news providers, having a basic understanding of what algorithms are and do has become a crucial element of news literacy (Swart, 2021). Previous research has examined aspects of algorithm literacy, such as awareness and knowledge of algorithms, trust and confidence in algorithms, algorithm appreciation, and algorithm avoidance (Shin, Rasul, & Fotiadis, 2021; Joris, Grove, Van Damme, & De Marez, 2021). The interrelationships among these aspects and news literacy, however, are yet to be discovered in the context of algorithmic news recommendation systems.

Algorithmic Audiences

The relationship between media and its "audience" has been widely examined in communication research before. Traditionally, the term "audience" implies the passive reception of news and information. "Active audience" is used to indicate a reactive, responsive, and even participatory type of audience.

Recent years have seen a profound recasting of the notion of the "audience," along with the rise of digital technologies and social media. Media theorist Jay Rosen (2006) proposed a new media maxim, "people formerly known as the audience," to articulate the profoundness. The notion of "the former audience" and its relationship to media signifies the fundamental shift in the direction of communication from a one-to-many broadcasting system to a many-to-many conversational one (Anderson, 2011).

But neither of the terms "active audience" or "people formerly known as the audience" is adequate or appropriate to describe users of algorithmic news apps. News apps like Google News and Apple News give willing users the possibility to read, recommend, and send feedback on news stories and thus curate their news exposure. In turn, its "machines" obtain the data users generate and then analyze and "learn" about each individual user. Each user is coded to a profile in terms of gender, occupation, age, educational background, smart phone model, and so on. The users' information consumption patterns are traced over time in terms of topics of interest, view duration, comments, forwards, and so forth. Through sophisticated algorithms, individuals are matched with tailored offerings of content, taking into consideration a controlling third dimension, circumstantial features such as weather, geographic location, holidays, and network connectivity (see an illustration of the rationale in Figure 1.2).

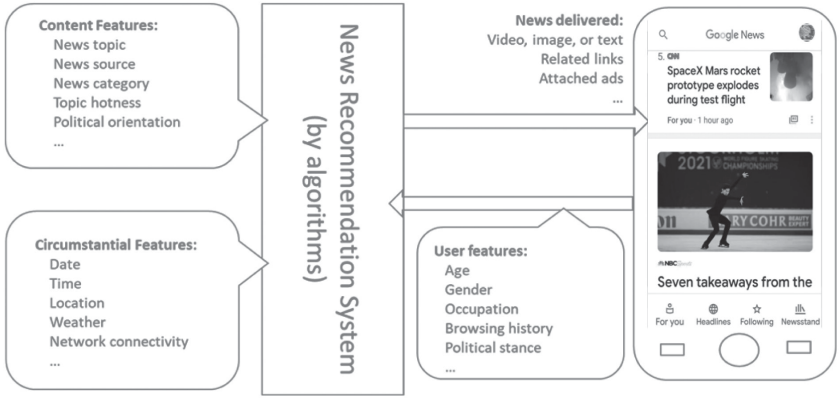

Figure 1.2 AI-Based News Recommendation System

Apparently, this tailored communication process is neither "one-to-many" nor "many-to-many." Users of algorithmic news apps, who in fact are involved in a one-to-one communication process, are probably best described as members of an "algorithmic audience" (Anderson, 2011). The concept of algorithmic audience denotes a whole new notion of the information communication process that is fundamentally transformative of the relationship between media and its "audience."

The application of algorithms in the journalism context has been sporadically examined in the past few years (e.g., Anderson, 2013; Beam, 2014; Napoli, 2014; DeVito, 2017; Carlson, 2018; Diakopoulos, 2019; Shin, 2020). However, much of such research is limited to the content production and distribution process, such as automated news writing and automated content selection. Little scholarly attention has been paid empirically to the possible effects from an audience perspective.

Other Theoretical Connections: Newsworthiness, Uses and Gratifications, Gatekeeping, Selective Exposure, and Agenda-Resisting

The practice of algorithmic media and the popularity of news apps make it necessary to revisit the newsworthiness and gatekeeping concepts, the active audience paradigm, and the agenda-setting, selective exposure, and uses and gratification theories.

Newsworthiness, or news value, has long been core to journalism and news media. Traditionally, journalism scholarship has defined newsworthiness with several dimensions, or elements, represented by William and Martin in *The Practice of Journalism* (1911, 1922), Curtis MacDougall in *Interpretative Reporting* (1932, 1935, 1938, 1949, 1957, 1963, 1968, 1972, 1982, 1987), and Johan Galtung and Mari Holmboe Ruge in *The Structure of Foreign News* (1965). As Parks (2019) notes in his historical and longitudinal study of the most influential journalism textbooks spanning 125 years dating back to 1894, although many dozens of discrete terms have been used to describe news selection criteria over the past century, a handful—timeliness, proximity, prominence, magnitude, unusualness, conflict, human interest, and impact—stand out as resilient consensus values and have been fundamentally stable since the early 1900s. In particular, Parks notes that even the 21st-century textbooks, which emerged from a multimedia or convergence media landscape, bear basic definitions of news values that are essentially the same as in the old days. It is worth pointing out that these definitions of news values come

primarily from a content-producer's (i.e., message sender's) viewpoint. Do the news audiences (message recipients) share these views of newsworthiness? As the era of Web 3.0 matures and the age of algorithm emerges, how much do the algorithmic news consumers share such norms of news values? By what criteria do the audiences judge newsworthiness in news and information processing? What could be some new dimensions? For instance, with news consumption mostly taking place in the cyber space instead of the physical space, is proximity still a geographic concept? In a rapidly evolving media market, achieving relevance, giving audiences the news they want and find interesting to keep them engaged, is an increasingly important goal for media outlets and news aggregators seeking to maintain market share. In revisiting news values in the age of social media, Harcup and O'Neill (2017) find a contemporary set of news values that includes new dimensions such as shareability (likely to generate sharing and comments via Facebook, Twitter, and other forms of social media), entertainment (concerning sex, showbusiness, sport, lighter human interest, animals, or offering opportunities for humorous treatment), audio-visuals (having arresting photographs, video, and/or audio that can be illustrated with infographics), and relevance (regarding groups or nations perceived to be influential with, or culturally or historically familiar to the audience). In the age of algorithm and social media, the definition of news value may well evolve from content-producer-centered to audience-centered. In search for updated journalistic values in AI-based news recommendation systems, Bastian, Helberger, and Makhortykh (2021) notice that the integration of recommendation algorithms into journalism moves audience-centered perspectives more to the front as the concept of news values undergo fundamental changes caused by evolving distribution practices. Unlike the self-centered content-producer perspectives, which deal primarily with internal journalism practices and their products, audience-centered values are outward-looking, care more on the interactions between media organizations and their audiences. As such, personal relevance, usability, enjoyment, surprise, and user agency may well be identified as new dimensions of newsworthiness.

Uses and gratifications theory assumes that audience members are not passive consumers of media. Diverging from other mass media effect theories that largely question "what does media do to people?", uses and gratification theory is audience-centered, asking "what do people do with media?" It focuses on how users deliberately choose media that will satisfy given needs and allow one to enhance knowledge, relaxation, social interactions/companionship, diversion, or escape. Key to algorithmic recommendation systems, personalization fulfils some of these gratifications for news consumers. Uses and gratifications theory can certainly explain the increasing popularity of algorithmic news apps.

Uses and gratifications theory also holds that the audience has power over their media consumption and assumes an active role in interpreting and integrating media into their own lives. It argues that audiences are responsible for choosing media to meet their desires and needs to achieve gratification. An algorithmic user is active in that he or she curates his or her news consumption by determining what to have and what not to have, thus playing a quasi-gatekeeper role, thanks to machine-learning and algorithms. Consequently, the algorithmic users are empowered to refuse to be a part of the general public in an agenda-setting process, which is termed "agenda-resisting" in this study.

Customized news systems are intrinsically selective. Previous research has found that using personalized news systems increases selective exposure. Research on selective exposure has demonstrated that people tend to view information that supports their own perspective, and attitude-consistent information tends to reinforce pre-existing attitudes and decisions (Festinger, 1964; Beam, 2014). According to Festinger's (1964) selective exposure theory, dissonant information, or information that does not match with the user perception or attitude, tends to increase uncertainty and discomfort in a user. As a result, the individual user tends to consume information that is congruent with user behavior (pro-attitudinal) and tries to avoid information that conflicts with one's perspectives (counter-attitudinal). An algorithmic news recommendation system allows the possibility to selectively filter news based on personal preferences and to easily disregard stories deemed irrelevant or counter-attitudinal, thereby eroding the editorial control of news information by traditional gatekeepers in the news media (Beam, 2014). Selective exposure on the Internet may also breed political polarization and extremism. As Stavrositu (2014) suggests, due to easy online access, people are likely to hold even stronger views than those they started with; when these views are problematic, selective exposure may further distort their political beliefs and ultimately their participation in the public sphere.

With the emergence and popularity of AI-powered media like the algorithmic news apps, the affordance of the Internet has evolved from participatory to algorithmic. Rapid growth rates in algorithmic news app usage invite speculation about and reflection on the practice and profession of journalism. One key dimension of power that appears to be at stake in the public sphere is the role of traditional "gatekeepers" (McQuail, 1993), that is, the production of news is subject to the multilayered screening of various "gatekeepers" (sources, journalists, editors) before reaching the audience (Shoemaker & Vos, 2014). The democratic deficit in such a traditional gatekeeping process lies in the inability and incapacity of audiences to involve themselves in those selections. In a media landscape featuring scarcity with limited numbers of news outlets regularly sharing routines, sources,

and journalistic cultures alike, the audience is largely powerless, with probably the only option being to distance or disengage from traditional news media, just like increasing numbers from younger audiences have been doing (Goode, 2009).

The democratic appeal of Internet-based news lies in the possibility of easing that scarcity. While new possibilities emerged for public participation along the news production process, blogs, citizen journalism, and social news sites have made the professional media and its working journalists into mediators instead of gatekeepers (Goode, 2009). Furthermore, the algorithmic audience of news apps gets to decide virtually what kinds of news and information they wish to be exposed to and thereby participate actively in the agenda-setting process (McCombs & Shaw, 1972); this represents a new form of gatekeeping and speaks for an "agenda-resisting" culture.

The personalization communication model easily maps onto the notion that agenda-setting and gatekeeping are escaping from the hands of professional media elites. How news app users utilize such information service platforms may be far from passive consumption. In other words, they are not a general "public" being fed a "set" agenda in a traditional agenda-setting process. News app users, through active engagement such as commenting, sharing, and providing feedback to the algorithm regarding their preferences, virtually decide their own subsequent media exposure. It may be too early to say that the emergence of algorithmic audiences constitutes the end of agenda-setting by elite media and its working professionals, but the phenomenon does send a strong signal and should not be neglected or taken lightly by media researchers.

As Moores (1993) points out, the newer notion that news production does not end with the news outlet has already been theorized through the active audience paradigm, which emphasizes the role of audiences themselves as proactive producers of meanings as they digest and discuss media content in various ways, sometimes reframing them in the process. The renewed active audience paradigm, however, has not theorized an audience that is active to the extent of being in a gatekeeping role itself. It is necessary to look into this emergent new mode of gatekeeping power. The algorithmic news app phenomenon calls for a theoretical synthesis of the active audience perspective, the gatekeeping perspective, and the uses and gratifications perspective. These perspectives need to be developed to embrace the existence of the algorithmic audience. The agenda-setting theory, which was initiated in a traditional media landscape half a century ago and assumes a relationship between a "wholesale" media and an aggregated and general public, also needs to be revisited and redefined.

In broad terms, an algorithmic audience like that of AI-based news apps does nurture an unprecedented potential power for individuals who consume news and information online. Nevertheless, as always, democracy or power comes

with a price. The algorithmic gatekeeping and agenda-resisting may raise ethical concerns, as with any other AI practices, which can arguably operate with biases.

Why Bother?

Does algorithm news recommendation facilitate or constrain news consumption? Are AI and algorithms an opportunity for, or a threat to, the democratic role of the news media and the well-being of their audiences? This study employs a mix-methods approach to examine and interpret the algorithmic news consumption phenomenon from several interrelated perspectives, including tailored communication, customization, gatekeeping, agenda-resisting, and news literacy. Potential implications for an empowered or, rather, (information-) cocooned public are explored. The project aims to illuminate the renewed relationship between media and audience and the effects on users of algorithmic processes. This study calls for the theoretical development of a renewed conception of the active audience and the redefinition of agenda-setting to advance this new and understudied "algorithmic audience" subject matter.

To its merit, personalization can be useful as it filters news based on the preferences and interests of a news seeker. However, personalized news consumption may limit users' exposure to different types of news and affect users' behavior in the long run, leading to avoidance of counter-attitudinal information and opinions (Helberger, 2019; Raza & Ding, 2021). As some scholars have warned, the algorithm is a new type of actor that intervenes directly in communication processes and has the capacity to shape and impact on individual lives (Beer, 2009; Napoli, 2014). An "information cocoons" effect, with concerns about the demise of a well-rounded public sphere and the formation of biased and ignorant individuals who see a distorted world, remains compelling. Unfortunately, as algorithmic news itself is such a fledgling concept, such research is still rare and sporadic, to say nothing of more specific research on its impact on the audience. Much of the research on algorithmic news recommendation has been conducted from a technical perspective by computer scientists in both the academia and the industry sectors, ignoring the potential effects of algorithmic news consumption on users, socially and personally. Meanwhile, the limited amount of discussion, likely among people in the mass communication and information law fields, that addresses the effects of algorithmic news consumption on the public seems to be short of supporting evidence. The potential impact that algorithmic media may have on members of the public and on society as a whole in the long run is a growing concern and needs to be empirically and carefully investigated.

This study takes a first step to relate news appreciation, selective exposure, gatekeeping, uses and gratifications, agenda-setting, algorithmic literacy, and news literacy to the recent phenomenon of algorithmic news consumption. It represents a substantive effort to develop this research line. As we head towards the age of AI, research on the role and impact of algorithms and artificial intelligence on news audiences is essential for understanding the future of journalism, and the future of civic society as a whole.

Research Question and Hypotheses

Facilitated or constrained? While the potential impact of algorithmic media on their audiences has yet to be further researched and articulated, hypotheses for a positive or negative impact on news appreciation, news literacy, and public agendas seem plausible, at a minimum. Based on previous research, this exploratory study proposes the following general research question and hypotheses:

RQ: Does algorithm-powered news recommendation have an effect on an audience's news appreciation, news literacy, and public agenda?

H1: Level of exposure to algorithmic news is associated with news appreciation, need for cognition, need for orientation, locus of control, access and skepticism towards news media, and current events knowledge.

H2: Algorithmic literacy influences news literacy.

H3: The public agenda (MIP — most important problem) among heavy algorithmic news app users differs from that of their light-user peers.

Outline of the Book

The aim of this book is multifaceted: (1) to describe the phenomenon of AI-based news recommendation; (2) to explore the user experience of consuming recommended news; (3) to analyze the effects that algorithmic news consumption has on audiences; (4) to raise awareness of the impact of algorithmic news consumption; (5) to inform the public, technocrats, and policy makers of the effects of algorithmic news consumption; (6) to guide debate on ethical decision-making and possible policy change. Through an empirical investigation process, this volume examines algorithmic news consumption from a user perspective and dissects the complex effects caused by such consumption.

Chapter 1 (this chapter) begins the book with an overview that places algorithmic news recommendation and news consumption in light of the recent

technological advancements and the changing media landscape. It explicates the possible theoretical connections for the algorithmic news consumption phenomenon and lays the rationale ground for the investigation. Chapter 2 reviews the brief history of algorithmic news recommendation systems and presents key terms and definitions used in the study. Chapter 3 introduces the methods that this study used to collect empirical data, including a pilot study of a convenience sample of local students and a large-scale study of a national sample. Chapter 4 and Chapter 5 present the findings generated from the pilot study with 300+ participants, including a survey, an experiment, and a series of follow-up interviews. Chapter 6 takes the volume to a national scope and starts the large-scale inquiry by discussing the results of the national survey of 1000+ participants. As demography is key in social sciences, Chapter 7 focuses on demographic matters, showing the impacts of such factors as gender, age, major/occupation, and education level on news consumption. Chapter 8 carries on the national-level inquiry by presenting qualitative findings resulting from in-depth discussions with a volunteer sample of 100+ news app users nationwide. Chapter 9 specifically draws on the users of the Google News app and the Apple News app, profiles of which are compared. Chapter 10 concludes the volume by reiterating key findings, addressing limitations in the current inquiry, and looking forward to future directions.

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CHAPTER 2

A Brief History of NRS, Key Terms, and Definitions

If the most important development in the media sector in the last decade of the 20th century is news becoming searchable, and sharing and forwarding news is the most significant feature in the first decade of the 21st century, made possible by the social networking media, then consuming news via algorithm-based news recommendation systems (NRS) may be the most notable breakthrough of the second decade onward, made possible by the phenomenal popularity of AI-based news apps installed in mobile devices among the general public. This chapter reviews the significance and evolution of the algorithm-based recommendation system and how it applies to news content distribution and news consumption. The chapter also presents the key terms and their definitions used in this inquiry.

A Brief History of NRS

Since the Year of Internet, 1995, the World Wide Web has evolved from Web 1.0 to Web 2.0, and then to Web 3.0. The news media industry, which has gone digital and online along with the evolution of Internet technologies, develops in tandem with the pace of technological advancements. As such, it is worthwhile to revisit the evolving communication models that are associated with these

technological advancements because it will allow us to make sense of the current state of the media.

Web 1.0, the first version of the Web, also referred as "static Web" or "read-only Web," had what can be called a "one-to-many" top-town communication model. In this model, the role of the news consumer was limited to reading news and information that is largely textual, provided by the traditional media outlets, be it print, broadcast, or digital native. Users had no option to communicate information to the content producers. There was no existing feedback channel between the message sender and the message receiver. It was simply a case of traditional media outlets shoveling the content they produced in their traditional way into the cyber space.

The advent of the new millennium marked the beginning of Web 2.0, which can be labeled "interactive Web" or "read-write Web." Web 2.0 is participatory in nature and facilitates interaction between information producers and information consumers. It allows a user to communicate with fellow users as well as content providers. In this "many-to-many" communication model, everyone has the capacity of dual roles—information consumer and information producer. User-generated content is a signature feature of the Web 2.0 era. Since the birth of social media such as Facebook and Twitter, news and information are also distributed and cross-shared among different sites and networks. As such, the communication model for Web 2.0 can be categorized as "many to many." With the innovation in interactive communication technology, the Internet has become a major source of news. In 2018, Pew Research Center reported that 93% of adults in the United States tend to consume news online, either mobile or desktop, through digital news media, social media, or news apps.

The second decade of the new millennium (2010s) began with witnessing the application and popularization of algorithm technology in e-commerce enterprises such as Amazon and Netflix. Social networking sites also picked up algorithm technology and helped drive the Web into the Web 3.0 era. This new era of the Web can be named "semantic Web" or "read-write-execute Web," in which computers use algorithms to interpret information via machine learning and then perform decision-making like humans (artificial intelligence). Algorithms are often used to achieve personalization and customization for the purpose of marketing and customer retention. As such, the communication model for Web 3.0 can be categorized as "one to one," a distinctive characteristic of this whole new era.

In the news media sector, while online news consumption became more and more prevalent as the Web provided access to news content from millions of sources around the globe, a big challenge for news media lay in helping users find the news content they generated interesting and relevant and thus retain audience.

Algorithms therefore came into play to help intelligently generate and distribute relevant content tailored to the interpreted need of a particular user. News organizations such as the BBC, CNN, The New York Times, Washington Post, The Guardian, and the like, invested tremendous resources to develop recommendation algorithms to provide more personalized news content to their audiences via their websites and apps. In the early days of news recommendation practice, a basic level of personalization was achieved by having users select categories of news that are of interest and then pushing content packages such as newsletters accordingly. Algorithm technology took news recommendation to a whole new level of sophistication and effectiveness. The AI-based news apps that were born in Web 3.0, represented by news aggregators such as the U.S.-based Google News and BuzzFeed, and the China-based Jinri Toutiao (Today's Headlines), are designed to adapt to a user's reading interests and improve over time based on the browsing history and activities of the user, which are fed back in the form of user data and help the algorithm improve future recommendations. The ever-learning "machine" behind these news apps obtains the data users generate, such as browsing history, rating, recommending, commenting, and sharing activities, and then analyzes and "learns" about each individual user, whose profile is coded in terms of gender, occupation, age, education background, smart phone model, and so on. The users' information consumption patterns are traced over time in terms of topics of interest, view duration, comments, forwards, and so forth. Through sophisticated algorithms, individuals are matched with tailored offerings of content, taking into consideration a controlling third dimension, circumstantial features such as weather, geographic location, holidays, and network connectivity. It is an immense accomplishment, from a business standpoint, to provide customers with products that reflect their interests. According to a Pew Research Center study conducted in mid-2021, 73% of the highest-traffic news outlets have apps that incorporate algorithms.

Apparently, this kind of tailored NRS is neither "one-to-many" nor "many-to-many." Algorithm-based news apps symbolize a one-on-one model of communication, which is the keynote of Web 3.0. To further illustrate how an algorithmic NRS works, take Google News for example. For users who are logged in and have enabled Web history, Google News engineers build recommendation systems based on the profiles of users' news interests generated from their past click behavior. To identify how users' news interests change over time, they conduct extensive analyses of Google News users' click logs. Based on the analyses, they develop an algorithm for predicting a user's current news interests from the activities of that particular user and the news trends demonstrated in the activity of all users. They then combine the content-based recommendation mechanism, which

uses user profiles, with an existing collaborative filtering mechanism to generate personalized news recommendations. They continuously experiment on the live traffic of the Google News website to test the recommendation system so as to allow self-correction in the algorithm for the purpose of ensuring quality of news recommendation and maintaining traffic to the site.

Personalized NRS, since its birth, has evolved as one solution for many people to deal with the massive and ever-increasing growth of information sources available online. As intended, AI-based NRS can lead users to the relevant information that matches their areas of interest and satisfies their needs and preferences, without having to sift through uninteresting or irrelevant news and information by themselves. While more and more news aggregators, as well as stand-alone news media, become more and more algorithmic in their content distribution process, more and more people intentionally or unintentionally become AI-based news app users as such apps come in handy as pre-installed systems in their mobile devices that they use every day. As mobile technologies and applications become ubiquitous in people's lives, news recommendation feeds from news aggregators such as Google, Yahoo, and Apple, and social media such as Facebook and Twitter, have more or less taken over how the ordinary public discover and consume news. Once a news portal's recommendation functionality is installed, the algorithm rules.

According to Statista[1], in 2017, 26% of the U.S. population used news apps. In July 2020, Business Insider[2] estimated that total news app users in the United States would reach 114.1 million in 2020 (43% of the U.S. population), a 15% increase over 2019.

Key Terms and Definitions

The key terms involved in this inquiry are presented and defined as the following.

Active Users

People who use a certain medium or a particular product with a certain level of regular engagement, such as daily, weekly, or monthly.

1 https://www.statista.com/statistics/308175/news-app-usage/

2 Nina Goetzen, "News app usage is spiking in 2020, but will fall again next year." https://www.businessinsider.com/2020-news-app-usage-will-spike-but-fall-next-year-2020-7

Algorithm

A technical term that means a set of steps that are followed in calculations to complete a computing process. It is usually carried out by a computer. In computer science, an algorithm is a finite sequence of well-defined instructions, the set of logical rules used to organize and act based upon a body of data for the purpose of solving a problem or accomplishing a task goal such as calculations, data processing, automated reasoning, or automated decision-making. An algorithm is typically modeled, trained on a body of data, and then adjusted as the results are examined.

Algorithmic Literacy

The awareness of what algorithms are and do, how they work and interact with human behavioral data in information systems, the understanding of the social and ethical issues related to the existence and involvement of algorithms, and the critical thinking skill for judging the reliability and credibility of algorithm-involved information and consumer products. In a media landscape that is becoming increasingly algorithmic with a growing number of AI-based personalized news providers, having a basic understanding of what algorithms are and do, and the bias and injustice they entail, has become a crucial element of news literacy.

App

App is short for "application," typically a small, specialized program designed for and downloaded by a user onto a mobile device such as a smartphone.

Artificial Intelligence (AI)

Intelligence demonstrated by machines, as opposed to natural intelligence displayed by animals or human beings. It involves the design of computers or other programmed mechanical devices to simulate human-like intelligent behavior and thought process. AI is expected to be able to interpret and absorb new information for improved problem-solving, and recognize patterns. Examples of AI include Web search engines such as Google; recommendation systems such as those used by YouTube, Amazon, and Netflix; speech recognition; facial recognition; chat bots; and unmanned vehicle navigation. AI relies on machine-learning capabilities and training data. Humans are involved in creating or collecting training data.

Customization

The act or process of building, fitting, modifying, or altering consumer products that are in accordance with individual or personal specifications, preferences, needs, or requirements.

Echo Chamber

An informational compartment around a user, where the user is only exposed to information that resonates his or her existing beliefs. See also "filter bubble," and "information cocoon."

Filter Bubble

A situation of intellectual isolation in which an Internet user encounters only information and opinions that conform to and reinforce their own beliefs, which may be caused by algorithms that assume what an individual wants to see and personalize an individual's online experience.

Information Cocoon

A cocoon is a silky spun casing that the larvae of moths and other insects make for themselves before they grow into adults. The information cocoon is a concept proposed by Harvard professor Cass Sunstein in his book entitled "republic.com." The term implies that users of personalized recommendation systems, such as AI-based news apps, will likely select and be exposed to information and perspectives that are in their favor. This term has been cited widely to warn about such ethical concerns as, at the societal level, the threat that the choices made by individuals will add up collectively to a fragmentation of society so pervasive that the public sphere will cease to exist; at the individual level, people will be exposed only to the kinds of information and opinions they want to hear (as a result becoming uninformed in other regards and biased), and members of like-minded subgroups will interact only with their fellow members and never with those with whom they disagree.

Machine Learning

A branch of computer science that uses and develops computer systems that can learn and self-adapt without following explicit instructions, using algorithms and

statistical models to analyze and draw inferences from patterns in data and make predictions. Machine learning algorithms build a model based on sample data, known as training data. The purpose of machine learning is to enable computers to automate analytical model-building so computers can learn from data with little human intervention. It is considered a part of artificial intelligence.

News App

An application specialized in news distribution that is downloaded onto digital devices. A news app can be developed by a news aggregator or a single news media outlet to facilitate news consumption.

News Consumption

The act or process of reading, watching, listening, or browsing news. News consumption now most commonly occurs online as consumers now use social media for keeping up to date. As of 2021, nearly half of U.S. adults use social media for news often or semi-regularly[3].

News Literacy

The awareness of how journalism and news media work, and the critical thinking skill for judging the reliability and credibility of news information, be it from print, television, or the Internet. This is a particularly important skill in the digital age, as people struggle with information overload, and in the "post-truth era," as people struggle with misinformation and disinformation. News literacy concerns how and why people use news media, how they access, evaluate, analyze news, and make sense of what they consume, and how individuals are affected by their own news consumption. News literacy consists of several dimensions, such as need for cognition, need for orientation, locus of control, skepticism toward news media, and news appreciation, and current event knowledge. To be news literate means one is knowledgeable of press principles and practices and has the ability to access, evaluate, and analyze news content, as well as the awareness of current affairs.

3 https://www.statista.com/topics/1640/news/

News Recommendation System (NRS)

A system that produces news recommendations as output or has the effect of pruning large information spaces so that users are directed toward news content that the automated system determines best meets their needs and preferences. An NRS is usually personalized and intended to relieve information overload.

Personalization

The act or process of tailoring something to meet an individual's specifications, needs, or preferences. For instance, the process of filtering search results or modifying the available content of an online platform to match an individual's expressed or presumed preferences, established through creating user profiles and using that data to predict whether and how an individual will act on algorithmically selected and distributed information. Personalization is a key element in social media and algorithmic recommendation systems.

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CHAPTER 3

Methods of Inquiry

This research project comprises a large-scale national survey and an in-depth qualitative study on a U.S. national sample, preceded by a pilot study using a convenience sample of local participants. The pilot study includes a survey, an experiment, and a series of follow-up individual interviews. The surveys were administered via Qualtrics, the leading research software commonly used to aid social science studies.

A questionnaire with mostly close-ended questions was employed to delineate relevant characteristics of the news audience, in this case, algorithmic media users and their counterparts for the survey. The measurements were designed in the light of previous studies along the research lines of news literacy, customization, tailored communication, algorithm literacy, source diversity, trust in media, newsworthiness, and agenda-setting. Interview instruments were created with a list of open-ended questions and used in qualitative studies on both the local and the national samples.

The Pilot Study

The Survey

Sampling. The pilot study used a convenience sample of college students. This is a group of news consumers from the segment of the general population that consumes news online and uses news apps the most. It is also the target group that is of the most scholarly concern in terms of news literacy. The project used administrative access to reach out to undergraduate students enrolled in GE (general education) courses at a large public university in order to avoid a disciplinary bias and maximize representation. A total of 317 GE students responded to the survey. The sample, representative in terms of racial, ethnic, gender, and geographic diversity because of the particular university's unique student body composition, was ideal to serve the research purpose. Participants were recruited via administrative and collegial channels across the academic disciplines on campus in early 2020.

Measures. In light of previous research, this research project devised an eight-section questionnaire to collect quantitative data, which includes groups of measurements forming the constructs. Aside from the "Current Events Knowledge," "Media Use and News Consumption," and "Demographic Information" sections, which contain ratio-level true-value measurements and categorial variables, the other five sections each contain multiple 5-point Likert-scale statements to be rated from "strongly disagree" to "strongly agree." These five sections correspond respectively to the five constructs of need for cognition (e.g., "I prefer complex to simple problems"; "The notion of deep thinking is appealing to me"; "I would rather do something that is sure to challenge my thinking abilities than something that requires little thought,") need for orientation (e.g., "I want to know more about different aspects of a current topic/issue"; "I want to be instantly informed about recent developments in the world and my community"; "I follow the news for my own good,") locus of control (e.g., "I am in control of the information I get from the news media"; "The main thing that affects my knowledge about the world is what I myself do"; "If I pay attention to different sources of news, I can avoid being misinformed,") skepticism toward news media (e.g., "I question the content of the media, including if it is from a credible source"; "I can effectively use various media tools to access different sources for news"; "I can evaluate the possible consequences in case I share messages that contain unreal and purposeful information,") and news appreciation (e.g., "The news that I have access to consume is interesting"; "The news that I have access to consume is easy to understand"; "I often recommend/forward news to my friends"). Current events knowledge is measured by 10 questions on current news that were compiled from sources such as the

Washington, D.C.-based nonpartisan nonprofit News Literacy Project (https://newslit.org/about/), Google News (Web version), and the BBC. These questions cover the most recent news in world, politics, business, health, science and technology, sports, and entertainment. As for media use and news consumption, several variables are included to measure algorithmic news app use (a list of AI-based news apps was compiled based on previous research and Web resources), including "number of news apps used on a regular basis," "on average, how much time in a typical day do you spend consuming news on news apps?" and "what percentage corresponds best to the proportion of time you spend getting news from news apps, among other ways."

Data processing. Data collected via the survey were entered into SPSS (Statistical Package for the Social Sciences) for statistical analysis and hypothesis testing. A series of ANOVA (analysis of variance) and correlation analyses were performed to explore the differences and relations respectively. For the ANOVA test, the independent variable was news app use, measured in categories as using none, 1-2, or 3+ news apps on a regular basis. For the correlation analysis, the news app use variable was measured as true value—that is, number of news apps used on a regular basis.

The Experiment

Following the survey of news audiences among college students, an experiment was designed and conducted in the spring of 2020. Among the 317 survey participants, 57 volunteered to remain in the study for an experiment of longitudinal nature, Time 2 of which is approximately one month after the initial survey (Time 1). Among the 57 participants, 37 consented to follow instructions and refrain from consuming recommended news, while the rest served as the control group (non-random group assignment). Upon completion of the experiment process, 13 participants agreed to continue with the study for follow-up interviews.

The one-month field experiment was conducted right after the end of the survey in April 2020 (Time 1). The experiment period ended in May (Time 2). During the one-month period, participants of the experiment group were instructed to refrain from consuming recommended news and, instead, maintain a proactive approach to seek for news (see Appendix 3.1). Specifically, they were instructed to (1) uninstall all news apps at the beginning of the experiment period; (2) refrain from opening/reading news feed/push notifications; (3) refrain from consuming news from social media, such as Facebook, Twitter, Instagram, and YouTube, which track user profiles and online behavior; (4) when getting news from a Web browser, be sure his or her account is signed out so that their browsing

pattern is not being tracked. At the beginning of the experiment period, informed consent was obtained in writing, which includes a Statement of Pledge as follows:

"By answering 'yes,' I pledge that I will follow the instructions. I will maintain a PROACTIVE approach to seek for news and refrain from consuming recommended news for a month before completing the follow-up survey."

The same measurements were used in Time 2 to assess participants' news consumption behaviors and news literacy. At Time 2, the experiment group was compared to the control group using independent sample t-test; and compared to its Time 1 using paired sample t-test.

The Follow-up Interviews

Right after the experiment, the 37 experiment subjects were invited to participate in a follow-up in-depth interview. Thirteen of them agreed to take part at this last stage of the pilot study. Because of the COVID-19 lockdown, it was impossible to conduct in-person interviews as per the original project design. As such, some participants chose to do the interview via Zoom. Some others chose CAPI (computer-assisted personal interview). For CAPIs, semi-structured interview questions with branches for automated skip/display logics were pre-organized and made accessible via Qualtrics for interviewees, with an open option for the participants to reach out to the researcher and vice versa for further communication and follow-up. Judging by the quality of the data eventually collected via Zoom and Qualtrics, the researcher believes that the pandemic-confined data collection is largely equivalent to in-person interviews. The researcher finds no obvious reason to believe that the quality has been compromised.

The interview instrument consists of a total of 10 main questions, which are open-ended. Subjects were asked to talk about their user experience during the experiment period and their views on using/not using algorithmic news apps.

The National Study

The National Survey

After the initial research in the pilot study, which used college students as a sample to represent the youth population (N = 317), the research was expanded to include the general public. A questionnaire, largely the same as the one used in the pilot study except for minor adjustments to fit the national context, was employed to measure relevant characteristics of the algorithmic audience and their counterparts. The national survey was also administered via Qualtrics.

Sampling. To allow for a sample of national scope with a limited budget, Amazon Mechanical Turk (MTurk) was considered an appropriate and desirable sampling channel. MTurk has a pool of respondents for surveys managed by Amazon, which is now widely used by many research and higher education institutions. It is considered an effective and efficient tool to access a sample that is closely representative of the U.S. population, although not a random sample. This national survey used a volunteer sample of MTurk Human Intelligent Task (HIT) workers who are U.S. residents with MTurk records showing an approval rate of 99% or higher, and the number of HITs approved being 100 or more. Participants were recruited via MTurk and the survey administered via Qualtrics was completed in June 2021. A small monetary reward is paid to each participant as a token of appreciation. A total of 1212 respondents took part in the survey. Eliminating invalid cases (mostly those with an unreasonably short time spent on the survey) resulted in the final sample of 1156 cases. The sample was representative in terms of age, gender, education, income, and geographic diversity, which is ideal to serve the research purpose.

Measures. In light of previous research and the preceding pilot study, the national survey used a questionnaire that was similar to the pilot study to collect quantitative data, which includes groups of measurements forming the constructs. Aside from the "Current Events Knowledge," "Media Use and News Consumption," and "Demographic Information" sections, which contain ratio-level true-value measurements and categorial variables, the other five sections each contain multiple 5-point Likert-scale statements to be rated from "strongly disagree" to "strongly agree." These five sections correspond respectively to the five constructs of *need for cognition* (e.g., "I prefer complex to simple problems"; "The notion of deep thinking is appealing to me"; "I would rather do something that is sure to challenge my thinking abilities than something that requires little thought,") *need for orientation* (e.g., "I want to know more about different aspects of a current topic/issue"; "I want to be instantly informed about recent developments in the world and my community"; "I follow the news for my own good,") *locus of control* (e.g., "I am in control of the information I get from the news media"; "The main thing that affects my knowledge about the world is what I myself do"; "If I pay attention to different sources of news, I can avoid being misinformed,") *skepticism toward news media* (e.g., "I question the content of the media, including if it is from a credible source"; "I can effectively use various media tools to access different sources for news"; "I can evaluate the possible consequences in case I share messages that contain unreal and purposeful information,") and *news appreciation* (e.g., "The news that I have access to consume is interesting"; "The news that I have

access to consume is easy to understand"; "I often recommend/forward news to my friends"). Current events knowledge was measured by 10 questions on current news that were compiled from sources such as the Washington, D.C.-based nonpartisan nonprofit News Literacy Project (NLP, https://newslit.org/about/), Google News (Web version), and the BBC. As for media use and news consumption, several variables were included to measure algorithmic news app use (a list of AI-based news apps was compiled based on previous research and Web resources), including "number of news apps used on a regular basis" to measure variety, "on average, how much time in a typical day do you spend consuming news on news apps" to measure duration, and "what percentage corresponds best to the proportion of time you spend getting news from news apps, among other ways" to measure proportion.

The national survey questionnaire also embedded a news literacy quiz hosted on the NLP website and quiz scores were recorded by Qualtrics to be used for news literacy measurement reliability cross-check. In addition, in light of the pilot study, a new block of questions was included that measures participants' algorithm literacy, trust in algorithm technology, perceived source diversity, and reliability (e.g., "I am aware that news apps may recommend news based on algorithms"; "I have trust and confidence in news apps when it comes to recommending the news fully, accurately, and fairly"; "I am exposed to news that has source diversity and diverse viewpoints"; "I believe that news app recommendations are reliable"; and "I think that the recommended news in the news apps I use reflect my personalized preferences and are a good match to my needs").

Data Processing. Data collected via the survey were entered into SPSS for statistical analysis and hypothesis testing. A series of ANOVA and correlation analyses were performed to explore the differences and relations respectively. For the ANOVA test, the independent variable was news app use, measured in categories as low (<1 hour), moderate (1–3 hours), or heavy (<3 hours) use on a regular basis (duration of use). For the correlation analysis, the news app use variable was measured as true value—that is, number of news apps used on a regular basis (breadth of use). Structural equation modeling analysis was conducted to explore and confirm the relationships among the variables.

The Qualitative Study

Further to the national survey of news app users, which used primarily quantitative measurements, a qualitative study of individual news users followed. It

was originally designed as in-depth personal interviews but due to COVID-19 restrictions, quasi-interviews in the format of an open-ended questionnaire were conducted instead. Volunteer participants were recruited via Amazon Mechanical Turk. To respect and preserve the anonymous nature of MTurk workers, semi-structured interview questions with branches for automated skip/display logics were pre-organized and made accessible via Amazon MTurk and Qualtrics for participants, with an open option for the participants to reach out to the researcher and vice versa for further communication and follow-up. As such, we call these acts quasi-interviews. In total 101 participants completed the quasi-interviews in the summer of 2021. NVivo (a qualitative data analysis software package produced by QSR International) was used to analyze and code the qualitative responses. Judging by the quality of the qualitative data collected via MTurk and Qualtrics, the researcher believes that the pandemic-confined data collection is largely equivalent to in-person interviews. The researcher finds no obvious reason to believe that the quality of the research has been compromised.

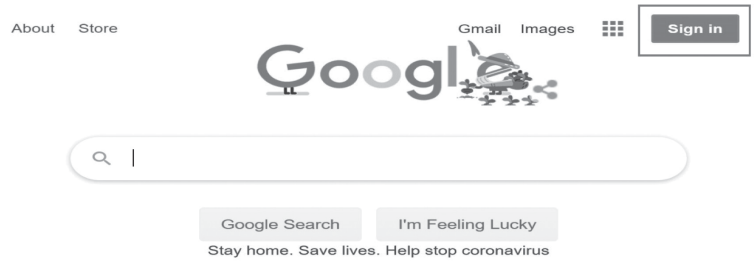
Appendix 3.1

Instructions for News Consumption During the Study Period

1. Study duration: One month, from April 23 to May 22.
2. General guideline: Maintain a PROACTIVE approach to seek for news during the study period. Avoid recommended news. Refrain from opening/reading news feed/push.
3. Uninstall all ***news apps*** by April 23 (Note: app is short for "application," typically a small, specialized program downloaded onto mobile devices) in your devices, such as Google News, Apple News, BuzzFeed News, Flipboard, and Microsoft News, which have algorithm-based news recommendation systems (you can install them back as soon as you complete the study on or after May 22).
4. During the study period, please refrain from consuming news from ***social media***, such as Facebook, Twitter, Instagram, and YouTube, which track your profile and online behavior.
5. During the study period, when getting news from a Web browser, be sure your account is ***signed out*** so that your browsing pattern is not being tracked.

For example:

In Google/Chrome, at the upper right corner, you will see your account icon. Please be sure it is signed out. Your account icon will become a "Sign in" button (see image below) when you are signed out.



Likewise, in the Yahoo website, you can do the same, as shown below:

CHAPTER 4

The Pilot Study: The Survey

This pilot study answers a set of research questions and tests a hypothesis through a small-scale survey using a convenience sample of college students. As mentioned in Chapter 3, the sample comprises a group of news consumers from the segment of the general population that consumes news online and uses news apps the most. It is also the target group that is of the most scholarly concern in terms of news literacy. For specific details regarding sampling and data collection procedures, please see Chapter 3.

According to the United Nations, "youth" is defined as those persons between the ages of 15 and 24 for statistical consistency across regions. This age range corresponds to high school, college, and graduate school students. A large majority of youth receive their news content via online sources and news apps. According to the newly released Digital News Report of 2019 by the Reuters Institute for the Study of Journalism at the University of Oxford, young people rely heavily on mobile phones and spend a lot of time with social networks, which means much of their media use and news consumption is algorithmically curated and personalized. As such, should we be concerned that youth will end up in an "information cocoon"? How might the use of algorithmic news apps affect their news literacy? Do such algorithmic news apps facilitate or constrain news consumption?

Research Questions and Hypothesis

Facilitated or constrained? Will algorithmic media leave some groups of people worse off? While the potential impact of algorithmic media on individuals has not been fully researched and articulated, a hypothesis for a positive or negative impact on news appreciation and news literacy is plausible (see Chapter 1). Based on previous research, this pilot study proposes the following research question(s) and hypothesis:

RQ: *Does the use of algorithmic news apps* ***have an effect on*** *an individual's news literacy?*

Specifically:

RQa: *Are heavy algorithmic news app users* ***less likely to prefer*** *mindful thought processing (need for cognition) relative to their light-user peers?*

RQb: *Are heavy algorithmic news app users* ***less motivated*** *toward news consumption (need for orientation) relative to their light-user peers?*

RQc: *Do heavy algorithmic news app users feel* ***less in control*** *of news media influence (locus of control) relative to their light-user peers?*

RQd: *Do heavy algorithmic news app users have a* ***lower level of skepticism*** *toward news media relative to their light-user peers?*

RQe: *Do heavy algorithmic news app users have a* ***higher level of news appreciation*** *relative to their light-user peers?*

RQf: *Are heavy algorithmic news app users* ***less knowledgeable about current events*** *relative to their light-user peers?*

Hypothesis: *Level of exposure to algorithmic news is* ***positively associated with*** *news appreciation, and* ***negatively associated with*** *need for cognition, need for orientation, locus of control, skepticism toward news media, and current events knowledge.*

Findings

A total of 317 responses from the college student sample were collected via Qualtrics, a professional online survey tool. After verification and data cleaning,

the number of valid cases was finalized to 288. The sample included students from across all academic disciplines at a particular university: arts and performances, business and economics, communications, engineering and computer science, health and human development, humanities and social sciences, and natural sciences and mathematics. This sample is representative in terms of racial, ethnic, gender, and geographic diversity due to the particular university's unique student body composition and is ideal to serve the purpose of a pilot study.

The study's general research question inquires if the use of algorithmic news apps has an effect on an individual's news appreciation and news literacy. ANOVA test (Table 1) shows significant differences among the three groups (using none, 1-2, or 3+ news apps) in terms of need for cognition ($F = 3.58$, $p < 0.05$), need for orientation ($F = 9.61$, $p < 0.001$), news appreciation ($F = 7.77$, $p < 0.05$), and current events knowledge ($F = 9.40$, $p < 0.001$). There are no significant effects detected for skepticism or locus of control.

Table 4.1 Differences in Scale Variables (ANOVA, N = 288)

News app use	Need for cognition	Need for orientation	Skepticism	Media locus of control	News appreciation	Current events knowledge
	M	M	M	M	M	M
None	10.10	13.81	16.11	14.18	19.83	5.14
Moderate (1–2 apps)	10.84	15.21	16.56	14.64	21.22	6.02
Heavy (3 or more apps)	10.91	16.19	16.38	13.97	22.69	6.85
	df (2/278)	*df* (2/277)	*df* (2/272)	*df* (2/276)	*df* (2/271)	*df* (2/285)
	F = 3.58	F = 9.61	F = .85	F = 1.01	F = 7.77	F = 9.40
	p = **.029***	*p* < **.001****	*p* = .431	*p* = .366	*p* = **.001***	*P* < **.001****

* difference is significant at the .05 level.
** difference is significant at the .01 level.

Specifically, the results of the post hoc tests in Table 4.1a, Table 4.1b, Table 4.1c, and Table 4.1d show that respondents in the none and moderate news app use categories exhibit significant differences in need for cognition; in terms of need for orientation, news appreciation, and current events knowledge, nonusers have significant differences with both moderate users and heavy users. In other words, moderate users and heavy users do not differ much in their overall news literacy. Taken together, the answer to the general RQ is that use of algorithmic news apps does have an effect on certain individuals' news literacy. The effects specifically lie

in the aspects of need for cognition (such as mindful thought processing), need for orientation (such as motivations for news consumption), news appreciation, and current events knowledge.

Table 4.1a Post-hoc Test for Differences in Need for Cognition (LSD Sig.)

	None	Moderate (1–2 apps)
Moderate (1–2 apps)	p = **.012***	
Heavy (3 or more apps)	p = .083	p = .888

* difference is significant at the .05 level.

Table 4.1b Post-hoc Test for Differences in Need for Orientation (LSD Sig.)

	None	Moderate (1–2 apps)
Moderate (1–2 apps)	p = **.001***	
Heavy (3 or more apps)	p < **.001****	p = .115

* difference is significant at the .05 level.
** difference is significant at the .01 level.

Table 4.1c Post-hoc Test for Differences in News Appreciation (LSD Sig.)

	None	Moderate (1–2 apps)
Moderate (1–2 apps)	p = **.006***	
Heavy (3 or more apps)	p < **.001****	p = .057

* difference is significant at the .05 level.
** difference is significant at the .01 level.

Table 4.1d Post-hoc Test for Differences in Current Events Knowledge (LSD *Sig.)*

	None	Moderate (1–2 apps)
Moderate (1–2 apps)	p = **.002***	
Heavy (3 or more apps)	p < **.001****	p = .052

* difference is significant at the .05 level.
** difference is significant at the .01 level.

Meanwhile, it is worthwhile to inquire whether such an effect is positive or negative, as RQa to RQf all ask (Table 4.2). Is news consumption facilitated or constrained by algorithmic news apps? One way to answer this question is by looking at the means of the groups. The mean scores in Table 4.1 show, in general, that heavier news app users have higher scores than their none or relatively light user counterparts, which means algorithmic news consumption does not have

a negative impact on their overall news literacy. Specifically, the answers to the questions in RQa, RQb, and RQf are all no, and the answer to RQe is yes, the use of algorithmic news apps does have a positive effect on an individual's news appreciation. RQc (locus of control) and RQd (skepticism) have no certain answers due to non-significant test results. However, if we look at the means in Table 4.1, we can interpret that moderate news app use helps with news evaluation (skepticism) and media locus of control. But once the use becomes heavy, people may start to lose necessary skepticism and locus of control and, therefore, their news literacy may suffer from heavy use of algorithmic news apps.

Table 4.2 Summary of Research Questions and Answers

Research Question	Answer
RQa: Are heavy algorithmic news app users less likely to prefer mindful thought processing (need for cognition) relative to their light-user peers?	*No*
RQb: Are heavy algorithmic news app users less motivated toward news consumption (need for orientation) relative to their light-user peers?	*No*
RQc: Do heavy algorithmic news app users feel less in control of news media influence (locus of control) relative to their light-user peers?	*Not Significant*
RQd: Do heavy algorithmic news app users have a lower level of skepticism toward news media relative to their light-user peers?	*Not Significant*
RQe: Do heavy algorithmic news app users have a higher level of news appreciation relative to their light-user peers?	*Yes*
RQf: Are heavy algorithmic news app users less knowledgeable about current events relative to their light-user peers?	*No*

Another way to answer the "facilitated or constrained" question is to conduct a correlation test in response to the general research hypothesis that "*level of exposure to algorithmic news is* ***positively associated with*** *news appreciation, and* ***negatively associated with*** *need for cognition, need for orientation, locus of control, skepticism toward news media, and current events knowledge.*" As Table 4.3 illustrates, news app use is significantly and positively associated with not only news appreciation, but also motivations for news consumption (need for orientation) and current events knowledge. The study's general hypothesis is supported in terms of the effect on news appreciation, but unsupported for the predicted negative impact on need for orientation and current events knowledge. In other words, the use of algorithmic news apps appears to lead to higher levels of news literacy in general (the associations between news app use and need for orientation, skepticism, and media locus of control are non-significant) when usage levels are compared.

Table 4.3 Correlation between News App use and Other Variables

Pearson Correlation r	Need for cognition	Need for orientation	Skepticism	Media locus of control	News appreciation	Current events knowledge
News app use	.106	**.269****	.017	−.022	**.255****	**.256****

* correlation is significant at the .05 level (2-tailed).
** correlation is significant at the .01 level (2-tailed).

As the study includes alternative measurements for news consumption ("On average, how much time in a typical day do you spend consuming news on news apps?" and "What percentage corresponds best to the proportion of time you spend getting news from news apps, among other ways,") we conducted an inter-item correlation test to make sure "number of news apps used" is a reliable measurement. As Table 4.4 shows, these three app use variables are all significantly and positively correlated.

Table 4.4 Correlation among News Consumption Variables

Pearson Correlation r	Duration of news app use	% of time using news apps (among all news consumption)
Duration of news app use		**.336****
Number of news app used	**.410****	**.332****

** difference is significant at the .01 level.

Overall, this research did not find significant empirical evidence to support an information-cocoon argument. In general, the use of algorithmic news apps does not seem to have a negative impact on an individual's news literacy.

Discussion

The most striking finding in this study, contradictory to our prediction, is that heavy use of algorithmic news media does not seem to be taking its toll on the news literacy of these youth audiences. Instead, these AI-based and tailored news recommendation systems appear to be facilitating news consumption and adding to news literacy in general. This is at odds with some previous research, which has found that the use of a personalized news recommender system has a negative direct effect on knowledge gain (e.g., Beam, 2014).

Surprisingly enough, results from this research show that heavy algorithmic news app users are more likely to prefer mindful thought processing, are more

motivated toward news consumption, and are even more knowledgeable about current events relative to their light-user peers. What's not so surprising is that, as we expected, these tailored communication systems are doing a good job in enhancing people's news appreciation—the more they use AI-based news apps, the more appreciative of news consumption they are. People who use more algorithmic news apps are more likely to find the news interesting, easy to understand, important, and objective. These news app users are also more likely to find consuming news a pleasure and more likely to often recommend/forward news to friends. Such a finding regarding news appreciation is in line with previous research on tailored communication and customization, which largely maintains that customized messages have certain advantages over non-customized ones, such as being more persuasive and memorable, and thus more appreciated (Noar, Benac, & Harris, 2007; Beier, 2007; Kalyanaraman & Sundar, 2006).

Cass Sunstein's "information cocoons" and Nicholas Negroponte's "The Daily Me" concepts seem appealing, plausible, and worth noting but they are not evidenced in this study. If there is anything found in this exploratory study that is agreeable with these two concepts, it is the test results (non-significant) with regard to media locus of control and skepticism toward news media. As mentioned in the findings section, in terms of access and skepticism toward news media, heavy users of AI-based news apps score lower than moderate users; in terms of media locus of control, heavy users score lower than both nonusers and moderate users. These non-significant test results also convey useful information for us to understand the phenomenon. There could be a curvilinear pattern in AI-based news consumption—that is, moderate use of algorithmic news media may help with news literacy in general but once the use goes up to a certain high level, it starts to constrain news consumption and impair news literacy. Specifically, heavy use of algorithmic news apps may hinder effective use of various media tools to access different sources for news, leading to inability to question the content of the media and to evaluate the possible consequences if sharing messages that contain unreal and purposeful information; in addition, it may also cause a loss of control in news consumption and a debility to stay properly informed. A larger sample in future research may be able to provide statistically significant evidence to buttress this contention.

As warned by some scholars (Beer, 2009; Napoli, 2014), the algorithm is a new type of actor that intervenes in the communication process and has the capacity to shape and impact on individual lives. An information cocoons effect, with concerns about the formation of biased and ignorant individuals who see a distorted world, remains compelling. Research on the potential effect that algorithmic media may have on members of the public and on society as a whole,

in the long run, has yet to be empirically and carefully investigated. Much of the previous research on the application of algorithms in the journalism context (e.g., Anderson, 2013; Beam, 2014; Napoli, 2014; DeVito, 2017; Carlson, 2018) is limited to the content production and distribution process. More scholarly attention needs to be paid to the audience perspective. This pilot study represents an first-hand effort within the mass communication research field to relate news appreciation and news literacy to the recent phenomenon of algorithmic news apps from an audience's perspective.

As to practical implications, this research shows that algorithmic news consumption may not be as dangerous as warned. In fact, AI-based news apps may facilitate news consumption and enhance news literacy. However, the findings in this study also caution against excessive use of algorithmic media, which may turn positive effect into the negative direction, in which case an information cocoon may be formed to the disadvantage of an individual.

Although this pilot study yields significant results in examining the effects of using personalized algorithmic news apps, the results should be interpreted with caution, as they come with certain limitations. The study sampled college students as participants, and they are homogeneous in terms of education level and age. The result may not be generalizable to explain other demographic groups such as teenagers or older adults. In further research, researchers will need to expand the sampling scope in order to examine the general population of news app users. On another note, to examine a causal relationship, experimental study is a better approach than survey. Further research may employ a pretest-posttest field experiment method, if circumstances allow, in order to control possible confounding factors and sort out the real cause and effect.

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Appendix 4.1

Survey Questionnaire

You are cordially invited to participate in a research study examining media use and news consumption behaviors. The research is conducted by Dr. XXX of the XXX University (Study #HSR-XXX).

This questionnaire will take about 10 minutes to complete. Your participation is completely voluntary. You are free to discontinue your participation at any time. However, we hope you will choose to participate because our results will not be complete without you. Your personal information will be kept confidential and will not be associated with any public release of research results. The overall findings of the study may be published, but never in a way that will link your answers to you.

There are no expected potential risks from taking part in this survey. The probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life. There will be no costs to you nor will you receive payment for taking part in this current study. However, you may be eligible to receive a US$50 cash reward if you volunteer to participate in a small-group follow-up study, in which case you can leave your contact information toward the end of this questionnaire.

If you have any questions or wish to have further information about the study, you may contact Dr. XXX by e-mail at XXX@XXX.edu.

By proceeding to answer the following questionnaire, you agree to participate in this research study.

Thank you very much for your participation!

Section I: Automatic vs Mindful Thought Processing (measurements for need for cognition)

On a scale of 1 to 5 where 1 is strongly disagree and 5 is strongly agree, please rate how much you agree or disagree with this statement.

	Strongly Disagree				Strongly Agree
1. I prefer complex to simple problems.	1	2	3	4	5
2. The notion of deep thinking is appealing to me.	1	2	3	4	5
3. I would rather do something that is sure to challenge my thinking abilities than something that requires little thought.	1	2	3	4	5
4. I feel relief rather than satisfaction after completing a task that requires thinking hard and for a long time. (reverse)	1	2	3	4	5
5. I would prefer a task that does not require much thought and is less important over a task that is intellectual, difficult, and more important. (reverse)	1	2	3	4	5
6. I don't like to do a lot of thinking. (reverse)	1	2	3	4	5

Section II: Information Relevance and Need for Orientation (motivations for news consumption)

On a scale of 1 to 5 where 1 is strongly disagree and 5 is strongly agree, please rate how much you agree or disagree with this statement.

	Strongly Disagree				Strongly Agree
1. I think a lot of news is relevant to me.	1	2	3	4	5
2. I follow the news for my own good.	1	2	3	4	5
3. I don't mind not knowing a lot about current events. (reverse)	1	2	3	4	5
4. I want to be instantly informed about recent developments in the world and my community.	1	2	3	4	5

	Strongly Disagree				Strongly Agree
5. I want to know more about different aspects of a current topic/issue.	1	2	3	4	5
6. I don't see what news does for me. (reverse)	1	2	3	4	5

Section III: Media Locus of Control

On a scale of 1 to 5 where 1 is strongly disagree and 5 is strongly agree, please rate how much you agree or disagree with this statement.

	Strongly Disagree				Strongly Agree
1. I am in control of the information I get from the news media.	1	2	3	4	5
2. The main thing that affects my knowledge about the world is what I myself do.	1	2	3	4	5
3. If I pay attention to different sources of news, I can avoid being misinformed.	1	2	3	4	5
4. I am misinformed by the news media as a whole.	1	2	3	4	5
5. I don't care if I am misinformed by the news media. (caution for reverse)	1	2	3	4	5
6. If I take the right actions, I can stay informed.	1	2	3	4	5

Section IV: News Access and Evaluation

On a scale of 1 to 5 where 1 is strongly disagree and 5 is strongly agree, please rate how much you agree or disagree with this statement.

	Strongly Disagree				Strongly Agree
1. I can effectively use various media tools to access different sources for news.	1	2	3	4	5
2. I question the content of the media, including if it is from a credible source.	1	2	3	4	5

	Strongly Disagree				Strongly Agree
3. I can evaluate the possible consequences in case I share messages that contain unreal and purposeful information.	1	2	3	4	5
4. I don't care about the purposes for which media content is presented or shared to me as long as it is what I like to know about. (reverse)	1	2	3	4	5
5. I don't think the news media tell the whole story.	1	2	3	4	5
6. I think the news media can be trusted. (reverse)	1	2	3	4	5

Section V: News Appreciation

On a scale of 1 to 5 where 1 is strongly disagree and 5 is strongly agree, please rate how much you agree or disagree with this statement (consuming = reading/watching/listening/browsing).

	Strongly Disagree				Strongly Agree
1. The news that I have access to consume is interesting.	1	2	3	4	5
2. The news that I have access to consume is easy to understand.	1	2	3	4	5
3. The news that I have access to consume is important.	1	2	3	4	5
4. The news that I have access to consume is objective.	1	2	3	4	5
5. I have pleasure consuming news.	1	2	3	4	5
6. I often recommend/forward news to my friends.	1	2	3	4	5

Section VI: Current Events Knowledge (to be updated before survey implementation)

Please choose the answer to the best of your knowledge.

1. Who is the current United Nations Secretary-General (U.S. Vice President)?	1. ***António Guterres*** 2. Ban Ki-moon 3. Nikki Haley 4. Kofi Annan
2. Who is the current World Health Organization Director-General?	1. Margaret Chan 2. Anthony Fauci 3. ***Tedros Adhanom*** 4. Deborah Birx
3. Which media organization recently parted ways with its host who dismissed the coronavirus pandemic as a conspiracy of "impeachment scam"?	1. CNN 2. Sky News ***3. Fox*** 4. One America News
4. Which company recently acquired popular weather app Dark Sky?	***1. Apple*** 2. Google 3. Microsoft 4. Amazon
5. A Super Bowl Champion died at 78 in March 2020. His name is:	1. Patrick Mahomes ***2. Goldie Sellers*** 3. Len Dawson 4. Joe Greene
6. Who is the Oscars 2020 winner for Actress in a Supporting Role?	1. Kathy Bates ***2. Laura Dern*** 3. Scarlett Johansson 4. Florence Pugh
7. After decades with almost no traffic to the moon, which country made a moon landing in 2019?	***1. China*** 2. U.S. 3. Israel 4. India
8. According to AAA, the US national average price for a gallon of gas dropped to approximately how much at the end of March 2020?	1. Under $1 ***2. $1–$1.99*** 3. $2–$2.99 4. Over $3

9. In which country did the "yellow vests" protest movement — against what was seen as the leadership's disregard for social inequality — take place?	1. Thailand ***2. France*** 3. Malaysia 4. Venezuela
10. In 2019, which country became the first to teach about global warming and the climate crisis in its schools?	***1. Italy*** 2. UK 3. Sweden 4. Australia

11. In your opinion, what is currently the most important problem facing the United States? _____
12. In your opinion, what is currently the most important problem facing the world? _____
13. In your opinion, what is the top news story this week? _____

Section VII: Media Use and News Consumption (Note 1: consuming = reading/watching/listening/browsing; Note 2: App is short for "application," typically a small, specialized program downloaded onto mobile devices)

1. On average, how much time in a typical day do you spend consuming news (online and offline)?
   1 = less than 1 hour 2 = 1–3 hours 3 = more than 3 hours
2. On average, how much time in a typical day do you spend consuming news online (web and app)?
   1 = less than 1 hour 2 = 1–3 hours 3 = more than 3 hours
3. On average, how much time in a typical day do you spend consuming news on news apps?
   1 = less than 1 hour 2 = 1–3 hours 3 = more than 3 hours
4. Besides getting news online, do you also get news by reading newspapers, watching TV, or listening to radio?
   0 = no 1 = yes
5. What percentage corresponds best to the proportion of time you spend getting news online, among other ways?
   0 = none
   1 = between 0% and 50%
   2 = 50%
   3 = between 50% and 100%4 = 100%

6. What percentage corresponds best to the proportion of time you spend getting news from news apps, among other ways?
   0 = none
   1 = between 0% and 50%
   2 = 50%
   3 = between 50% and 100%4 = 100%
7. Are you an active user (Note: active = use almost every day) of the Google News app?
   0 = no 1 = yes
   If yes, for how long have you been using it? _____ years ____ months
8. Are you an active user (Note: active = use almost every day) of the Microsoft News app?
   0 = no 1 = yes
   If yes, for how long have you been using it? _____ years ____ months
9. Are you an active user (Note: active = use almost every day) of the Apple News app?
   0 = no 1 = yes
   If yes, for how long have you been using it? _____ years ____ months
10. Are you an active user (Note: active = use almost every day) of the BuzzFeed News app?
    0 = no 1 = yes
    If yes, for how long have you been using it? _____ years ____ months
11. Are you an active user (Note: active = use almost every day) of the Flipboard news app?
    0 = no 1 = yes
    If yes, for how long have you been using it? _____ years ____ months
12. Are you an active user (Note: active = use almost every day) of any news apps other than those mentioned above?
    0 = no 1 = yes
    If yes, what is the name of the other news app that you use most frequently? _____
    How long have you been using it? _____ years_____ months

Section VIII: Demographic Information

1. Your gender is:
   1 = male, 2 = female

2. Your education level is:
   1 = Middle school
   2 = High school
   3 = College/university
   4 = Postgraduate
3. Your major is _____
4. Your age is _____ years old
5. Your province/state of permanent residence _____ (example format: California)
6. Your country of permanent residence _____ (example format: Canada)

CHAPTER 5

The Pilot Study: Experiment and Interviews

Further to the survey of news app users among college students, an experiment was designed and conducted in the spring semester of 2020, as Phase II of the pilot study. Among the 317 survey participants, 57 volunteered to remain in the study for the follow-up longitudinal experiment, Time 2 of which was approximately one month after the initial survey (Time 1). Among the 57 participants, 37 consented to follow instructions and refrain from consuming recommended news, while the rest served as the control group. Upon completion of the experiment process, 13 participants agreed to continue with the study for follow-up interviews, as Phase III of the pilot study.

The One-Month Field Experiment

The one-month field experiment was conducted right after the end of the survey in April 2020 (Time 1). The experiment period ended in May (Time 2). During this one-month period, participants in the experiment group were instructed to refrain from consuming recommended news and, instead, maintain a proactive approach to seek for news (see Appendix 3.1). Specifically, they were instructed to (1) uninstall all news apps at the beginning of the experiment period; (2) refrain from opening/reading news feed/push; (3) refrain from consuming news from

social media such as Facebook, Twitter, Instagram, and YouTube, which track user profiles and online behavior; and (4) when getting news from a Web browser, to be sure they were signed out of their accounts so that their browsing patterns were not being tracked. At the beginning of the experiment period, informed consent was obtained in writing, which included a Statement of Pledge as follows:

"By answering 'yes,' I pledge that I will follow the instructions. I will maintain a PROACTIVE approach to seek for news and refrain from consuming recommended news for a month before completing the follow-up survey."

The same measurements as in Time 1 were used in Time 2 to assess participants' news literacy. For Time 2, the experiment group was compared to the control group using independent sample t-test; and compared to itself in Time 1 using paired sample t-test.

Table 5.1 Group Differences in News Literacy at the End of Experiment

Group	Need for cognition	Need for orientation	Skepticism	Media locus of control	News appreciation	Current events knowledge
	M	M	M	M	M	M
Control group	11.25	14.81	16.73	15.50	20.86	5.24
Experiment group	10.59	14.84	16.27	15.70	22.05	5.61
	t = .79	t = –.02	t = .50	t = –.23	t = –.93	t = –.72
	p = .43	p = .98	p = .62	p = .82	p = .36	p = .46

Table 5.2 Differences in News Literacy for Experiment Group

Time point	Need for cognition	Need for orientation	Skepticism	Media locus of control	News appreciation	Current events knowledge
	M	M	M	M	M	M
Pre-test (Time 1)	10.50	14.64	16.11	14.92	20.83	5.61
Post-test (Time 2)	10.59	14.84	16.27	15.70	22.05	5.61
	t = .97	t = –.23	t = –.30	t = –1.34	t = –.2.09	t = .00
	p = .33	p = .82	p = .76	p = .19	$\boldsymbol{p = .04}$*	p = 1

* difference is significant at the .05 level.

Table 5.1 shows that upon post-test, the experiment group showed no significant difference with the control group in terms of news literacy. In other words, it appears that refraining from algorithmic news consumption makes no significant difference to an individual's news literacy. Table 5.2 likewise resonates with Table 5.1 in that the experiment group's news literacy in Time 2, after minimizing the consumption of recommended news for a month, showed no significant difference with the pre-test (Time 1) in terms of need for orientation, need for cognition, skepticism, media locus of control, and current events knowledge. It seems that the only difference that can be attributed to the experiment's behavioral regime lies in news appreciation—after refraining from consumption of recommended news and instead proactively searching for news and information, participants in the experiment group appear to have developed higher levels of news appreciation. That is, compared to before, participants found news to be more interesting, objective, important, and easier to understand. Upon post-test, which was conducted at the end of the experiment period, they were more likely to find consuming news a pleasure, and to recommend/forward news to their friends. In other words, it seems that algorithmic news consumption is less a pleasure, compared to the non-algorithmic news consumption during the experiment period, although it may not be taking an obvious toll on news literacy.

It is worth noting that because of the small sample size, results of this experiment should be interpreted with reservations.

The Interviews

Immediately after the experiment ended, the 37 experiment subjects were invited to participate in a follow-up interview. Thirteen of them agreed to take part in this last stage of the pilot study. Due to COVID-19 lockdown, it was impossible to conduct in-person interviews as previously designed. As such, some participants chose to have the interview via Zoom. Others chose CAPI (computer-assisted personal interview), for which semi-structured interview questions with branches for automated skip/display logics were pre-organized and made accessible via Qualtrics for interviewees, with the open option for the participants to reach out to the researcher and vice versa for further communication and follow-up. Judging by the quality of the data eventually collected via Zoom and Qualtrics, the researcher believes that the pandemic-confined interviews are largely the equivalent of in-person interviews. The researcher finds no obvious reason to believe that the quality has been compromised.

The interview instrument consisted of 10 main questions, which were open-ended. Subjects were asked to talk about their user experience during the experiment period and views on algorithmic news apps. For instance:

"Why did you choose to participate in the one-month experiment study?"

"Did you feel any difficulties staying informed during the month while refraining from consuming recommended (algorithm-powered) news? If yes, what was it?"

"Did you experience any uncertainty and anxiety?"

"Without consuming recommended news, did you proactively search for news and information?"

"While refraining from consuming recommended (algorithm-powered) news, did you feel less informed or more informed about the world around you?"

"Overall, do you think recommended (algorithm-powered) news constrain or facilitate your news consumption?"

"After the participation in the one-month experiment, what changes in your news consumption behavior have taken place? What's different?"

"Have you installed back the algorithmic news apps that you uninstalled at the beginning of the experiment study? Why?"

The Zoom interviews were transcribed into text documents. Participants' answers in the Zoom meetings and Qualtrics were coded and computer-assisted-analyzed with NVivo. By reading/re-reading the answers, coherent information was organized into categories ("codes" as in NVivo). A descriptive label was assigned to represent each category, and in such a way major themes emerged. Major themes were then broken down into lower-level sub-themes to sort the responses more specifically. Representative quotes were then collected and organized into the correspondent themes. Visualizations such as word trees, word clouds, and sentiment charts were generated. Participants are identified in this chapter with their real first names, which in no way harms participants' privacy, although they consented to waive their anonymity as they received participation incentives supported by state funding.

Why Participate in the Experiment

The majority of the participants reported that they were motivated to participate in the experiment because the idea of refraining from consuming recommended news was appealing to them and they wanted to take a break from algorithmic news consumption and see how it feels, implying that they are dubious about

consuming recommended news (Table 5.3). Dayton, for example, says, "I chose to participate in the one-month experiment study because I felt that this study would really challenge my views and skillset. Early on in my education, I was encouraged to seek reputable sources that challenged my viewpoint, but at times I got lazy to do so. I saw that this was a really good opportunity to establish a good habit that I have always wanted to have … The idea of a break from the news sounded wonderful for my mental health, especially if it meant I could help with a research study."

Table 5.3 Why Participating in the Experiment

Major Theme	Participant*	Sample Quotes
Breaking from news	Jessica	*"With so much negativity happening in the world, the idea of a break from the news sounded wonderful for my mental health … I was also already quite suspicious of the media's bias, so to challenge myself to do my own research instead of reading the popular headlines sounded very beneficial."*
Breaking from social media	Jenna	*"This gave me a reason to not use social media or any news related things for a month."*
Appealed by research topic	Dayton	*"I chose to participate in the one-month experiment study, because I felt that this study would really challenge my views and skillset. Early on in my education, I was encouraged to seek reputable sources that challenged my viewpoint, but at times I got lazy to do so. I saw that this was a really good opportunity to establish a good habit that I have always wanted to have."*
	Christopher	*"I chose to be a part of the one-month experiment study because I wanted to see the impact that news consumption has on us. As this is something that is now part of our lives and is easily available to us but we do not question the sources that it comes from. So actively seeking out such information was a great experience. I wanted to not only see the difference but the impact of actively seeking out the news that we look at every day rather than using a pre-installed app that recommends what is trendy or what most people are currently looking at. I overall wanted to find and have a new experience and perspective. Also I thought it would be fun to participate in another study because I find them interesting and eye-opening."*
	Jenna	*"I personally am interested in the research process and thought I can gain insight into it by participating in one myself."*
Supporting research	Dayton	*"The idea of a break from the news sounded wonderful for my mental health, especially if it meant I could help with a research study."*

Difficulty, Uncertainty, and Anxiety

For the most part, these news app users more or less found it difficult to refrain from consuming recommended news during the one-month experiment. They also found it inconvenient to live without the news apps and social media. Some of them feared missing out important information, while others felt ignorant not knowing what their friends were talking about (Table 5.4). Nuria, for example, says, "It was difficult when my friends and boyfriend were talking about recent news events that I had no idea of. It was also very difficult when going on social media. I have Facebook notifications too so it was a bit hard that I had to swipe them away. I don't know how they set it up but there are always notifications pushed to my way and it was hard not to look into it. It's especially hard under the pandemic lockdown. I tried to stick to Orange County Register and that's it. When I know the Governor is talking about COVID-19, I worried that I miss out important information."

Table 5.4 Difficulty, Uncertainty, and Anxiety

Major Theme	Participant*	Sample Quotes
Fear of missing out (FOMO)	Nuria	*"It's especially hard under the pandemic lockdown. I tried to stick to Orange County Register and that's it. When I know the Governor is talking about COVID-19, I worried that I miss out important information."*
Feeling ignorant	Jenna	*"Sometimes it was hard not to check social media because I did follow some news related accounts. I know that during that time, there was a lot of news related to racial activism so I felt like I was being ignorant by not staying informed."*
Hard to resist	Nuria	*"It was difficult when my friends and boyfriend were talking about recent news events that I had no idea of. It was also very difficult when going on social media. I have facebook notifications too so it was a bit hard that I had to swipe them away. I don't know how they set it up but there are always notifications pushed to my way and it was hard not to look into it."*
	Jessica	*"It was very difficult when going on social media, as apps like Instagram and Snapchat have basically become secondary sources of news. I remember seeing interesting headlines and fighting the urge to click them."*
	Monica	*"I realized that I tend to click on news stories that my friends share on social media. I had to catch and stop myself countless times."*

Table 5.3 Continued

Major Theme	Participant*	Sample Quotes
	Ailin	*"It was difficult, especially when I am on social media daily and it was hard avoiding reading the news there."*
	Dayton	*"With algorithm-powered news consumption, it was a matter of convenience and most of the time it only gave me news that confirmed what I already believed. Over time I became reliant on this type of news and throughout the course of month it was hard for me to resist this type of easy news consumption."*
Time-consuming finding news elsewhere	Christopher	*"At first it was a bit difficult to stay informed during the month as I was refraining from consuming recommended news, as I had to look at reliable sources and actively seek out what I wanted to know and keep up with. I had to first look at what sources were reliable to get news from in the first place, then I was able to better find the news I was looking for. I honestly never thought that looking for news was difficult or time consuming, but it was a bit tedious trying to refrain from recommended news. As it is so easy just to look at one app and have all the news that you are interested and were looking at earlier as well as other news that was similar to that I was looking at earlier."*

While some participants reported no significant anxiety experienced during the experiment period as they refrained from consuming recommended news, a lot of them reported that they experienced uncertainty to some extent. "While I did not experience any major uncertainty or anxiety," says Dayton, "this was a new experience and with that came regular uncertainty that comes with any new experience. I experienced a small amount of anxiety in breaking from my routine of news consumption and reading news styles that I was not used to as well." Christopher also experienced uncertainty. "Throughout the study I did not experience anxiety but rather much uncertainty," he says. "I did feel as I did not have all the news that I wanted at hand or that I was constantly missing important news that I always look at. This was because a good portion of the recommended news that I used to read through was recommended and not sought after, so that way I would always have interesting articles to read through. So I had to look up news on a broad spectrum to find such articles to read after. I felt as if I was missing a huge portion of my daily news because I was not really aware of what I used to like reading, so when it came to researching the news I had no idea what I was looking for. I did feel much uncertainty in the news that I did find and read through as

it felt incomplete." Likewise, Ailin reported that although she did not experience much anxiety, she did feel left out of the loop, "especially when having discussions with my family who constantly watch the news and ask questions or elaborate their thought on certain subject matters."

On the other hand, in terms of uncertainty and anxiety, it was different for Jessica. "It was actually the opposite: I experienced less uncertainty and anxiety than I usually experienced with the constant flow of tragic news that left me feeling helpless."

Figure 5.1 is the "word tree" generated by NVivo, displaying the results as a tree with branches representing the various contexts in which the word "uncertainty" occurs in the participants' answers in this regard.

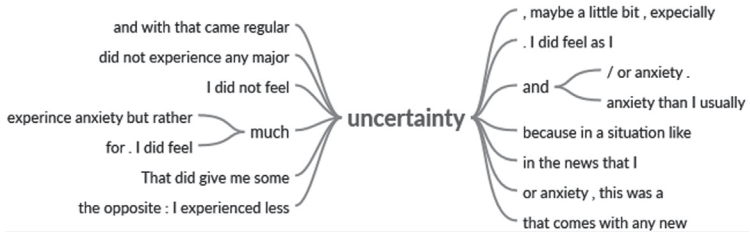

Figure 5.1 Word Tree for "Uncertainty"

Proactive Search

With news apps uninstalled and recommended news restrained, the majority of the participants turned to active search for news as instructed, although some did not bother searching and were content with minimal news exposure (Table 5.5).

Participants were instructed to search for news proactively during the one-month experiment period. As instructed, some participants searched for news as a remedy to minimize recommended news exposure. Christopher, for instance, says, "Without consuming recommended news, I did proactively search for news and information because it was something that was part of my every day and not having it there seemed weird. So there was about 5–10 minutes a day in the mornings and afternoons when I would be actively be searching for news that I may have read or would be interesting to read. This varied from technological advances to politics to consumer products. When it came to information it was quite different, I became more interested in this part where I began to question everyday occurrences and little bits of phrases and objects that I wanted to find out more about, so it really opened up my mind in this sense."

Table 5.5 Searching for News

Major Theme	Participant*	Sample Quotes
Proactive search	Nuria	*"So I was sticking to the online OC Register. I looked at my city and started from there. My parents live in another place, so I would looked into their place too. If I see something that I wanted to know further, I just went from there and try to find more information. Sometimes I go to NBC4 website to look for news and information too as they have something that the Register doesn't have."*
	Jessica	*"If I overheard something, such as the rumor that Kim Jon Un was potentially sick or dead, I would search for that."*
	Jenna	*"I searched and tried to find my own information relating to the corona virus and to the Black Lives Matter movement."*
	Monica	*"I would watch local news on TV more frequently."*
	Chayna	*"I would google what I wanted to learn more about after watching the news."*
	Dayton	*"I did proactively search for news and information. As instructed by the study I logged out of my account so that my searches would not be supported by an algorithm. When there was a topic I was particularly interested I would search it up and choose the sources that seemed the most reputable. I would choose both local sites as well as academic sites. Other than that I continued what I did prior to the study, which was watching local news channels in order to find out what was going on in the world."*
	Tiffany	*"If my friends were texting about it I would look it up. I would usually look at twitter or accounts I follow on Instagram that shares current news. I also would do a google search and find related topics from intercept, ProPublica, Vox, then NYTimes, Washington Post."*
	Briana	*"I did search for information on my own. I searched for Trumps COVID speeches on YouTube. I google searched questions I had about the speeches and conversations. From there, I clicked on the most interesting article on the page."*
	Christopher	*"Without consuming recommended news, I did proactively search for news and information because it was something that was part of my every day and not having it there seemed weird. So there was about 5–10 minutes a day in the mornings and afternoons when I would be actively be searching for news that I may have read or would be interesting to read. This varied from technological advances to politics to consumer products. When it came to information it was quite different, I became more interested in this part where I began to question everyday occurrences and little bits of phrases and objects that I wanted to find out more about, so it really opened up my mind in this sense."*

As some participants admitted, although they carried out search activity, it was not to the extent planned. Judging by what they reported that they did in search for news, it appears that their searches were largely superficial and hardly sufficient to serve as a remedy.

Ailin and Michelle were the two participants who did not bother much with news at all during the experiment period while staying away from recommended news. When asked if they proactively searched for news and information while they were not consuming recommended news, Ailin says, "Not so much, mainly I tried to avoid much of the news." As for Michelle, she seems to have become uninterested in news in general while refraining from recommended news. "I did not proactively search for news because at times I had no interest in the news since I refrained from doing so anyways."

Less Informed or More Informed?

While refraining from consuming recommended (algorithm-powered) news, did participants feel less informed or more informed about the world around them? Surprisingly enough, most participants reported that they felt less informed, with only two exceptions (Table 5.6). One exception was Tiffany, who says, "I felt more informed about the world around me, because I was watching the news more than I was previously. With algorithm-powered news I was getting news about a select few topics, but with the news I was able to find out a lot more. When I did want to find out more about a topic I would do my own research on the Internet, and I feel the sources I managed to find were more informative than sources provided by algorithm." Briana was the other exception, as she says, "I think I feel more informed about the right things. In other words, I was exposed to news in a less bias way. I got to form my own opinions because I knew that I had searched for it."

The majority of the participants reported that they felt less informed during the experiment period. "I am not that great at being a skeptical consumer of the news so finding news on my own and deciphering what is believable was difficult," says Jenna. "I actually felt less informed because I did feel that I was not getting all the news that I would usually get on a daily basis. As on the recommended news there was like a whole compilation of all different sources of news that covered a wide range of topics. This was something that I missed while having to actively look for the news that I would usually get on such apps. When I did look for my news on my own, I felt that it was more reliable and less biased because they were neutral news articles. This came to the sense that the algorithm was not recommending news or sides that I would usually take, so this allowed me to broaden my spectrum on perspective and personal views," says Christopher.

"I had two news apps (before participating in this experiment), one would cover something, and one would cover something else. When I was at work and the notifications showed up, I was like, ok, this happened; that happened. I did feel kind of not as informed as I was (before participating in this experiment), I guess. I was so used to those notifications," says Nuria.

Some participants pointed out that although they felt less informed, it was not to the point that hindered their daily life in any way.

Table 5.6 Less Informed or More Informed

Major Theme	Participant*	Sample Quotes
More informed	Briana	*"I think I feel more informed about the right things. In other words, I was exposed to news in a less bias way. I got to form my own opinions because I knew that I had searched for it."*
	Tiffany	*"I felt more informed about the world around me, because I was watching the news more than I was previously. With algorithm-powered news I was getting news about a select few topics, but with the news I was able to find out a lot more. When I did want to find out more about a topic I would do my own research on the internet, and I feel the sources I managed to find were more informative than sources provided by algorithm."*
Less informed	Nuria	*"I did feel kind of less informed, because I was so used to those notifications. I had those two news apps, one would cover something, and one would cover something else. It was rare when they would cover the same things. I did feel kind of not as informed as I was, I guess. I was so used to those notifications, when I was at work and the notifications show up, I am like, ok, this happened; that happened."*
	Jessica	*"I felt less informed, but not to the point that it hindered my daily life in any way."*
	Jenna	*"I felt less informed. I'm not that great at being a skeptical consumer of the news so finding news on my own and deciphering what is believable was difficult."*
	Bethany	*"I did feel less informed about the world around me. I knew there was a lot going on in the world and the news was constantly changing with many different stories to cover."*
	Chayna	*"I felt less informed. My news apps had brought me less mainstream information that was still important."*
	Ailin	*"I felt less informed, because whatever was going on in the world at the time I wasn't completely aware of. I got most of if any of the little news from my family."*

(*Continued*)

Table 5.3 Continued

Major Theme	Participant*	Sample Quotes
	Michelle	*"I felt less informed because I was not aware of what was occurring in the world."*
	Christopher	*"I actually felt less informed because I did feel that I was not getting all the news that I would usually get on a daily basis. As on the recommended news there was like a whole compilation of all different sources of news that covered a wide range of topics. This was something that I missed while having to actively look for the news that I would usually get on such apps. When I did look for my news on my own I felt that it was more reliable and less biased because they were neutral news articles. This came to the sense that the algorithm was not recommending news or sides that I would usually take, so this allowed me to broaden my spectrum on perspective and personal views."*

Constrain or Facilitate?

Overall, did the participants think that news recommendation (algorithm-powered) constrains or facilitates their news consumption? When asked about this, participants' views were mixed. Some thought it facilitates while others thought the opposite (Table 5.7). Jenna was on the positive side. "I think algorithm-powered news facilitates my news consumption," she says. "This may also be because they present it in a way that I like. In comparison, I get frustrated seeing the different sides with each side being so decisive that their point is correct." Jessica, on the other hand, was on the negative side, "The media definitely has a bias, with the ultimate goal of creating a widespread buzz around a topic," she says. "I think that recommended news absolutely restricts the viewer from getting the entire picture of a story, as it usually only presents one side." A good number of the participants felt neutral toward algorithm-powered news recommendation. They thought it does both—facilitating their news consumption in some aspects while constraining it in other ways. Briana, for example, says, "I think it does both. I felt like I was only having my ideas because I was choosing which article I wanted to read based off of the titles and I was asking my own questions. It was limited in that sense. I also think it facilitated my consumption because I felt like I had all my questions answered. I felt informed in my own ideas."

Table 5.7 Constrained or Facilitated

Major Theme	Participant*	Sample Quotes
constrain	Jessica	*"The media definitely has a bias, with the ultimate goal of creating a widespread buzz around a topic. I think that recommended news absolutely restricts the viewer from getting the entire picture of a story, as it usually only presents one side."*
	Dayton	*"I think that it constrains news consumption in that over time it closes your mindset off from different points of views other than those that appear on your recommended feed. Overall, I do not see it as a negative if you are able to use algorithm-powered news in conjunction with your own research. Recommended news can bring awareness to issues, while you use your own methods to find out more about the issues you found out about."*
	Tiffany	*"I definitely don't approve of algorithm-powered news! I don't know what motivation the company/platform/news has to purposely give us news catered to us. But I do like following who I trust and being an analytical/suspicious reader. Even news sources you trust can mess up. Checking sources who owns what etc is important."*
facilitate	Jenna	*"I think algorithm-powered news facilitates my news consumption. This may also be because they present it in a way that I like. In comparison, I get frustrated seeing the different sides with each side being so decisive that their point is correct."*
	Chayna	*"It facilitates. Because it shows me news that I may not ordinarily hear about."*
	Ailin	*"I think it facilitates. I believe that what I receive about news is constructed from what the algorithm believes I will enjoy reading about."*
	Bethany	*"I do think that it does constrain and facilitate a person's news consumption. For example, I often do not search or look at the political news so on my recommended news it never shows up. The news that does show up in my recommended are related to the topics I search like the industry of fashion. So by just looking at my recommended news and what highlighted stories show up it seems like it is definitely is curated to my topics of interest."*

(*Continued*)

Table 5.3 Continued

Major Theme	Participant*	Sample Quotes
Neutral	Briana	*"I think it does both. I felt like I was only having my ideas because I was choosing which article I wanted to read based off of the titles and I was asking my own questions. It was limited in that sense. I also think it facilitated my consumption because I felt like I had all my questions answered. I felt informed in my own ideas."*
	Christopher	*"I do believe that recommended news does tend to limit the amount of news that I look at. As it is recommended it tends to also be one sided to what I may believe or look at on a daily basis. So it may only show one side to the story which isn't good because that means that one is missing a huge portion to the truth of what the news may be reporting. Also it doesn't bring in new news because it is recommending what I usually read through so it is limiting in that sense but kind of nice because there is no filler unrelated news that I may not look at. So in the end it does tend to facilitate what news I may consume because of that limiting factor of perspectives."*
	Nuria	*"Well I honestly don't really care. It is actually nice not to have those apps bothering me because a lot of time they are not really catered to me. I feel that a lot of time it's what they think is important. When it came to the notifications they are not really giving me what I am interested. But overall I would say it facilitates my news consumption because they alert me of what they think is important, such as breaking news at least."*

Behavioral and Cognitive Changes in News Consumption

Participants in the one-month experiment appeared to some extent to have behavioral and cognitive change in terms of news consumption after taking a break from recommended news. Overall, they seemed to be less likely to expose themselves to algorithm-powered news content, and more conscientious about their news consumption (Table 5.8).

Table 5.8 Behavioral and Cognitive Changes

Major Theme	Participant*	Sample Quotes
Behavioral change	Monica	*"After the experiment period, I continued to watch local news more often than before."*
	Nuria	*"After participating this experiment study, I feel like I don't really need those apps. If I want to know something, I can just look up on Web. I don't even miss those apps. I get used to not having those apps any more. I actually like not getting those notifications all day, like, oh this is happening in whatever. It's been nice."*
	Jessica	*"I find myself clicking those enticing headlines less and less, and instead, I seek the information on the topic out for myself."*
	Ailin	*"I do much more research or read different articles about a certain subject to get a full picture and not a filtered summary."*
	Dayton	*"One thing that has really changed in my news consumption behavior now is that I set time aside in my day/evening to turn on and listen to local news. I also now understand the dangers of only receiving one type of news as well."*
Cognitive change	Jessica	*"I realized that I don't necessarily need to be informed of every devastating thing that happens in the world, and have instead directed more of my attention to the news that affects my state and county. I find it easier to recognize biases in the media, even when the bias is in my favor."*
	Jenna	*"I downloaded my news app again on my phone but I realized I never looked at it to begin with."*
	Tiffany	*"I've become more aware of what is being shown to me and why."*
	Christopher	*"It has allowed me to have a more open perspective on world news. As throughout the one-month experiment I had to look at news that was not just one-sided so it allowed me to look at many different perspectives that I have not read. Not only that but I was able to get a more complete picture of the situation or article. I also now tend to look at different more abstract news that I may have ignored before, more liberal and active news that has a spark of life in it. As I was so used to reading heavy based as well as fact-based articles so it is nice to look at different things every so often. One of the biggest changes was the sourcing of reliable sources, now I look at only reliable media outlets and information to have less distortion of the reality of world events."*

After the experiment period ended, more participants reinstalled the news apps that they had uninstalled at the beginning of the study than those that did not. Those that did not reinstall the apps reported that they realized through the experiment period that they did not really need them. "I have not reinstalled my news apps simply because I don't feel that I need them. I believe that they do more harm than good, and now prefer to be informed on my own accord," says Jessica. "I did not reinstall because I didn't find a motivation to reinstall them," says Michelle. Those who chose to reinstall the apps cited convenience, immediacy, and personalization as the main reasons. "I have reinstalled the apps because I feel more in touch with what was going on in the world by seeing news that I was interested in," says Jenna. "I reinstalled the news apps because they provide immediate notifications for major events," says Chayna.

Among those who chose to reinstall the news apps, some appear to have grown more heedful of potential harm. "I have installed back most of the apps but I do not use them as much as before. I rather google things I come across on my social media platforms," says Ailin. "I have installed back the algorithmic news apps that I uninstalled at the beginning of the experiment study," says Dayton, "because I feel that now that I have discovered my own methods of finding news I am able to use both these methods as well as the news apps. I feel that I am able to use both news apps and my new skills in order to find good and reliable news with the experience that I gained from the study." Briana says "I did install back the news app I used as I always liked the way they worded their stories. But now I do keep in mind that they are conservative," while Christopher comments: "I have reinstalled those apps but this is only because sometimes actively looking for news is time-consuming in this fast-paced world. It is hard to carve out like 20 minutes a day to dedicate to news and looking for it. So it is nice to have apps that give us a wide arrange of news at hand within a few minutes. I installed them for the convenience of having news fast and easily, although sometimes it may be one sided. But at least I can get through more news within less time, and then have time to look at different perspective with the time I saved actively looking for such news."

Discussion and Conclusion

The one-month field experiment, in which a group of college students, as experiment subjects, were instructed to refrain from consuming recommended news, found no significant effect in doing so in terms of overall news literacy. Staying away from recommended news does not necessarily contribute to news literacy(self-reported). In other words, consuming recommended news does not appear to be

detrimental to perception of news literacy. It seems that the only difference that refraining from algorithmic news consumption makes lies in news appreciation—after minimizing consumption of recommended news and proactively searching for news and information instead, participants in the experiment group appeared to have higher levels of news appreciation. Compared to before the experiment, they found news more interesting, objective, important, and easier to understand. Upon post-test, which was conducted at the end of the experiment period, they were more likely to find consuming news a pleasure, and to recommend/forward news to their friends. In other words, it seems that algorithmic news consumption is less a pleasure, although it may not be taking an obvious toll on news literacy.

During the experiment, some of the participants discovered their new selves in terms of news consumption—after one month of minimal consumption of recommended news, they realized that they could actually live without AI-based news apps. The experiment also seems to have raised awareness of the potential danger in AI-based news consumption and to have forced these college students to develop active news-searching skills. Some of them reported that, after the experiment, even though they may have reinstalled the news apps, they were now more mindful in using these apps. They became more proactive in search of news as well, using the search skills acquired during the experiment period.

In the follow-up interviews of the experiment subjects, some of these college students reported that refraining from using news apps led to some uncertainty, especially as it was a time of COVID-19 lockdown, while others felt indifference. After refraining from consuming recommended (algorithm-powered) news for a period of time, most participants reported that they felt less informed. Some participants, however, pointed out that although it made them feel less informed, it was not to a degree that hindered their daily life in any way. When asked whether news recommendation constrains or facilitates their news consumption, participants expressed mixed views. Some thought it facilitates while some others thought it does the opposite, with a good number of the participants feeling neutral towards it. They thought it does both—facilitating news consumption in some aspects while constraining it in other ways.

After the experiment period ended, many participants reinstalled the news apps that they had uninstalled at the beginning of the study. Those who did not reinstall the apps expressed that they had realized during the experiment period that they did not really need the apps. Those who chose to reinstall the apps cited convenience, immediacy, and personalization as their primary reasons.

It is worth pointing out that the results of this field experiment and its follow-up interviews should be interpreted with caution, as they come with certain limitations. The experiment sampled a small group of college students as participants,

and they are homogeneous in terms of education level and age. The result may not be generalizable to explain other demographic groups such as teenagers or older adults. As these are educated individuals who may have been exposed in school to some critical views on algorithms and their possible negative impacts, their responses and comments in this study may involve certain level of social desirability. In addition, the field experiment relied on self-discipline in media consumption during the one-month experiment period. It is possible that some experiment subjects did not strictly refrain from algorithmic news consumption and thus the data collected from these individuals may have more or less complicated the results.

CHAPTER 6

The National Survey

After the initial pilot study, which used a convenience sample of college students (N = 317), the research project was expanded in scope to (1) include the general public nationwide, and (2) examines additional aspects of the algorithmic news audience. A large-scale national sample would allow us to see a big picture of the algorithmic news audience. Will algorithms make the world a worse place? Do AI-powered news recommendation systems create information cocoons? Are heavy news app users worse off in terms of staying informed?

A questionnaire, largely the same as the one used in the pilot study except for minor adjustments to fit the national context and addition of new measurements for algorithm literacy, was employed to measure relevant characteristics of the algorithmic audience. The national survey was administered via Qualtrics, in conjunction with Amazon Mechanical Turk (MTurk), in the summer of 2021. For specific details regarding the sampling and data collection procedures, please see Chapter 3, "Methods of Inquiry."

Research Questions and Hypotheses

Does algorithmic news recommendation facilitate or constrain news consumption? Does it have an impact on news literacy? Does algorithm literacy play a role

in news literacy? Based on previous research, the national study addresses the following research question(s) and hypotheses:

RQ: *Does the use of algorithmic news apps* ***have an effect on*** *an individual's news literacy?*

Specifically:

RQa: *Are heavy algorithmic news app users* ***less likely to prefer*** *mindful thought processing (need for cognition) relative to their light-user peers?*

RQb: *Are heavy algorithmic news app users* ***less motivated*** *toward news consumption (need for orientation) relative to their light-user peers?*

RQc: *Do heavy algorithmic news app users feel* ***less in control*** *of news media influence (locus of control) relative to their light-user peers?*

RQd: *Do heavy algorithmic news app users have a* ***lower level of skepticism*** *toward news media relative to their light-user peers?*

RQe: *Do heavy algorithmic news app users have a* ***higher level of news appreciation*** *relative to their light-user peers?*

RQf: *Are heavy algorithmic news app users* ***less knowledgeable about current events*** *relative to their light-user peers?*

H1: *Level of exposure to algorithmic news is* ***positively associated with*** *news appreciation, and* ***negatively associated with*** *need for cognition, need for orientation, locus of control, skepticism toward news media, and current events knowledge.* In an attempt to find alternative factors for news literacy, the national survey incorporates algorithmic literacy measurements and proposes a new hypothesis as the following:

H2: *Algorithmic literacy* ***influences*** *news literacy.* Specifically:

H2a: *Algorithm awareness is positively associated with need for cognition, need for orientation, news appreciation, locus of control, skepticism toward news media, and current events knowledge.*

H2b: *Algorithm knowledge is positively associated with need for cognition, need for orientation, news appreciation, locus of control, skepticism toward news media, and current events knowledge.*

H2c: *Algorithm avoidance is negatively associated with news appreciation.*

H2d: *Algorithm trust is positively associated with news appreciation.*

As explained in Chapter 1, algorithmic news consumption may lead to agenda-resisting. As such, based on the agenda-setting theory, the following additional hypothesis is proposed in the national study:

H3: *The public agenda (MIP—most important problem) among the heavy algorithmic news apps users differs from that of their light-user peers.*

Findings

Profiles of Respondents

A total of 1212 responses were collected via Qualtrics in conjunction with Amazon Mechanical Turk (AMT). After verification and data cleaning, the number of valid cases was finalized to 1156. This sample included research subjects from across all 50 states, D.C. and Puerto Rico. The sample is representative in terms of geographic, gender, age, education/professional backgrounds, and education levels diversity (see Table 6.1 "Profiles of Respondents").

Table 6.1 Profiles of Respondents (*N* =1156)

		Frequency	*%*
Gender	Male	542	47.9%
	Female	573	49.6%
	Non-binary/Third gender	9	.8%
	Prefer not to say	7	.6%
Age	<30	191	16.6%
	30–39	349	30.2%
	40–49	205	17.8%
	50–59	158	13.7%
	60–69	108	9.4%
	70 +	26	1.3%
Education	Middle School (or lower)	4	.4%
	Higher School	208	18.4%
	College/University	694	61.4%
	Postgraduate	225	19.9%
Major/Area of Profession	Arts & Performances	61	5.4%
	Business & Economics	218	19.3%
	Communications	41	3.6%
	Education	102	9.0%
	Engineering & Computer Science	172	15.2%
	Health & Human Development	80	7.1%
	Humanities & Social Sciences	133	11.8%
	Natural Sciences & Mathematics	84	7.4%
	Other	143	12.7%
	None	96	8.5%

Analysis of Variance in News Literacy

The study's general research question inquires if the use of algorithmic news apps has an effect on an individual's news appreciation and news literacy. ANOVA test (Table 6.1) shows significant differences among the three groups (low, moderate, or heavy use of news apps) in terms of need for cognition ($F = 4.88, p < 0.05$), need for orientation ($F = 31.44, p < 0.001$), news appreciation ($F = 51.42, p < 0.05$), and locus of control ($F = 9.37, p < 0.001$). No significant differences are registered for current events knowledge among the three groups. There are no significant effects detected for skepticism either.

Table 6.2 Differences in Scale Variables (ANOVA, N = 1156)

News app use	Need for cognition	Need for orientation	Skepticism	Media locus of control	News appreciation	Current events knowledge
	M	M	M	M	M	M
Light (<1 hr)	10.45	10.92	12.65	11.63	10.51	7.78
Moderate (1–3 hrs)	11.20	12.35	12.61	12.19	12.18	7.78
Heavy (>3 hrs)	10.80	12.10	12.47	12.93	12.90	7.63
	df (2/1153)	*df* (2/1153)	*df* (2/1153)	*df* (2/1153)	*df* (2/1152)	*df* (2/1153)
	F = 4.88	F = 31.44	F = .17	F = 9.37	F = 51.42	F = .14
	p* = .008	***p* < .001****	*p* = .845	***p* < .001****	***p* = .001***	*p* = .871

* difference is significant at the .05 level.
** difference is significant at the .01 level.

Specifically, the results of the post hoc tests in Table 6.2a, Table 6.2b, Table 6.2c, and Table 6.2d show that respondents in the low and moderate news app use categories exhibit significant difference in need for cognition; in terms of need for orientation, news appreciation, and locus of control, low users have significant differences with both moderate users and heavy users. In other words, moderate users and heavy users do not differ much in their overall news literacy. Taken together, the answer to the general RQ is that use of algorithmic news apps does have an effect on an individual's news literacy. The effects specifically lie in the aspects of need for cognition (such as mindful thought processing), need for orientation (such as motivations for news consumption), news appreciation, and locus of control.

Table 6.2a Post-hoc Test for Differences in Need for Cognition (LSD Sig.)

	Low	Moderate
Moderate	p = **.002***	
Heavy	p = .559	p = .522

* difference is significant at the .05 level.

Table 6.2b Post-hoc Test for Differences in Need for Orientation (LSD Sig.)

	Low	Moderate
Moderate	p < **.001****	
Heavy	p = **.01***	p = .607

* difference is significant at the .05 level.
** difference is significant at the .01 level.

Table 6.2c Post-hoc Test for Differences in News Appreciation (LSD Sig.)

	Low	Moderate
Moderate	p = **.001***	
Heavy	p < **.001****	p = .132

* difference is significant at the .05 level.
** difference is significant at the .01 level.

Table 6.2d Post-hoc Test for Differences in Locus of Control (LSD Sig.)

	Low	Moderate
Moderate	p = **.001***	
Heavy	p = **.002***	p = .097

* difference is significant at the .05 level.

Meanwhile, it is worthwhile to inquire whether such an effect is positive or negative, as RQa to RQf all ask. Is news consumption facilitated or constrained by algorithmic news apps? One way to answer this question is by looking at the means of the groups. The mean scores in Table 6.2 show, in general, that heavier news app users have higher scores than their relatively light user counterparts in terms of news appreciation and media locus of control, which means algorithmic news consumption does not have a negative impact on their news literacy in these aspects. Specifically, the answers to the questions RQc and RQe are, yes, the use of algorithmic news apps does have a positive effect on an individual's news appreciation and locus of control. As for RQa and RQb, the means seem more complicated, but we can interpret that moderate news app use helps with mindful thought processing (need for cognition) and motivations for news consumption (need for orientation). But once the use becomes heavy, people may start to lose the conscientious cognition and orientation and, therefore, their news literacy may

suffer from heavy use of algorithmic news apps. In terms of current events knowledge, the mean score of the heavy users is slightly lower than those of the light and moderate users. Likewise, heavier users appear to be lower skepticism toward news media. That is, heavy use of algorithm-based news apps is associated with lower current events knowledge and lower skepticism toward news, although the differences are not statistically significant.

News App Use and News Literacy

Another way to answer the "facilitated or constrained" question is to conduct a correlation test in response to Hypothesis 1, which states that "*level of exposure to algorithmic news is* ***positively associated with*** *news appreciation, and* ***negatively associated with*** *need for cognition, need for orientation, locus of control, skepticism toward news media, and current events knowledge.*" As Table 6.3 illustrates, news app use is significantly and positively associated with not only news appreciation, but also mindful thought processing (need for cognition), motivations for news consumption (need for orientation), and locus of control. The study's general hypothesis is supported in terms of the effect on news appreciation, but unsupported for the predicted negative impact on need for cognition, need for orientation, skepticism toward news media, locus of control, and current events knowledge. In other words, the use of algorithmic news apps appears to lead to higher levels of news literacy in general (the associations between news app use and skepticism and current events knowledge are non-significant).

Table 6.3 Correlation between News App Use and Other Variables

Pearson Correlation r	Need for cognition	Need for orientation	Skepticism	Media locus of control	News appreciation	Current events knowledge
News app use	**.09***	**.27****	–.03	**.16****	**.37****	.01

* correlation is significant at the .05 level (2-tailed).
** correlation is significant at the .01 level (2-tailed).

As the study includes alternative measurements for news consumption for reliability check purposes ("On average, how much time in a typical day do you spend consuming news on news apps?" and "What percentage corresponds best to the proportion of time you spend getting news from news apps, among other ways"), we conducted an inter-item correlation test to make sure "number of news apps used" is a reliable measurement. As Table 6.4 shows, these three app use variables are all significantly and positively correlated.

Table 6.4 Correlation among News Consumption Variables

Pearson Correlation r	Duration of news app use	% of time using news apps (among all news consumption)
Duration of news app use		**.50****
Number of news app used	**.516****	**.562****

** difference is significant at the .01 level.

Algorithmic Literacy and News Literacy

As mentioned earlier, as we now live in a media landscape that is increasingly algorithmic with a growing number of AI-based personalized news providers available for news consumption, having a basic understanding of what algorithms are and do has probably become a crucial element of news literacy. Previous research has examined aspects of algorithm literacy, such as awareness and knowledge of algorithms, trust and confidence in algorithms, and algorithm avoidance. The interrelationships among these aspects and news literacy are predicted in Hypothesis 2 (algorithmic literacy influences news literacy) and tested. As Table 6.4 illustrates, it appears that algorithmic literacy does play a significant role in news literacy. Specifically, (1) as predicted in H2a, algorithm awareness is positively associated with need for cognition, need for orientation, news appreciation, locus of control, skepticism toward news media, and current events knowledge; (2) as hypothesized in H2b, algorithm knowledge is positively associated with need for cognition, need for orientation, news appreciation, locus of control, skepticism toward news media (association with current events knowledge is positive but not statistically significant); (3) as predicted in H2c, algorithm avoidance is negatively associated with news appreciation; and (4) as hypothesized in H2d, algorithm trust is positively associated with news appreciation.

Table 6.5 Correlations between Algorithmic Literacy and Media Literacy

Pearson Correlation r	Need for cognition	Need for orientation	Skepticism	Media locus of control	News appreciation	Current events knowledge
Algorithmic awareness	**.20****	**.24****	**.33****	**.124****	**.18****	**.10****
Algorithmic knowledge	**.23****	**.24****	**.20****	**.23****	**.29****	.05
Algorithm avoidance	−.02	**−.07***	−.01	**−.16****	**−.12****	−.01
Algorithm trust	**.10****	**.29****	.02	**.28****	**.36****	−.01

* correlation is significant at the .05 level (2-tailed).

** correlation is significant at the .01 level (2-tailed).

Structural equation modeling analysis was conducted to explore and confirm the relationships among the news literacy variables and the algorithm literacy measurements. A confirmatory factor analysis (CFA) model (χ^2 = 105.97, *df* = 33, $p < .001$; $\chi^2/df = 3.21$) is presented in Figure 6.1.

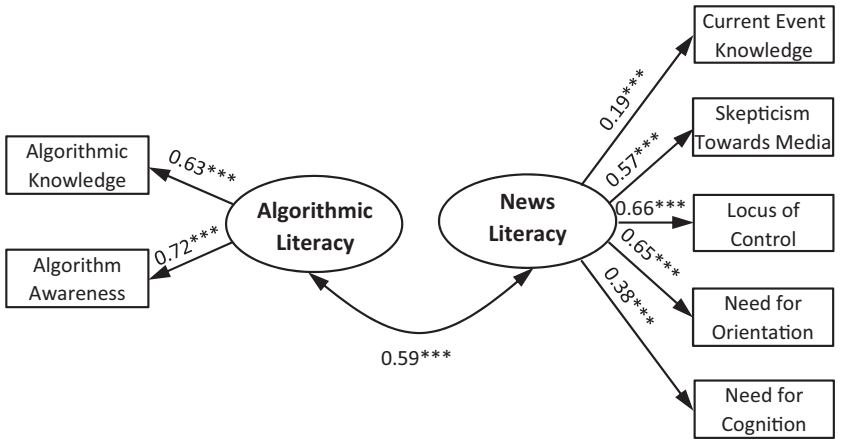

Figure 6.1 A Confirmatory Factor Analysis Model
(Note: *** correlation is significant at the .001 level)

As Figure 6.1 suggests, need for cognition, need for orientation, media locus of control, skepticism toward media, and current event knowledge are all significant factors of news literacy. Among them, media locus of control and need for orientation are the strongest predictors. On the other hand, algorithmic knowledge and algorithmic awareness are significant factors of algorithmic literacy, both of which being strong predictors. Between algorithmic literacy and news literacy (r^2 = .35), the model suggests that algorithmic literacy accounts for 35% of the variation in news literacy. In other words, algorithmic literacy has a significant influence on news literacy.

Agenda Resisting

As previously mentioned, news app users, through active engagement such as commenting, sharing, and providing feedback to the algorithm regarding their preferences, get to decide to some extent their own subsequent media exposure. In other words, they are not the general "public" being fed a "set" agenda in a traditional agenda-setting process. It may be too early to say that the emergence of algorithmic audiences constitutes the end of agenda-setting by elite media and its

working professionals, but the phenomenon does send a strong signal and deserves attention. In terms of agenda-resisting, our survey collected responses from the national sample with regard to the MIP ("in your opinion, what is currently the most important problem facing the United States?") to examine if the MIPs for heavy algorithmic news app users differ from those of their light-user peers.

Table 6.6 Most Important Problem Ranking (in parentheses) by Mentions

MIPs	Light users (<1 hr)	Moderate users (1–3 hrs)	Heavy users (>3 hrs)
Climate change	**6% (2)**	**9% (1)**	0%
COVID pandemic	**5% (3)**	**8% (2)**	**33% (1)**
Gun violence	2%	0%	**3% (3)**
Income inequality	**20% (1)**	3%	**3% (3)**
Political divide	2%	0%	0%
Health care	<1%	1%	**7% (2)**
Immigrant/border control	0%	<1%	**3% (3)**
Racial injustice/white supremacy	<1%	**5% (3)**	**3% (3)**
Religious conflict/war	0%	0%	**7% (2)**
Voting rights	2%	0%	0%

As Table 6.6 illustrates, the top 10 most important problems (MIPs) that participants mentioned as currently facing the United States are: climate change, the COVID-19 pandemic, gun violence, income inequality, political divide, health care, immigrants/border control, racial injustice/white supremacy, religious conflict/war. Among moderate news app users, climate change, the COVID-19 pandemic, and racial injustice/white supremacy are the top three MIPs mentioned respectively. Among light users, however, income inequality surpasses climate change and the pandemic as the top MIP mentioned. Heavy users appear to be erratic as their top MIP is the pandemic, followed by health care, religious conflict, and gun violence. This group comprises heavy users of news apps who report three or more hours of news app use daily. It is alarming that these heavy users of recommended news log zero mention of climate change as an MIP facing the country. These users seem to have been heavily exposed to news of conflicts, violence, and disasters, and are short of vision on other significant problems facing the nation. In a word, the public agenda among heavy algorithmic news apps users appear to differ from that of their light-user peers. This suggests a possible agenda-resisting effect.

Discussion

By and large, the use of algorithmic news apps does not seem to have a significant negative impact on an individual's news literacy. In general, as with the pilot study, this national survey does not find significant empirical evidence to support an information-cocoon argument, except that heavy users of algorithmic news apps are found to have slightly lower knowledge of current affairs than their moderate and light user counterparts (the difference is not significant). Algorithmic literacy, on the other hand, appears to have strong influence on news literacy.

The most remarkable finding from this national survey, contradictory to our prediction, is that the use of algorithmic news media does not seem to be taking its toll on the news literacy of news audiences. Instead, generally speaking, these AI-based and tailored news recommendation systems appear to be facilitating news consumption and adding to news literacy. Moderate level of use, in particular, seems to generate the strongest positive impact. Surprisingly enough, results from this research show that moderate algorithmic news app users are more likely than low users to prefer mindful thought processing, are more motivated toward news consumption, and even have higher levels of media locus of control relative to their light-user peers. This finding is in line with our pilot study, but is at odds with some previous research, which has found that the use of a personalized news recommender system has a negative direct effect on knowledge gain (e.g., Beam, 2014). This finding suggests that both algorithmic news consumption and news literacy may be more complicated than earlier believed.

What's not so surprising is that, as we expected, these tailored news recommendation systems are doing a good job in enhancing people's news appreciation—the more they use AI-based news apps, the more appreciative of news consumption they are. People who use more algorithmic news apps are more likely to find the news interesting, easy to understand, important, and objective. These news app users are also more likely to find consuming news a pleasure and more likely to often recommend/forward news to friends. Such a finding regarding news appreciation is in line with previous research on tailored communication and customization, which largely maintains that customized messages have certain advantages over non-customized ones, such as being more persuasive and memorable, and thus more appreciated (Noar, Benac, & Harris, 2007; Beier, 2007; Kalyanaraman & Sundar, 2006).

Cass Sunstein's "information cocoons" and Nicholas Negroponte's "The Daily Me" concepts are appealing and plausible, but this national survey finds no empirical evidence to support such arguments. If there is anything found in this exploratory study that is agreeable with these two concepts, it is the test results

(non-significant) with regard to skepticism toward news media and current events knowledge. As mentioned in the results section, in terms of access and skepticism toward news media, heavy algorithmic news app users have a lower level of skepticism toward news media relative to their light-user peers—they are less likely to question the content of the media and to evaluate the possible consequences if sharing messages that contain unreal and purposeful information; in terms of current event knowledge, heavy users score lower than both light users and moderate users.

The results with regard to need for cognition and need for orientation also convey useful information for us to understand the phenomenon. There could be a curvilinear pattern in AI-based news consumption—that is, moderate use of algorithmic news media may help with news literacy in general but once the use goes up to a certain high level it starts to constrain news consumption and impair news literacy. Specifically, heavy use of algorithmic news apps may hinder effective and mindful thought processing, leading to a tendency of automatic laziness in thought processing and an inability to think deep and hard; in addition, heavy exposure to algorithmic news recommendations may also cause a loss of current events knowledge and a debility to stay properly informed.

Our analysis of the public agendas among light and moderate users of news apps against heavy users unveils a public agenda difference. The public agenda among the heavy users is different than the rest. This group reported three or more hours of news app use daily. It is alarming that these heavy users of recommended news have no mention of climate change as a most significant problem facing the country. These users seem to have been heavily exposed to news of conflicts and violence, and are short of vision on other significant problems facing the nation. A possible agenda-resisting effect seems evident.

A key discovery of this national survey is the role of algorithmic literacy in news literacy. It appears that algorithmic awareness, in conjunction with algorithmic knowledge, can serve as strong predictors of algorithmic literacy, which plays a significant role in news literacy. Our findings suggest that a considerable part of the variation in news literacy can be explained by algorithmic literacy, which is understandable under the circumstances of an increasingly algorithm-based media landscape.

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Appendix 6.1

National Survey Questionnaire

You are cordially invited to participate in a research study examining media use and news consumption behaviors. The research is conducted by Dr. XXX of the XXX University (Study #HSR-XXX).

This questionnaire will take about 15–20 minutes to complete. Your participation is completely voluntary. There are no expected potential risks from taking part in this survey. There will be no costs to you. You will receive a monetary reward as a token of appreciation if you follow the instructions and complete the questionnaire properly.

If you have any questions or wish to have further information about the study, you may contact Dr. XXX by e-mail at XXX@XXX.edu.

By proceeding to answer the following questionnaire, you agree to participate in this research voluntarily.

Thank you very much for your participation!

Section I: Media Use and News Consumption (Note 1: consuming = reading/watching/listening/browsing; Note 2: App is short for "application," typically a small, specialized program downloaded onto mobile devices)

1. On average, how much time in a typical day do you spend consuming news (online & offline)?

   1 = less than 1 hour 2 = 1–3 hours 3 = more than 3 hours

2. On average, how much time in a typical day do you spend consuming news online (web & app)?
   1 = less than 1 hour 2 = 1–3 hours 3 = more than 3 hours

3. On average, how much time in a typical day do you spend consuming news on news apps?
   1 = less than 1 hour 2 = 1–3 hours 3 = more than 3 hours

4. What percentage corresponds best to the proportion of time you spend getting news online, among other ways?
   0 = none
   1 = between 0% and 50%
   2 = about 50%
   3 = between 50% and 100%4 = 100%

5. What percentage corresponds best to the proportion of time you spend getting news from news apps, among other ways?
   0 = none
   1 = between 0% and 50%
   2 = about 50%
   3 = between 50% and 100%4 = 100%

6. Are you an active user (Note: active = use every day or almost every day) of the Google News app?
   0 = no 1 = yes

7. Are you an active user (Note: active = use almost every day) of the Microsoft News app?
   0 = no 1 = yes

8. Are you an active user (Note: active = use almost every day) of the Apple News app?
   0 = no 1 = yes

9. Are you an active user (Note: active = use almost every day) of the News360 news app?
   0 = no 1 = yes

10. Are you an active user (Note: active = use almost every day) of the Flipboard news app?
    0 = no 1 = yes

11. Are you an active user (Note: active = use almost every day) of the Feedly news app?
    0 = no 1 = yes

12. Are you an active user (Note: active = use almost every day) of any news apps other than those mentioned previously?
    0 = no 1 = yes

    If yes, what is the name of the other news app that you use most frequently? _____

Section II: Current Events Knowledge (updated before each survey implementation), **MIP & Validation Quiz**

IMPORTANT: For the following 10 current news questions, please answer to your own knowledge. Your answers will not affect your participation reward. Please refrain from searching/getting help for answers.

Please choose the answer to the best of your knowledge.

1. Who is the current vice president of the United States?	• ***Kamala Harris*** • Mike Pence • Nancy Pelosi • Chuck Schumer
2. Who is the current director-general of the World Health Organization (WHO)?	• Margaret Chan • Anthony Fauci • ***Tedros Adhanom*** • Rochelle Walensky
3. Which COVID-19 vaccine did the FDA first authorize in the United States on December 11, 2020?	• Moderna COVID-19 Vaccine • Janssen COVID-19 Vaccine (Johnson & Johnson) • ***Pfizer-BioNTech COVID-19 Vaccine*** • Oxford-AstraZeneca COVID-19 vaccine
4. Which two billionaires are planning on riding their own spacecraft to space in July 2021?	• ***Jeff Bezos, Richard Branson*** • Bill Gates, Elon Musk • Bernard Arnault, Mark Zuckerberg • Warren Buffett, Michael Bloomberg
5. Which golfing legend was seriously injured in a car crash near Los Angeles on February 23, 2021?	• Phil Mickelson • Jack Nicklaus • Ernie Els • ***Tiger Woods***
6. After the United States landed the Perseverance rover on Mars in February, which country landed its first spacecraft on Mars in May 2021?	• Italy • ***China*** • Israel • India
7. On March 16, 2020, the Dow Jones plunged how many points in the worst drop in a single day since 1987?	• Under 1,000 • 1,000–1,999 • ***2,000–2,999*** • Over 3,000

8. In April 2020, the price of which of the following turned negative in the United States for the first time in history	• Sporting goods • ***Oil*** • Food • Alcohol
9. Who is the former police officer who was found guilty on April 20, 2021, on three charges for the murder of George Floyd?	• ***Derek Chauvin*** • Medaria Arradondo • Eric Nelson • Michel Moore
10. Which city is the host of the 2020 Summer Olympics, which was postponed due to the COVID-19 pandemic and is now set to be held in July-August 2021?	• ***Tokyo*** • Paris • Los Angeles • Beijing

11. In your opinion, what is currently the most important problem facing the United States? _____
12. Please copy this link and OPEN IN A NEW TAB to take the quiz: https://newslit.org/tips-tools/how-news-literate-are-you-quiz/

    When you are done with the quiz, you should be seeing your score. Please use the slider to record your score to the nearest whole number (your quiz score has no effect on your participation reward). You will need to pass the validation question (not related to your quiz score) following this step in order to receive your monetary reward for this survey participation.

13. Validation Question: What was the quiz that you just took all about (validation question is asked to ensure they have taken the quiz)?

    - ***News literacy***
    - Breaking news
    - First Amendment
    - COVID-19

Section III: Automatic vs Mindful Thought Processing (measurements for need for cognition)

On a scale of 1 to 5 where 1 is strongly disagree and 5 is strongly agree, please rate how much you agree or disagree with each statement.

	Strongly Disagree				Strongly Agree
1. I prefer complex to simple problems.	1	2	3	4	5
2. The notion of deep thinking is appealing to me.	1	2	3	4	5
3. I would rather do something that is sure to challenge my thinking abilities than something that requires little thought.	1	2	3	4	5

Section IV: Information Relevance and Need for Orientation (motivations for news consumption)

On a scale of 1 to 5 where 1 is strongly disagree and 5 is strongly agree, please rate how much you agree or disagree with this statement.

	Strongly Disagree				Strongly Agree
1. I think a lot of news is relevant to me.	1	2	3	4	5
2. I want to be instantly informed about recent developments in the world and my community.	1	2	3	4	5
3. I want to know more about different aspects of a current topic/issue.	1	2	3	4	5

Section V: Media Locus of Control

On a scale of 1 to 5 where 1 is strongly disagree and 5 is strongly agree, please rate how much you agree or disagree with this statement.

	Strongly Disagree				Strongly Agree
1. I am in control of the information I get from the news media.	1	2	3	4	5
2. If I pay attention to different sources of news, I can avoid being misinformed.	1	2	3	4	5
3. If I take the right actions, I can stay informed.	1	2	3	4	5

Section VI: News Access and Evaluation (skepticism toward media)

On a scale of 1 to 5 where 1 is strongly disagree and 5 is strongly agree, please rate how much you agree or disagree with this statement.

	Strongly Disagree				Strongly Agree
1. I can effectively use various media tools to access different sources for news.	1	2	3	4	5
2. I question the content of the media, including if it is from a credible source.	1	2	3	4	5
3. I can evaluate the possible consequences in case I share messages that contain unreal and purposeful information.	1	2	3	4	5

Section VII: News Appreciation

On a scale of 1 to 5 where 1 is strongly disagree and 5 is strongly agree, please rate how much you agree or disagree with this statement (consuming = reading/watching/listening/browsing).

	Strongly Disagree				Strongly Agree
1. The news that I have access to consume is important.	1	2	3	4	5
2. I have pleasure consuming news.	1	2	3	4	5
3. I often recommend/forward news to my friends.	1	2	3	4	5

Section VIII: Algorithm Literacy (Note: An algorithm is a set of instructions designed to perform a specific task, which can be used in customized recommendations such as in a news app)

On a scale of 1 to 5 where 1 is strongly disagree and 5 is strongly agree, please rate how much you agree or disagree with this statement.

	Strongly Disagree				Strongly Agree
1. I know how algorithm-based technologies work.	1	2	3	4	5
2. I am aware that news apps may recommend news based on algorithms.	1	2	3	4	5

	Strongly Disagree				Strongly Agree
3. I would avoid algorithm technologies if I can.	1	2	3	4	5
4. I would avoid algorithm-based news apps if I can.	1	2	3	4	5
5. I have trust and confidence in algorithm technologies.	1	2	3	4	5
6. I have trust and confidence in news apps when it comes to recommending the news fully, accurately, and fairly.	1	2	3	4	5

Section IX: Demographic Information

1. Your gender is:
   1 = male, 2 = female 3 = bisexual 4 = rather not say
2. Your education level is:
   1 = Middle school or lower
   2 = High school
   3 = College/university
   4 = Postgraduate
3. Your age is _____ years old
4. Your state of permanent residence _____ (example format: California)
5. Your major of study (or area of profession) _____

Cash Incentive Distribution Instructions

1. Please write down any comments you might have regarding this survey study.
2. Your validation code for Amazon Mechanical Turk is ${e://Field/random}. Please carefully take note of this code for any future reference.

CHAPTER 7

Demographic Matters

Worldwide, the rapid development of algorithmic news media has brought profound changes to people's daily lives, especially their news consumption habits. Nowadays news consumption can be freed from its previously restricted space-time and digital skill constraints. News is constantly consumed throughout the course of the day while people keep the appropriate devices handy (mostly their smartphones with news apps preinstalled and automatically on) to fill in the gaps between their scheduled and routine activities. Getting news from algorithmic news recommendation systems is associated with a high level of immediacy and convenience, which may create an expectation that relevant news will always come to us automatically whether we seek it or not, whether we have friends sharing/forwarding it or not. As mentioned earlier, if searching for news was the most important development in the last decade of the 20th century, and sharing and forwarding news the most significant feature in the first decade of the 21st century, then consuming news via algorithm-based news recommendation pushes may be the most notable breakthrough of the second decade onward, made possible by the phenomenal popularity of AI-based news apps among the general public.

So what are the defining characteristics of these algorithmic news consumers? Are gender, age, major/occupation, and education level shaping the public's appetite for and attitude toward getting news on news apps, and if yes, how? Demography is key in social sciences. It has been an essential element in both practical and scholarly research. In the United States a social scientific orientation characterized

the work of demographers from the turn of the 20th century. Demography contains elements of behavioral science, which is not to be missed out in any empirical research of news audience like this current study.

The national survey (N = 1156) conducted in 2021 using Amazon Mechanical Turk reveals a U.S. news audience that is largely made up of active users of AI-based news apps. To better understand algorithmic news consumption, and to answer the research questions we raise, demographic analysis was conducted using the demographic variables included in the survey. This chapter presents results that center around demographic factors.

The Appetite for News Apps

It is not surprising to see that about 75% of the respondents in the national survey are active users of algorithmic news apps (use almost every day, as the survey defines). In other words, it appears that only one fourth of the public are not using such news apps on a daily basis. According to the survey, the top three news apps that Americans use actively are Google News, Apple News, and Microsoft News, followed by News360, Flipboard, and Feedly (Table 7.1). More than half of the respondents indicate they are active users of Google News, and about one third of the respondents report using Apple News; approximately one third of them are active users of one of these news apps, and one fourth use two. As for the time consumed getting news from these apps (Table 7.2), most people (78.3%) report spending less than one hour per day (non-users and light users), while 19% are moderate users (1–3 hours); only a small portion (2.6%) of the respondents are heavy users (more than 3 hours) of algorithm-based news apps (Figure 7.1).

Table 7.1 *Top News Apps Americans Use, by Ranks* (N = 1156)

	Frequency	*%*
1. Google News	583	*50.4*
2. Apple News	315	*27.2*
3. Microsoft News	198	*17.1*
4. News360	98	*8.5*
5. Flipboard	96	*8.3*
6. Feedly	85	*7.4*
7. other apps	360	*31.1*

Table 7.2 How Much Time Spent on News Apps

	N	%
Less than 1 hr	905	*78.3*
1–3 hrs	221	*19.1*
More than 3 hours	30	*2.6*
Total	*1156*	*100.0*

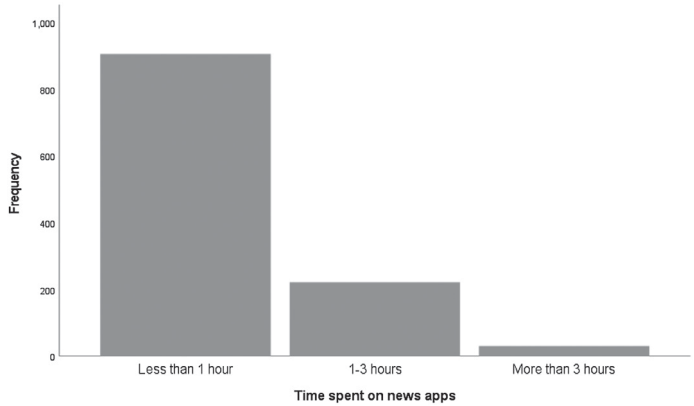

Figure 7.1 User Groups by Time Spent Using News Apps

User Profiles of Top Three News Apps

According to this national survey, Google News, Apple News, and Microsoft News are the top three news apps that Americans use on a daily basis. As such it is worthwhile to examine the profiles of these three groups of users. Table 7.3 presents such profile information.

In terms of gender, Apple News has more female users (51.8%) than males, making it unique among others (Google News = 48.4% female; Microsoft News = 47.4% female). That is, Apple News users are more likely to be female than users of other news apps. In terms of age, Apple News stands out again as its users tend to be younger than those of the other two apps—a larger proportion (21.1%) of its users are under 30 years old, compared to 16.8% for Google News and 16.5% for Microsoft News; and a smaller proportion of its users are over 60 (6.4%), compared to those of Google News (10.9%) and Microsoft News (13.4%). As for education level, Apple News stands out as well with 25.6% of its users reporting postgraduate education, compared to Google News's 18% and Microsoft News's 16.5%. It seems that a typical Apple News user is a young and higher educated female.

Table 7.3 User Profiles of Top Three News Apps

		Google News N = 583	Apple News N = 315	Microsoft News N = 194
		Frequency (%)	Frequency (%)	Frequency (%)
Gender	Male	286 (*50.0*)	144 (46.*0*)	101 (*52.1*)
	Female	277 (*48.4*)	**162 (51.8)**	92 (*47.4*)
	Non-binary/ Third gender Prefer not to say	5 (*.9*) 4 (*.7*)	4 (*1.3*) 3 (1.0)	0 (*0.0*) 1 (*.5*)
Age	<30	96 (*16.8*)	**66 (*21.1*)**	32 (*16.5*)
	30–39	214 (*37.4*)	116 (*37.1*)	65 (*33.5*)
	40–49	122 (*21.3*)	68 (*21.7*)	45 (*22.7*)
	50–59	78 (*13.6*)	43 (*13.7*)	26 (*13.4*)
	60–69	49 (*8.6*)	**15 (4.8)**	19 (*9.8*)
	70 +	13 (*2.3*)	**5 (1.6)**	7 (*3.6*)
Education	Middle School (or lower)	3 (*.5*) 103 (*18.0*)	2 (*.6*) 37 (*11.7*)	2 (*1.0*) 23 (*11.6*)
	Higher School College/University	361 (*63.1*)	194 (*62.0*)	137 (*69.2*)
	Postgraduate	105 (*18.0*)	**80 (*25.6*)**	32 (*16.5*)
Major/ Area of Profession	Arts & Performances	28 (*4.9*)	20 (*6.4*)	12 (*6.2*)
	Business & Economics	109 (*19.1*)	72 (*23.1*)	45 (*23.3*)
	Communications	21 (*3.7*)	11 (*3.5*)	11 (*5.7*)
	Education	47 (*8.2*)	30 (*9.6*)	18 (*9.1*)
	Engineering & Computer Science	105 (*18.4*)	44 (*14.1*)	35 (*17.7*)
	Health & Human Development	43 (*7.5*)	26 (*8.3*)	18 (*9.3*)
	Humanities & Social Sciences	65 (*11.4*)	37 (*11.9*)	**15 (*7.6*)**
	Natural Sciences & Mathematics	42 (*7.4*)	23 (*7.4*)	**8 (*4.1*)**
	Other	64 (*11.2*)	31 (*9.9*)	21 (*10.9*)
	None	47 (*8.2*)	18 (*5.8*)	10 (*5.2*)
News App Use	Low (<1 hr)	390 (*66.9*)	206 (*65.4*)	109 (*55.1*)
	Moderate (1–3 hrs)	167 (*28.6*)	89 (*28.3*)	**68 (*34.3*)**
	Heavy (>3 hrs)	26 (*4.5*)	20 (*6.3*)	**21 (*10.6*)**

Microsoft News users, on the other hand, are unique in terms of area of study/profession and news app use. Its users are less likely to be in the areas of humanities and social sciences (7.6%), or natural sciences and mathematics (4.1%), compared to 11.4% and 7.4% for Google News, and 11.9% and 7.4% for Apple News. Interestingly enough, Microsoft News users are more likely to be heavier users of news apps overall—44.9% of its users are moderate or heavy users, compared to a mere 33.1% for Google News and 34.6% for Apple News.

To examine the possible influences of demographic factors on news consumption and news literacy, the study further uses the measurements of gender, age, major/occupation, and education level to conduct a series of statistical analyses, including correlation, ANOVA, and chi-square (cross tabulation) tests. Overall, gender, age, education level, and professional background (major/occupation) all appear to have a significant impact on certain aspects of news consumption and literacy.

Gender

In terms of algorithmic media use, it seems that gender does not play a role. There is no significant difference detected (by t-test) between males and females in terms of how much time they spend on algorithm-based news apps. It seems the two genders use a largely equal number of apps (Male = 1.56; Female = 1.46) and spend roughly the same duration of time (slightly more than 1 hour) getting news from those apps (Figure 7.2). Another media use measurement included in the study (for reliability checking), "proportion of time spent getting news from news apps

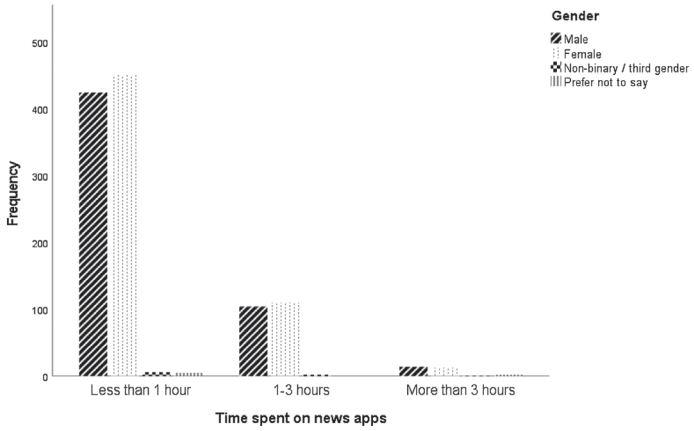

Figure 7.2 Time Spent on News Apps by Gender

among other ways," also brings consistent results—males and females report the same extent on average (between 0% and 50%).

Gender matters, however, when it comes to certain aspects of news literacy (Table 7.4). Men and women exhibit significant differences in need for cognition, need for orientation, current event knowledge, and NLP (News Literacy Project) quiz score. In terms of need for cognition, it seems men are more likely than women to prefer mindful thought processing. As for need for orientation, it appears that men have stronger motivations for news consumption. Moreover, men's average scores are significantly higher than women for both the current events knowledge quiz (Male = 7.90/10; Female = 7.64/10) and the NLP quiz (Male = 6.68/12; Female = 6.27/12).

Table 7.4 *Gender Differences* (N = 1115)

Measures	Male *N* = 542	Female *N* = 573	*t*
Need for cognition	10.93	10.32	**3.19***
Need for orientation	11.25	11.22	**2.31***
skepticism	12.64	12.67	.21
News appreciation	10.83	10.99	–1.02
Media locus of control	11.74	11.86	–.88
Current event knowledge quiz score	7.90	7.64	**2.89***
NLP news literacy quiz score	6.68	6.27	**3.06***

* difference is significant at the .05 level

Age

As well as gender, age appears to play a role in certain aspects of the study. Results suggest that, overall, age is negatively correlated with algorithmic media use (r = –.091 with number of news apps used; r = –.033 with duration; r = –.109 with proportion of time). In other words, younger people in general tend to be slightly heavier users of algorithm-based news apps, but the correlation is not statistically significant.

As for news literacy, findings show that age is positively associated with current event knowledge (r = .161) and NLP quiz score. That is, older people seem to exhibit higher levels of news literacy, which is not surprising.

Table 7.5 *Correlation between Age and News Literacy* (N = 1156)

Pearson Correlation r	Need for cognition	Need for orientation	Skepticism	Media locus of control	News appreciation	Current events knowledge quiz score	NLP news literacy quiz score
Age	.014	.007	.035	.006	.005	**.161****	**.071***

* correlation is significant at the .05 level (2-tailed).
** correlation is significant at the .01 level (2-tailed).

Education Level

Education seems to come into play in many aspects—results show that a lower level of education is associated with heavier news app use, although the correlation is not particularly strong (r = −.070 with number of news apps used; r = −.022 with duration; r = −.048 with proportion in news consumption time). Positive associations are evident between education level and news literacy. Specifically, education level is significantly associated with need for cognition, news appreciation, current event knowledge, and NLP quiz score. That is, people with higher levels of education tend to prefer more mindful thought processing, such as preferring complex over simple problems, finding the notion of deep thought appealing, and preferring to do something that's sure to challenge thinking abilities than something that requires little thought; they are also more likely to appreciate the news that they have access to consume, find it a pleasure, and recommend/forward news to friends. Not surprisingly, they tend to have better knowledge of current events and achieve higher scores in the NLP news literacy quiz.

Table 7.6 *Correlation between Education Level and News Literacy* (N = 1156)

Pearson Correlation r	Need for cognition	Need for orientation	Skepticism	Media locus of control	News appreciation	Current events knowledge quiz score	NLP news literacy quiz score
Education level	**.136****	.056	−.05	.048	**.059***	**.107****	**.123****

* correlation is significant at the .05 level (2-tailed).
** correlation is significant at the .01 level (2-tailed).

Major/Profession

Professional background seems to matter for many aspects as well (Table 7.7), much as education level does. Among the eight groups of people with different professional backgrounds (study major or occupation), the ANOVA test reveals significant differences in terms of need for cognition ($F = 3.69, p < 0.001$), need for orientation ($F = 2.64, p < 0.01$), current events knowledge ($F = 2.20, p < 0.05$), and NLP ($F = 6.72, p < 0.001$).

In terms of need for cognition, the natural sciences and mathematics group seems to be most likely to prefer mindful thought processing (max = 11.46/15) with the health and human development group being least likely (min = 9.75/15); in terms of need for orientation, people from the humanities and social sciences appear to be most motivated to consume news (max = 11.89/15); communication specialists tend to know current events the best (max = 8.07/10); and humanities and social sciences people rank highest in the NLP news literacy quiz (max = 7.51/12).

Interesting enough, among all backgrounds, humanities and social sciences people stand out as having the highest scores in three aspects of the news literacy measurements. On the other hand, people with a health and human development background stand out for the opposite reason—they have the lowest scores in three other aspects. It is also worth noting that education-sector people have the highest news appreciation (max = 11.30/15) whereas those from engineering and computer science seem to least appreciate the news they access and consume (min = 10.65/15).

Table 7.7 *Major/Profession Differences* (N = 1130)

Major/profession	Need for cognition	Need for orientation	Skepticism	Media locus of control	News appreciation	Current events knowledge quiz score	NLP news literacy quiz score
	M	M	M	M	M	M	M
Arts & performances (N = 61)	10.70	11.02	12.62	**11.23 (min)**	10.90	7.44	6.31
Business & economics (N = 218)	10.70	11.29	12.73	11.81	11.04	7.83	6.53
Communications (N = 41)	10.68	11.00	12.41	11.46	10.93	**8.07 (max)**	6.76
Education (N = 102)	10.63	11.88	12.74	12.02	**11.30 (max)**	7.69	6.73
Engineering & computer science (N = 172)	11.23	10.98	12.30	11.70	**10.65 (min)**	7.97	6.33
Health & human development (N = 80)	**9.75 (min)**	10.95	**12.26 (min)**	11.25	10.98	**7.39 (min)**	6.08
Humanities & social sciences (n = 133)	10.96	**11.89 (max)**	12.85	**12.11 (max)**	11.29	7.86	**7.51 (max)**
Natural sciences & mathematics (N = 84)	**11.46 (max)**	11.23	12.77	11.95	10.67	7.99	6.95
Other (n = 143)	9.78	**10.83 (min)**	12.71	11.74	10.71	7.73	6.13
none (N = 96)	10.03	10.99	**12.95 (max)**	12.10	10.66	7.48	**5.49 (min)**
	df (9/1120)	*df* (9/1120)	*df* (9/1120)	*df* (9/1120)	*df* (9/1120)	*df* (9/1120)	*df* (9/1120)
	F = 3.69	F = 2.64	F = 1.75	F = 1.67	F = 1.14	F = 2.20	F = 6.72
	p < **.001****	*p* = **.005****	*p* = .072	*p* = .090	*p* = .331	*p* = **.019***	*p* < **.001****

* difference is significant at the .05 level.

** difference is significant at the .01 level.

The results of the post hoc tests in Table 7.7a, Table 7.7b, Table 7.7c, and Table 7.7d illustrate group-wise differences. These findings show that respondents in the health and human development area exhibit significant difference in need for cognition than those from humanities and social sciences as well as natural sciences and mathematics; in terms of need for orientation, education people seem to stand at odds with people in the engineering and computer sciences, health and human development, and humanities and social sciences fields. In terms of current events knowledge, the health and human development group is at odds with the business and economics, communication, and engineering and computer sciences groups. As for the NLP news literacy quiz, humanities and social sciences people definitely stand out as their average scores show significant differences to those of five other groups of people.

Professional background (or major of study) does appear to have an effect on an individual's news literacy. The effects specifically lie in the aspects of need for cognition (such as mindful thought processing), need for orientation (such as motivation for news consumption), and news appreciation. It also leads to differences in current events knowledge. Such differences are also evident as revealed via the NLP news literacy quiz.

Table 7.7a *Post-hoc Test for Differences in Need for Cognition (LSD Sig.)*

	Business & economics	Communications	Education	Engineering & computer science	Health & human development	Humanities & social sciences	Natural sciences & mathematics
Arts & performances							
Business & economics					p = **.023***		
Communications							
Education							
Engineering & computer science					p = **.001***		
Health & human development						p = **.007***	p = **.001***
Humanities & social sciences							
Natural sciences & mathematics							

* difference is significant at the .05 level.

Table 7.7b *Post-hoc Test for Differences in Need for Orientation (LSD Sig.)*

	Business & economics	Communications	Education	Engineering & computer science	Health & human development	Humanities & social sciences	Natural sciences & mathematics
Arts & performances			p = **.035***			p = **.026***	
Business & economics						p = **.032***	
Communications							
Education				p = **.004***	p = **.014***	p = **.002***	
Engineering & computer science					p = **.001***		
Health & human development						p = **.009***	
Humanities & social sciences							
Natural sciences & mathematics							

* difference is significant at the .05 level.

Table 7.7c *Post-hoc Test for Differences in Current Event Knowledge (LSD Sig.)*

	Business & economics	Communications	Education	Engineering & computer science	Health & human development	Humanities & social sciences	Natural sciences & mathematics
Arts & performances		p = **.036***		p = **.017***			p = **.029***
Business & economics					p = **.023***		
Communications					p = **.016***		
Education							
Engineering & computer science					p = **.004***		
Health & human development						p = **.026***	p = **.010***
Humanities & social sciences							
Natural sciences & mathematics							

* difference is significant at the .05 level.

Table 7.7d . *Post-hoc Test for Differences in NLP News Literacy Quiz (LSD Sig.)*

	Business & economics	Communications	Education	Engineering & computer science	Health & human development	Humanities & social sciences	Natural sciences & mathematics
Arts & performances						$p = .001^{*}$	
Business & economics						$p < .001^{**}$	
Communications							
Education						$p = .008^{*}$	
Engineering & computer science						$p < .001^{**}$	$p = .035^{*}$
Health & human development						$p < .001^{**}$	$p = .012^{*}$
Humanities & social sciences							
Natural sciences & mathematics							

* difference is significant at the .05 level.
** difference is significant at the .01 level.

Demographic Influence in Media Use

The differences in media literacy due to demographics presented above remind us that demographics can be related to the use of algorithmic news apps, as mentioned earlier in this chapter. Transforming media use, age, and education level to categorial measures, a series of chi-square tests were conducted with time spent on news apps against gender, age groups, education level, and area of study/profession to examine if there exists such an influence and, if so, where exactly such influence lies.

Findings from the chi-square tests reveal that there is no statistically significant difference in duration of news app use among genders (Figure 7.2), or among age groups (Figure 7.3). Results also suggest no statistical difference among education levels (Figure 7.4) or professional backgrounds (Figure 7.5) in terms of time spent consuming news on news apps. As such, these chi-square test results seem to reassure us that demographics are not playing a spurious role in the possible cause-and-effect relationship between algorithmic news app use and news literacy.

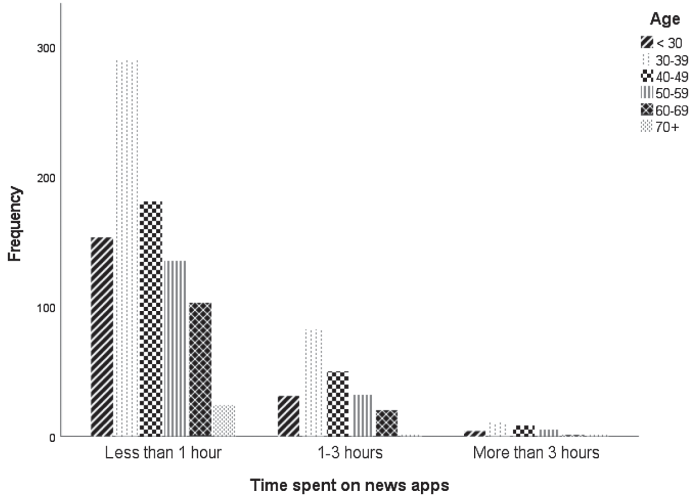

Figure 7.3 Time Spent on News Apps by Age Group

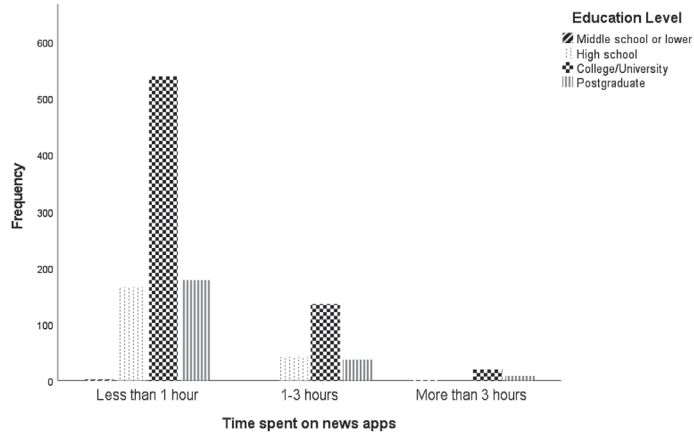

Figure 7.4 Time Spent on News Apps by Education Level

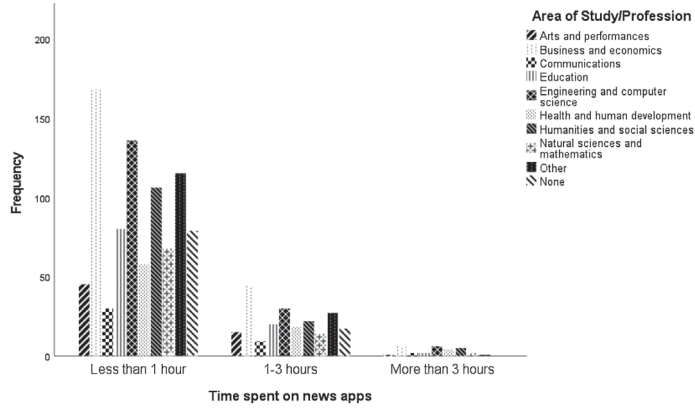

Figure 7.5 Time Spent on News Apps by Area of Study/Profession

Chapter Summary

The adoption and use of AI-based news apps and the consumption of recommended news by the general public is growing. To understand algorithmic news consumption from a demographic perspective, this study conducted analyses using the demographic variables included in the survey. This chapter presents results that center around demographic factors. Overall, findings from the chi-square tests reveal that men and women tend to spend equal amounts of time on news apps; people of different age groups, different education levels, and different professional backgrounds appear equal in terms of news app use. There is no statistically

significant difference detected in duration of news app use among genders, or among age groups. Results also suggest no statistical difference among education levels or professional backgrounds in terms of time spent consuming news on news apps.

Demographics, however, seem to play a significant role in news literacy. Gender matters in certain aspects of news literacy—men and women exhibit significant differences in need for cognition, need for orientation, and current events knowledge. In terms of need for cognition, it seems men are more likely than women to prefer mindful thought processing. As for need for orientation, it appears that men have stronger motivations for news consumption. Moreover, men's average scores are significantly higher than those of women for current events knowledge. As well as gender, age appears to play a role in certain aspects of news literacy. Results suggest that, overall, age is positively associated with current events knowledge ($r = .161$) and NLP quiz score. That is, older people seem to exhibit higher levels of news literacy in general, which is not surprising. Positive associations are evident between education level and news literacy—results suggest that those with higher levels of education tend to prefer more mindful thought processing; they are also more likely to appreciate the news that they have access to consume, find it a pleasure, and recommend/forward news to friends. Unsurprisingly, they also tend to have better knowledge of current events and achieve higher scores in the NLP news literacy quiz. Professional background (or major of study) also appears to have an effect on an individual's news literacy. The effects specifically lie in the aspects of mindful thought processing, motivation for news consumption, and news appreciation. Professional background also leads to differences in current events knowledge. People with a health and human development background appear to have the lowest level of news literacy overall; education people have the highest news appreciation; while those from engineering and computer science seem to be quite indifferent to the news they access and consume—they care the least, showing the lowest levels of news appreciation.

CHAPTER 8

The Stories Told by News App Users

Further to complement the national survey of news app users, which used primarily quantitative measurements, we expanded the research to the qualitative area. The qualitative study intends to answer the research questions through a series of CAPIs (computer-assisted personal interviews) with users of AI-based news apps. Volunteer participants were recruited via Amazon Mechanical Turk (MTurk). To respect and preserve the anonymous nature of MTurk workers, semi-structured interview questions with branches for automated skip/display logics were pre-organized and made accessible via MTurk and Qualtrics for interviewees, with the open option for the participants to reach out to the researcher and vice versa for further communication and follow-up. As such, we call these CAPIs quasi-interviews.

In total, 101 participants completed the quasi-interviews in the summer of 2021. The sample includes participants from across 34 states in the United States. It is representative in terms of geography, gender, age, education/professional backgrounds, and education level diversity (see Table 8.1 "Profile of Interviewees"). The sample consists of 55% male subjects and 44% female, with the age range being 19–65 (mean = 34), and education level ranging from high school to postgraduate. Among them, 24 participants are from an engineering and computer science background while 19 are from the business and economics field. A majority of the participants' household incomes fall between $30,000 and $100,000. About 20% of the participants are from upper-middle class or rich households (more than $100,000).

Table 8.1 *Profiles of Respondents* (N = 101)

		Frequency	*%*
Gender	Male	55	54.5%
	Female	44	44.3%
	Non-binary/Third gender	1	1.0%
	Prefer not to say	1	1.0%
Age	<30	40	39.6%
	30–39	32	31.7%
	40–49	23	20.0%
	50–59	4	3.5%
	60–69	2	2.0%
	70 +	0	0.0%
Income	< $30,000	19	18.8%
	$30,000–$59,999	38	37.6%
	$60,000–$99,999	24	23.8%
	$100,000–199,000	17	16.8%
	200,000 +	3	3.0%
Education	Middle School (or lower)	0	0.0%
	Higher School	18	17.8%
	College/University	60	59.4%
	Postgraduate	23	22.8%
Major/Area of Profession	Arts & Performances	6	5.9%
	Business & Economics	19	18.8%
	Communications	6	5.9%
	Education	7	6.9%
	Engineering & Computer Science	24	23.8%
	Health & Human Development	11	10.9%
	Humanities & Social Sciences	11	10.9%
	Natural Sciences & Mathematics	1	1.0%
	Other	10	9.9%
	None	6	5.9%
News App Use	Less than 1 hour	63	55.8%
	1–3 hours	40	35.4%
	3+ hours	10	8.8%

A typical participant in these quasi-interviews is relatively young, college-educated, and spends less than one hour on news apps getting news on a daily basis. A small group of the participants (8.8%) state that they spend three hours or more consuming news apps almost every day while about 35% report 1–3 hours of daily news app consumption.

Among these participants, 58% are active users of Google News, while 40% use Apple News; 33% use News360; 32% use Microsoft News; 24% use Feedly; and 16% use Flipboard. According to this interview study, and consistent with the findings of the national survey, Google News remains the most used app among news app users.

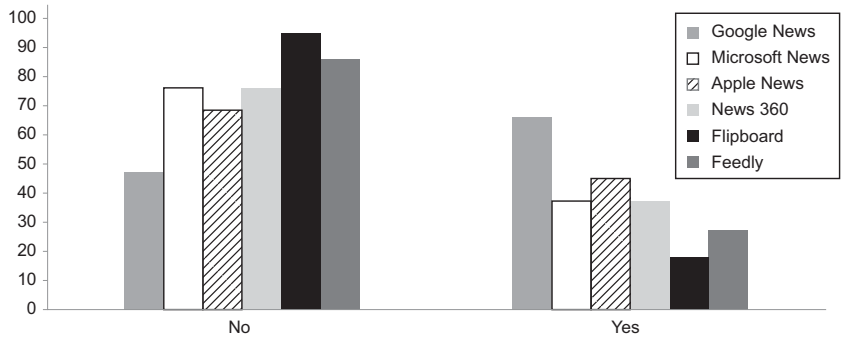

Figure 8.1 Most Used News Apps

The semi-structured quasi-interview instrument consisted of a total of 30 questions, 10 of which were open-ended. Aside from basic demographic information, subjects were asked to talk about their news consumption pattern and their user experience as well as their views of algorithmic news apps. For instance:

"Overall, is using news app a pleasant or unpleasant experience? Why?"

"Compare the time now, when you have news apps in hand, and before (when you did not); do the personalized feeds make you happier consuming news? Do you feel more satisfied?"

"Compare the time now, when you have news apps in hand, and before (when you did not); do you feel more informed and knowledgeable than before? Why?"

"Compare the time now, when you have news apps in hand, and before (when you did not); do you feel more empowered (for instance, being in control of exposure to news; not having to sift through irrelevant/general news)? Why?"

"With news apps pushing content to you at your convenience, is your search (active seeking) activities for news (of particular interest) reduced? Are you less proactive in search of news? Why?"

"Do you trust the news content that news apps recommend/push to you? Why?"

"Have you ever worried about missing news and information that you were supposed to (or needed to) know? Why?"

"Are you aware that most news apps are algorithm-based, recommend personalized news, and feed content to you based on your interests and preferences?" If yes, "How much do you know about how news recommendation works?"

"Have you ever tried to curate your news consumption by actively using a news app's interactive functions, such as "hide," "mute," "report," or "less this"? Why?"

"Do you think you may become biased using AI-based news apps over a period of time, given that you are NOT exposed to diversity of views/opinions?" If yes, "What would you do in that regard? Would you let it be, or would you want to change the status quo? How? What would be your solution? And why?"

To preserve the anonymity of MTurk workers, each participant was identified with an alphanumeric code. The code starts with the participant's gender ("F" for female, "M" for male), followed by a number to differentiate each of them from others within the same gender.

The answers in the quasi-interviews were coded and computer-assisted-analyzed with NVivo. By reading/re-reading the answers, coherent information was organized into categories. A descriptive label was assigned to represent each category, and in such a way major themes emerged. Major themes were then broken down into lower-level sub-themes to sort the responses more specifically. Representative quotes were then collected and organized into the correspondent themes. Visualizations such as word trees, word clouds, and sentiment charts were generated.

Overall News App Use Experience

Participants were asked of their overall experience using algorithmic news apps. As Figure 8.1 and Figure 8.2 illustrate, more users feel the experience to be positive overall than those who feel it to be negative, while a good number of the participants have mixed or neutral feelings (Table 8.2). On the positive side, "pleasant" appears to be the most frequently used word to describe user experience (Figure 8.3).

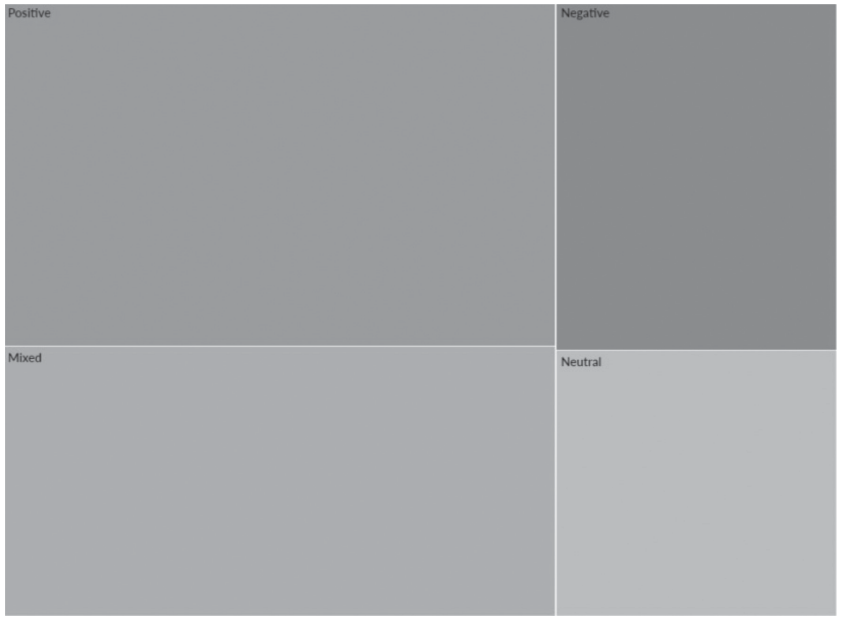

Figure 8.2 Sentiments toward News Apps

Figure 8.3 Word Cloud of News App User Experience

Table 8.2 User Experience

Major Theme	Participant*	Sample Quotes
mixed	M35	*"I like being able to gather info that's largely irrelevant (i.e. Jeff Bezos spacecraft) quickly just through a headline and then delve deeper into topics that impact me (i.e. Biden's student debt plan). Overall, most are a pleasant experience, but they often are too complex and fancy for their own good."*
	F34	*"Overall, I like using news apps. It is a pleasant experience, because it makes checking the news easy and convenient. Using a news app makes me feel informed. However, I have noticed that when using solely news apps I am not fully informed and there are a lot of important news that I was not shown, which makes me question the algorithms these apps use."*
neutral	M19	*"Overall its fine, it divides and gives news based on their content and are usually top news. It is noticeable that they are based on algorithms because there is content that can be similar. If you're looking for organized stories based on their categories, apps like google news can work just fine."*
	F31	*"It's a neutral experience. I find them easier to navigate than the new websites on my mobile device, but I don't like the tracking and algorithms. It feels invasive. I also don't like the ads. Also, I wish the news stories were updated more frequently with less confusing headlines. I am tired of click bait and I wish it was just the facts."*
negative	M50	*"I find using news apps to be decidedly unpleasant. Although I get "news" I don't like the fact that it's been curated based on what I've consumed before. I get the sense that I'm being shown what the app thinks I want to see rather than simply raw, unadulterated news. On the other hand, I cannot deny that having everything all in one place makes selecting and reading news items much more convenient than searching for it elsewhere online."*
	M20	*"I previously used news apps and overall it was unpleasant. I felt the news that was given was biased and misleading. I also found the majority of the news given was negative. I feel the sources are not trustworthy and therefore I do not actively seek or watch news."*

Table 7.6 Continued

Major Theme	Participant*	Sample Quotes
positive	M3	*"I find it to be a pretty pleasant experience, as it lets me get a vague look at world events all in one place. Before apps in general became a thing, I always had to sort of go to different websites or find different newspapers if I wanted to know about everything going on in the world, so news apps have made it much easier and faster for me personally."*
	F42	*"I like using news apps because I can easily filter the information that I am seeking. Applications provide a pleasant experience with the ease of use. I can view the hottest topics that are trending at the tip of my fingers. Trending news is available without searching. It is very easy to stay in the know and informed on what is going on in the world around us."*
	F40	*"I absolutely love using news apps, because it is a quick and easy way to find information from reliable sources. It also is a digestible way to read news on your phone rather than going to a website or just looking on social media for the information you want to know."*

*Note: M = Male; F = Female.

On the negative side, participants expressed concerns over source bias and the catering nature of news apps. Male 10, aged 22, high-school-educated, says, "Bias is always a major issue. This is especially true when regarding major issues or events that have been heavily politicized. Overall, it's a negative experience. The content of the news in the news apps is certainly unpleasant most of the time." Male 18, aged 64, also high-school-educated, while acknowledging the convenience of news apps, says, "Although I get 'news' I don't like the fact that it's been curated based on what I've consumed before. I get the sense that I'm being shown what the app thinks I want to see rather than simply raw, unadulterated news." A few other participants also pointed out that the news app zeroes in on what they like and starts to show only things that it thinks interest them, in which case they are concerned that they are not exposed to diverse views.

On the positive side, many participants report that their user experience with news apps is pleasant overall. The mentions of "pleasant experience" (see word-tree illustration in Figure 8.4) show that news app users appreciate the source variety, convenience, ease of use/access, informativeness, usefulness, and personalization of news apps.

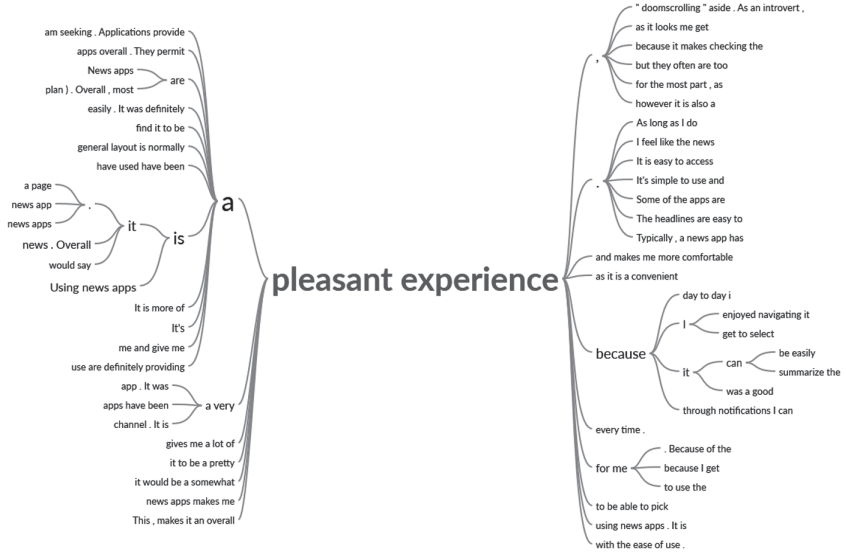

Figure 8.4 Word Tree for "Pleasant Experience"

Male 1, aged 48, high-school-educated, says, "News apps are a pleasant experience for me because I get a wide variety of news. I tend to look up news from a lot of sources so my news apps deliver a wide variety of content for me. I like being able to go to one place to see a lot of different types of news from a lot of different sources." Female 3, aged 25, high-school-educated, says, "I find it to be a pretty pleasant experience, as it lets me get a vague look at world events all in one place. Before apps in general became a thing, I always had to sort of go to different websites or find different newspapers if I wanted to know about everything going on in the world, so news apps have made it much easier and faster for me personally." Male 2, aged 21, in college with humanities and social sciences, says, "It's simple to use and the interface on many of them is also pleasant. It's just a matter of receiving a news notification on your phone and tapping on it. On some apps it not only shows news for the country you're in, in my case the U.S., but local and global news. Keeping informed through the news is important, to know what's going around in the world and at home. So far the news apps I use are definitely providing a pleasant experience." Female 9, aged 21, also in college, says, "A news app has a nice user experience that is engaging, interesting, and simple to use. Users can utilize such an interface to expedite their search options, mark certain areas, and save the content for future viewing. More appealing features can be added to any news app. Aside from published content articles, the app allows users to view related video, audio, and image data, further enticing them." Female 27,

aged 32, college-educated, says, "So far using news apps has been a very pleasant experience. I feel like the news that comes up in my news apps are tailored to my interest based on the algorithms they use. I very rarely skip over the news articles that are suggested to me." A few other participants also appreciated the relevance that personalization brings to them. They state that the user-based algorithmic recommendations allow them to easily get news that fits their needs and thus stay knowledgeable and up-to-date on the topics they are particularly interested in.

News App Consumption Satisfaction

When asked if they feel happier and more satisfied consuming news now that they have news apps in hand compared to before, when they did not, only a very small group of the participants report negative sentiments with mentions of dissatisfaction or unhappiness, while the majority report positive, neutral, or mixed feelings (Figure 8.5). Fifty-five "very positive" and 36 "moderately positive" references are recorded. The "very negative" and "moderately negative" mentions are a lot less frequent, with 26 and 24 respectively.

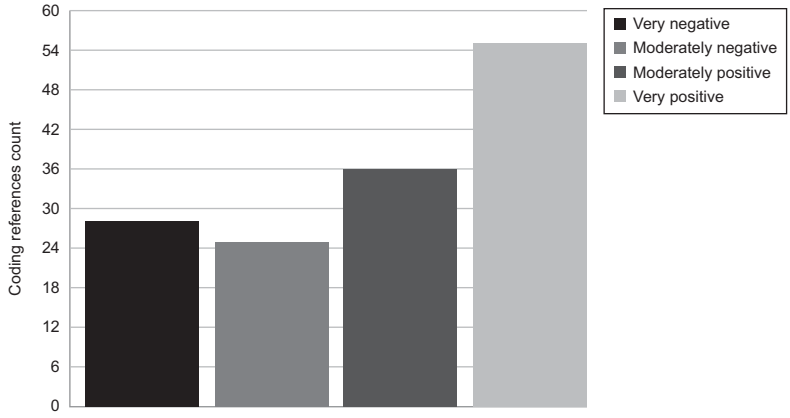

Figure 8.5 Sentiments toward "News App Consumption Satisfaction"

On the positive side, "personalized," "satisfied," and "happier" appear to be the top buzz words used to describe app user feeling, with 53, 53, and 41 mentions respectively.

Tailored communication appears to be key to news apps. User satisfaction seems to be achieved largely by algorithms that attend to and figure out users'

interests, preferences, and tastes, and tailoring the offerings accordingly to attract clicks and views. In theory, tailored communication can customize the source, message, and channel of a given communication to a given individual, presumably maximizing the relevance of the communication of that person.

Figure 8.6 Word Cloud for "News App Consumption Satisfaction"

The majority of participants appear appreciative of personalization and tend to associate happiness and satisfaction with it (Figure 8.6; Figure 8.7). For instance, Female 22, postgraduate-educated, aged 29, earning an income between $80,000 and $89,999, says, "I do prefer personalized feeds like the ones I have now. They allow me pick and choose the topics I like to stay informed about. I feel more satisfied because I don't have to wade through topics I'm not interested in in order to get to the ones I am. I am only interested in certain political topics so I don't have to search through the ones I don't want to read over." Male 52, college-educated, aged 28, earning an income between $50,000 and $59,0000, says, "Personalized feeds definitely make me happier when it comes to consuming news. I hardly watch TV news anymore because with my news app I get to choose which stories I think are worth reading (or viewing). People complain about algorithms, but I prefer that to a news channel on TV with directors who pick and choose what they want me to hear without any real input on my behalf. I get more satisfaction out of 30 minutes with a news app than from an entire news broadcast on TV." Male 23, college-educated, aged 19, earning an income of over $90,000 in the business and economics field, says, "The personalized feeds make me happier always. Watching news based on my interest is very satisfying. It was really hard to search the news among all the news feed when I did not have these news app in hand. Now, it is very easy for me. Because of personalized news feed I feel satisfied with the daily news consumption."

Figure 8.7 Word Tree for "Satisfied"

On the other hand, a small number of app users express reservations toward personalized news recommendation and consumption. Male 12 points out that such consumption is addictive, because "it makes it more likely that the next story will interest me. And if I am more likely to click on the next story, I will consume more news." Fear of missing out (FOMO) is another reason for having reservations. For instance, Female 1 says, "I don't prefer the personalized feeds because I feel like that makes it easier for me to miss certain news stories entirely. Seeing news based only on what I'm personally interested in could leave me completely ignorant of serious issues outside my realm of 'interests'." Likewise, Female 34 is worried about missing out information with the use of news apps. She says, "I sometimes worry about missing news and information that I need to know. It is because ever since I started using news apps, I noticed, on numerous occasions, that I know nothing about important issues and I have missed important news that I was supposed to know. It makes me think that I cannot trust fully the news apps and have to use additional sources of news in order to be adequately informed." Female 9 also fears missing news and information that she is supposed to know: "While I feel that I am in a constant state of news overload, I often feel as though I am only accessing the big stories and missing a lot of other important information. I feel

this is especially the case with local news. It is not pushed near as much and I feel as though I miss important information being shared that pertains to the town in which I live."

Another concern is limited perspective. Female 6 says, "While it does make me happier to have the news personalized as I get to be able to read what I want to read while not being bombarded with other things, that does limit my perspective of the world, which I dislike." Some fear the speculating and tracking nature of algorithmic technology. Female 23 says, "To be completely honest, I am not a big fan of the personalized news feeds within news apps. I think it tends to creep me out that the news app can know so much about me and what I am interested in. I'd rather have the news apps not personalize my feed."

Algorithm Awareness

The majority of participants report an awareness of news apps' personalized feed of news content, with only six subjects (6%) completely unaware of such operation. Interestingly enough, among the small group of unaware, females (4) outnumber males (2).

Among those aware, some are more knowledgeable than others about how the AI-powered recommendation system works its way to their user interface. Some users appear nonchalant as to how it works, so long as they receive relevant information and news of their particular interests. Overall, a moderate level of awareness toward algorithmic news is observed.

Male 22

"I am not super familiar with how exactly respective news algorithms work, but I know that they seek to maximize their user's attention/time spent in the app. They keep track of a bunch of data such as which articles read, how much spent per article, topics most clicked on, and the like in order to recommend articles that feed into the user's habit and keep them in the app for as long as possible."

Female 35

"I do not know the computer science/programming background behind news recommendation algorithms, but I do know that the algorithms recommend certain articles/topics based on the articles you have been reading, how much time you spend reading about certain topics, and your search history (what kinds of articles/topics are you seeking out)."

When asked what they know about algorithmic news recommendation systems, participants tend to talk in terms of browsing history and search history from a user perspective, as the Table 8.3 illustrates.

Table 8.3 Algorithmic Awareness

Major Theme	Participant*	Sample Quotes
Browsing/ search history	F3	*"I believe the news recommendation works based on your browsing history and search habits. It recommends things it thinks you'll be interested in based on what websites you view, products you buy, and things like that. It also probably takes into account other articles you've read on the app."*
	F8	*"Recommendations are based on prior search/reading history and other data aggregated from various sources as one browses. I try to turn off most of those for privacy reasons, but sites will still try to push things, just without a filter, so I get a lot of trending topics and stuff that's probably not really tailored the way the algorithms are designed."*
	M19	*"Just by using news apps and social media regularly I think most people figure out how recommendations from algorithms work. They use data obtained from your app history to show you stories you are interested in and then reap rewards by advertising to you."*
	F28	*"I don't know much about how any algorithm works but I do know my phone loves listening to me on the sly. That and my search history probably make the whole thing run. I've often talked about something or searched for something and the next day my news feed is covering just those things and they have a not interested button for things I didn't even add to it in the first place. It takes what you give it and automatically presents you news attributed to that."*

*Note: M = Male; F = Female.

Some participants, however, seem to perceive the news app algorithm beyond browsing history and demonstrate a higher level of understanding. Male 6, college-educated, aged 21, says, "I understand that companies use tracking data to develop algorithms to find articles that are similar to what you look for in news feeds. Algorithmic recommendations is something that many tech companies use to generate ads as well. Google is a great example of this." M20, aged 49, who is in the engineering and computer science field, talks about algorithms in a technology-wise way: "Content-based filtering algorithms are given user preferences for items and recommend similar items based on a domain-specific notion of item content. This approach also extends naturally to cases where item metadata is available (e.g., movie stars, book authors, and music genres)." Male 45, aged 24, who is "decently fluent in several programming languages," says that "long periods of time can lead to shockingly accurate analysis by way of recorded keywords, timestamps, engagement time, and other metrics related to viewing. This, combined with the demographic data you give upon sign-up, is more than enough to recommend new

stories." Male 53, aged 41, points out that news app recommendation is based on algorithms that are bi-directionally formed, in other words, top-down and bottom-up: "My news app allows me to select the different 'tabs' or sources, so in that sense I heavily contribute to the articles that are pushed my way. However, the main (or home) page of my news app is a collection of news articles across a wide spectrum of topics and from many sources, many of which I have not selected as a tab. On that page especially, I get articles pushed at me based on my reading history. When I click on a Top Ten List of Hollywood's Worst Films, for example, I can expect to see other Top Ten lists pushed at me and/or more about Hollywood. I'm perfectly fine with that because, for one, I still can choose not to view a pushed article and, for another, I generally want to see an article that matches my interests."

More Informed and Knowledgeable than Before?

Do news app users feel more informed and knowledgeable than before, comparing the time now, when they have news apps in hand, with before, when they did not? When asked about this, a small group of participants appears less optimistic than the majority. Female 1, aged 31, while appreciative of the general accessibility that news apps afford, does not feel more informed due to news app use. She says, "For better or for worse, algorithm media has expanded the variety of news stories that I come across in my day-to-day life and I have to try my best to curate an online experience that weeds out misinformation." Male 9, aged 22, while appreciating the ease of access afforded by news apps, does not feel more knowledgeable per se. He says, "I do not become any more informed than I would have been before unless I seek out the information even within the app. We have to be critical about each source that you read, and think about how that information is being marketed, and by whom." Male 55, aged 26, who shares the sense of not being more knowledgeable than before, says, "I feel as though having the news apps in hand all of the time depresses me and I often take breaks from reading news articles when I believe that they are all hyper-focused." Some participants even feel less informed when using news apps. For instance, Female 6, aged 32, thinks that news apps hinder her ability to see the whole picture. She says, "I actually feel less informed and knowledgeable than before … I prefer looking for news online through Google searches and just watching some of it on TV. The apps are too personalized. They can also be distracting and prevent you from seeing everything that's out there. You have to stop and think. Why do people want you to use news apps in the first place? So they can make money! Newspapers are free and paid by our taxes locally. It is nice to not have to buy a paper like The New York Times, but I actually miss reading it and then recycling the paper. Anyway, I feel less

informed via apps overall because there is too much information to navigate and the platforms can be confusing."

The overwhelming majority, however, have neutral, mixed, or, most likely, positive comments. On the positive side, participants consider accessibility, relevance, and timeliness as the primary merits that news apps bear that allow them to feel more knowledgeable and informed (Figure 8.8).

Figure 8.8 Sentiments toward "Whether feeling more informed and knowledgeable"

Table 8.4 More Informed and Knowledgeable Than Before?

Major Theme	Participant*	Sample Quotes
Accessibility	F10	*"I definitely feel more knowledgeable and informed with the news readily accessible right in my hand. I am able to look something up and see it in seconds rather than waiting for it to come on TV or waiting for it to be in a newspaper or some kind of print. You can also fact check from your phone to see if what you are reading is actually true and accurate."*
	F37	*"Absolutely, yes, I feel more informed and knowledgeable than before. News apps are easily accessible whenever we want. We can store as many news as we want and no space needed. If we have newspaper, We need space to store papers. but, in news apps we don't need any space. Just need a memory chip."*
	F40	*"I feel more knowledgeable than before, because I am able to access the news easier which makes me check it more frequently than before. News apps also allow me to view more varying stories rather than those that I specifically search for. This makes learning about new topics in the news way more convenient."*
	F27	*"I feel more informed now and feel like I am more knowledgeable on the current events occurring in the world today. It used to be a hassle to have to sort through news articles that pertained to me. It got to the point that I didn't actively seek out looking at the news because it was such a hassle."*
Relevance	M2	*"I feel more informed because I am being shown more news through personalization. This takes the effort out of sifting through places to find critical information in a short and concise manner. It gives me the news that's relevant to me and that I would be interested in. Yes, the news apps are definitely making me more informed."*
	M11	*"I do feel more knowledgeable now than before because these apps get their information from literal news centers and most of the time have their news information center linked in a sentence at the bottom of the page or right after their informative story."*
	M16	*"I definitely feel more informed and knowledgeable than before. News apps allow me to compare numerous perspectives within a few minutes and lets me extrapolate the truth of a particular event more easily. Furthermore, the news apps tend to display topics which are more relevant to my interests and this results in me consuming data for longer periods."*
	M26	*"The news app sends me personalized feeds, which makes me very happy consuming news each and every time. I feel more informed and knowledgeable than before because I get the relevant news easily through this app."*

Table 8.3 Continued

Major Theme	Participant*	Sample Quotes
Timeliness	M13	*"I do feel more knowledgeable with a news app. The news app updates regularly and before I had to wait until the next day to see the news. Although it doesn't always seem that it refreshes as quickly as I would like with new stories."*
	M47	*"The apps also draw my attention to urgent and breaking topics. I need to be made aware of things that I don't know are happening and the apps alert me to these topics."*
	F35	*"I definitely do feel more informed and knowledgeable that before I used news apps because I do not typically go out of my way to find news articles and read them, unless something major has happened that many people are talking about. However, when I get notifications from news apps on recently published articles with their respective headlines, it encourages me to read them as they seem interesting. It is much more convenient to stay up to date on current events, which is why I like to use the news apps. News apps make knowledge much more accessible and have allowed me to be more informed about topics such as politics."*
	F40	*"I do feel more informed. If I didn't make the time to sit down and watch the news during the news hour than I missed information and felt uninformed when important events happened. I downloaded the App during the COVID outbreak to hear the latest news and actions the government was taking. Now I continue to rely on it to summarize the events of the day and keep me informed."*

*Note: M = Male; F = Female.

A very interesting side finding is that it seems females care more about the accessibility of the news apps while males are more concerned with relevance, although timeliness matters to app users of both genders (Table 8.4).

Empowerment

Do people feel more in control of their exposure to news with algorithmic news apps in hand, not having to sift through irrelevant news? When asked if they feel more empowered, comparing the time now, when they have news apps in hand, with before, when they did not, participants' answers were mixed, with 75 mentions classed as neutral, 54 mixed, 53 positive, and 16 negative. In terms of

empowerment, these users hold different views. Some of them do feel a sense of participation in the distribution and exposure process, and thus empowered. Others feel neutral or negative (Figure 8.9).

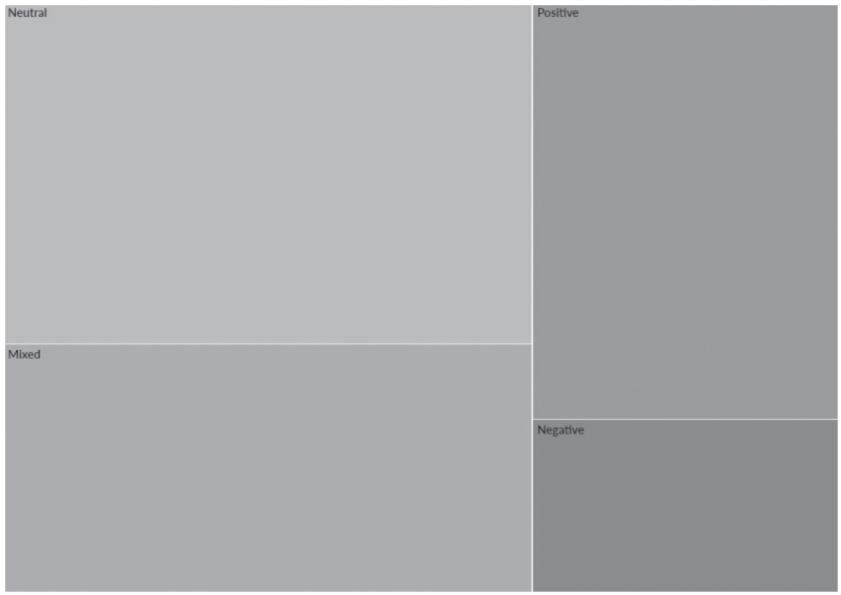

Figure 8.9 Sentiments toward "Whether feeling more empowered"

Male 1, high-school-educated, aged 48, from the arts and performance field, does not feel more empowered because "the stories delivered are chosen by the app." He says, "Before, I used to go through the stories and pick the ones I wanted to read, and then go to the next source. Now it's done for me so it's fast but I don't have as much control." Male 13, college-educated, aged 39, who has a business and economics background, cites addiction as the reason for not feeling empowered. He says, "I don't feel more empowered. The news apps have seemingly taken the social media course and are almost as addictive as social media has become. Addiction is the opposite of control." Male 40, college-educated, aged 26, who is also in the field of business and economics, says, "I feel like I have less exposure. If the story isn't recommended by my apps then it is much less likely that I will see it because I don't search out the main news on my own as much as I used to. Things definitely slip through the crack because of this." Male 50, high-school-educated, aged 64, who chooses not to disclose his professional background, feels a strong sense of powerlessness using news apps. He says, "No, I do not feel more empowered, nor do I feel a sense of being in control of exposure to news and I am

increasingly worried that it is becoming much more difficult to identify irrelevant or general news from relevant and specific news. I find that the lines between the two are growing more and more blurry, to the point where I am exhausted and disgusted, so much so that my desire to seek out the truth has dramatically waned. Yes, I have control insofar as I am able to either open the app or not but I am less and less certain that if I choose to open it and consume what's there, I am consuming unbiased news." Female 33, college-educated, aged 36, who has a health and human development background, expresses the strongest negative feeling. She says, "No, I am not more empowered. I am simply more mad that more and more is being hidden, or not considered useful to me. I decide that algorithms are dumbing down people by giving them information that leads to rabbit holes."

On the other hand, some participants appear enthusiastic about being empowered by news apps. Female 3, aged 33, enjoys the relevance and control: "I definitely feel more empowered with the ability to use a news app. I like that I can just see what is relevant to me and not every little thing that comes up. I love that I can control which news I see and which I don't want to so that I never have to read a bunch of boring articles I don't care about." A few other participants share her enthusiasm. Male 46, college-educated, aged 42, says: "I do feel more empowered now, now that I have the news app. Before, I had to sort through whichever articles was available till I found something I liked. Now that I am delivered articles based mainly on my tastes, I feel more in control." Female 10, college-educated, aged 23, says, "Yes I definitely do feel more empowered. It is easier to access what you want to see and what you are looking for. With the different articles to choose from, I do not have to sit through a video or a live broadcast just to listen to the one story that I wanted to hear about. This is definitely easier for everyone that uses the apps and likes to keep up with different news stories daily." Male 35, in college, aged 20, says, "I do feel more empowered because I have so many different sources I can gather information from. Rather than just checking a single website or relying on a newspaper, I can get news from pretty much anywhere. Sometimes I go searching for news from a country such as China or Japan, and I still am able to find relevant articles to assist me."

Proactive News Seeking

With news apps pushing content to people at their convenience, are search activities for news reduced? Are people less proactive in information seeking? When asked in this regard, the overwhelming majority of the participants indicate that search activities are indeed "reduced," with only a very few reporting "no change" or "not reduced."

"I'm generally less likely to search for news of particular interests but if I read something and want to know more about that thing then I will continue searching for more information about it. So I'm less proactive seeking new topics, but still want to search for more information about existing ones," says Female 1, aged 31. Likewise, Female 2, aged 20, says, "I am not as proactive in search of news with news apps, mainly because I used to get iPhone news notifications and would just read those. However, if I was really interested in the news topic, I would search up more news articles (meaning I was more proactive in my news search). When I would just use the newspaper for access to the news, I was very proactive because there's no generated news feed." Female 27, aged 32, also reports that her active news seeking was reduced but not eliminated: "I still search for certain information on current events, but honestly the news app algorithms usually bring me the news articles that I am currently interested in anyway." While these app users seem to be trying to balance their exposure to recommended news by still maintaining active news seeking activities, others appear to be content with what they have and just let it be (Table 8.5).

Table 8.5 News Seeking

Major Theme	Participant*	Sample Quotes
Reduced	M2	*"It is definitely more convenient to me due to not having to search what I want to see or read on the news. It gives it to me in a digestible manner that provides me with less proactive searches and more reactive to the news in question. It's less searching for what interests me and more consuming what is presented to me in an efficient way."*
	R1	*"Yes, pushing content on news app reduced my seeking or searching activities, because if there was anything else that important, usually it would show up everywhere, as I use multiple sources."*
	M13	*"Yes, I am less proactively searching for news with the use of news apps. It seems like I get my fill of news using just the app, with the additional use of reddit I don't seem to do additional searching most of the time."*
	M24	*"I searched for so many news based on my interest when I did not have the personalized news app in hand. It was a big trouble facing the irrelevant news. Now my search activities are reduced because of the personalized news apps."*
	M53	*"My search activities are reduced because of my news app. It filters what news I see based on my pre-selected preferences and my user history, so I don't have to google search the internet for news. Now, that doesn't mean I just click on every article my news app puts in front of me, so in that sense I am still selective, it's just that I no longer have to spend time searching for news topics that interest me."*

Table 8.3 Continued

Major Theme	Participant*	Sample Quotes
	F35	*"My search activities for news is definitely reduced because articles are suggested to me based on my interests identified through the algorithm used by news apps. I am much less proactive in search of news, unless it is about a topic that is controversial or an event that many people are talking about."*
	F40	*"Search activity is reduced as the ease of finding topics that are enjoyable is enhanced due to the algorithm, so it can save a ton of time, while still introducing you to new topics you otherwise may not have been exposed to on a news channel or social media."*

*Note: M = Male; F = Female; R = Rather not say gender.

Trusting Recommended Content?

Do people trust the news content that news apps recommend and push to them? When asked of trust in recommended news content, participants' answers are mixed overall, with 59 mentions considered neutral, 47 mixed, 53 positive, and 20 negative (Figure 8.10).

Figure 8.10 Sentiments toward "Trust in recommended content"

Male 9, high-school-educated, aged 22, expresses trust in most of the basic information that is provided by any news source that shows up in his news app, but he does not always trust the intent. "I don't think there's some news conspiracy pushing mind control, but I do think the suggestibility of news outlets presented through something as simmered down and concentrated as a personalized news app can be harmful to someone who isn't so good at thinking critically." Male 30, aged 46, also high-school-educated, also exhibits conditional trust. He says, "There are some news apps which I trust to provide a balanced take on the news. There are others which may be aggregators of news articles which may push me to sources which I don't trust. I try to take everything that I read with a relative grain of salt in that at any time, there may be an article or editorial which is biased or not entirely true. And I have to trust my instinct. If I feel that something is not right or may be untrustworthy, I will search for a second source. I realize with so many options of news apps, there are bound to be some which produce sensational or biased articles and I try to be cautious of this."

Participants who express strong distrust in news apps most likely cite algorithm bias and ideology bias. Male 6, college-educated, aged 21, believes that all news media have a role in the way the message is relayed or portrayed, no matter what the story is. "Sometimes it involves a lot of bias which can create two different stories between two different apps. This is similar to how Fox News shows a bit of conservative bias in their news and CNN showing liberal bias in their news." Female 1, college-educated, aged 31, is wary of the content news apps recommend in general, with her mistrust of algorithms being due to the potential for blind spots in her news consumption. She says, "I think letting my only news intake be dictated by an app gives a lot of power to someone/something else to try and influence my world view." Female 36, in college, aged 20, says, "I know that it would just be an algorithm doing the recommending, however that algorithm was designed by someone with bias and their own agenda so it's difficult to say if they built it with the intentions of pushing a certain perspective or worldview. And, honestly, I don't want to just be fed things that I agree with."

Interestingly enough, participants who exhibit trust in news apps tend to be those who conscientiously curate their news apps' personalization. Male 8, college-educated, aged 35, uses both Apple News and Google News. He considers that the recommendations are mostly to be trusted: "In these trusted news apps you can easily organize and manage the news. You can create a custom feed with your favorite news sources. The most important news will appear at the top of the feed." Male 53, college-educated, aged 41, seems to enjoy ownership of the news app he uses. He says: "I trust it as much as I trust anything else online and abundantly more than I trust TV news. Do I believe every article pushed at me? No, of course

not, but again, I am the one who prepares my news feed on my news app, so I can select sources for news that I do generally trust. For example, I have found a channel on my news app for a news source called Reason. I love Reason because it gives me in-depth coverage of contemporary news, and I have found it very trustworthy and accurate, much more so than some of the more mainstream news outlets." Likewise, Male 54, postgraduate-educated, aged 22, says, "Yes, I trust the news content that gets pushed to me since I am the one that dictates what sources and genres of news get pushed to me in the first place. I am very much aware of the various biases that can poison our ability to view news (and reality) in a more objective light, and I choose my sources in a way that purposefully attempts to avoid this problem. I also try to get a healthy dose of international, domestic, and, perhaps most importantly, local news."

Curating News Consumption

While some participants indicate that they do actively use the interactive functions available in the apps to curate news consumption, others report that they have not tried to curate the news recommendations. Among these non-curators, a few are simply unaware of these functions, and some are just unconcerned about what comes into their hands, whereas others intentionally leave the app as it is because they are afraid that if they do curate, they might miss out on something important in the future (Table 8.6).

Among the curators, some actively use a news app's interactive functions, such as "hide," "mute," "report," or "less this," for a variety of reasons, including information overload, mismatched recommendation, and vulgar content.

Table 8.6 Why Curating News Consumption

Major Theme	Participant*	Sample Quotes
Information overload	M6	*"I have tried to curate my news consumption by actively using a news app's interactive functions, such as "hide", "mute", "report", or "less this". I have done this because sometimes I get overwhelmed with the amount of recommended news articles I receive. Sometimes I lose track of time because I get caught up in too many articles that I lose time to do other things. To avoid this, I mostly use the "less this" tool to show less news feeds."*

(*Continued*)

Table 8.3 Continued

Major Theme	Participant*	Sample Quotes
Mismatched recommendation	R1	*"The news recommendations are not always accurate. Sometimes there would be information that I have no interest in, so I put it to see less of similar content. But I do not use as much of the mute or report."*
	F37	*"Yes, I have tried to curate your news consumption by actively using a news app's interactive functions. I muted the unwanted news. I reported the news content if It is not a correct content. I hid the sexual content news."*
Vulgar content	M53	*"I do use my news app's interactive function to curaate my news consumption. For example, there are news sources that I have consistently found lacking, either because they are loose with the facts or aren't well written, and I have chosen to "hide" these sources so that I never have to see them show up on the home page of my news app.."*
	M9	*"Yes, if I can tell that an app has picked up on something either by accident, or by a stray search I made, I usually click the "less of this" button to make sure it does not start skewing the whole thing that way, just in case. I only use this for things that are just patently out-there or sensational, though, and try not to use it on things I just disagree with."*
	F17	*"Mostly news apps are algorithm based recommend personalized news and feed content to me based on my interests and preferences but some time it will suggest vulgar content to me based on their advertisement offers at that time. I try to do things such as hide, mute, report, less this."*

*Note: M = Male; F = Female; R = Rather not say gender.

Biased by News Apps?

Would people become biased using AI-based news apps over a period of time, given that one may not be exposed to a diversity of views/opinions? When asked of this, participants are evenly divided with about half of them thinking so and half saying "no."

Those who fear they may become biased frequently mention "echo chamber," "source," "viewpoint," "opinion," and "perspective." Apparently, the major concern here is that algorithmic news app users may end up trapped in an echo chamber, or, in other words, a comfortable information cocoon. As 24-year-old and college-educated Male 22 points out, by design, the algorithm is meant to keep users in

their app for as long as possible: "Users usually will not like dissenting opinions, so it is in the best interest of the app to recommend articles that the user likes, eventually forming an echo chamber. I am different in that I seek differing perspectives and that is what I want the status quo to be. I want my algorithm to recommend articles that do not reinforce my view but rather attack it so I can be more informed."

A few participants warn of the danger of the echo chamber. High-school-educated 22-year-old Male 9, for instance, "would want to change the status quo of things" because "an echo chamber of people sharing and re-sharing the same sentiment with no room for thinking outside of their own heads is not only dangerous," he thinks that "it makes people legitimately stupid." He says, "There should probably be some restriction limiting algorithms on how homogeneous they are allowed to become." In this way, there would be a variety of viewpoints and people would be exposed to more than just what makes them comfortable or validated. Likewise, Male 23, a 19-year-old college student, expresses the view that he would definitely want to change the status quo as he really appreciates hearing from multiple perspectives: "I am of the belief that falling into an echo chamber can be very dangerous for one's development of their personal beliefs, so hearing from different sources is something I always want to do."

"I have definitely become more biased with all of the personalized news," says Female 2, a 20-year-old college student. She proposes that news recommendation systems add labels or tags such as "written by a conservative" or "written from a conservative viewpoint" and vice versa on heavily biased news articles: "This way people know and can recognize they are getting biased news and can formulate better opinions and understandings." Male 50, 64 years old, is "unwilling to be manipulated in any way by anyone or any algorithm." As he wisely puts it, "If I want to participate in the conversations of society, I need to understand how those with whom I am conversing receive and internalize information; therefore, I cannot afford to simply cut myself off from sources of information that the vast majority of my fellow citizens use. I believe that the horse has already left the barn with regard to coming up with a comprehensive solution. But, there are far greater minds out there than mine, so I can always hope. So, no, I won't just let it be. Rather, what I will do is find a way to overcome the fatigue such that I can continue to effectively and tirelessly search until I am satisfied that I have a truthful representation of the facts of a given story. I am ultimately responsible to find a way to make it work no matter what technology comes up with to either intentionally or inadvertently make it more difficult to discern truth and accuracy from fiction and inaccuracy."

Discussion

Technological advancement can be a blessing and a curse. Amid the increasing use of algorithms in news recommendation practice, this qualitative study examines user experience and perception of AI-based news apps through semi-structured CAPIs (computer-assisted personal interviews). While the overall sentiment among app users is found to be more positive than negative, users, especially those who are more algorithm-aware, have expressed concerns about the effect of personalized news consumption.

In line with some previous research (Logg, Minson, & Moore, 2019; Thurman, Moeller, Helberger, & Trilling, 2019), this qualitative study finds that news apps users often trust and even prefer algorithmic to human judgement, but at the same time, are concerned about missing out on important information and challenging viewpoints, as well as about their privacy. Many participants are ambivalent about living with algorithm-based news recommendations.

Admittedly, the most remarkable beauty of the Internet-based algorithm is probably its affordance for unlimited specialization of contacts and information. There is a convenient populism at play with algorithm-based news apps. However, it becomes concerning if objective newsworthiness becomes secondary to subjective personal favors. As mentioned earlier, algorithm-based personalized news recommendation reminds us of the "information cocoons" concept, a term first coined by Harvard professor Cass Sunstein in 2001. It also reminds us of "The Daily Me" concept, which was prophesied by MIT professor Nicholas Negroponte at the emergence of the Internet age—"The Daily Me" was an entirely personalized newspaper in which each individual could select perspectives that he or she liked. Both the "information cocoon" and "The Daily Me" terms have been cited to warn against filtered information, tailored news consumption, and favored opinions.

Participants in this study commonly exhibit a sense of comfort, appreciation, and gratification with news apps' personalized news feeds, calling the use of news apps a pleasant and satisfactory experience. Personalization appears to be the key in uses and gratifications. While participants in general report being less active in searching information after using news apps, ironically, many participants believe that they are more informed and knowledgeable now that they have the news apps in hand, citing accessibility, relevance, and timeliness as the primary merits that news apps bear to allow such possibility.

Some participants, likely those who actively curate their news apps' recommendation functions, tend to trust the recommended content and do not worry about missing out information beyond what's available in the app used. Others,

likely those who demonstrate a higher level of understanding of the backstage algorithm, are more vigilant of the potential threats. Some of them realize and worry that they have become more biased with all the personalized news pushed to their fingertips. A small group of participants appear to be able to take ownership of their news consumption by going above and beyond recommended news. These people tend to conscientiously perform fact-checking, alternative sourcing, and perspective countering. After all, news recommendation algorithms are optimized for engagement, not for truth or civil dialogue.

References

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CHAPTER 9

Google News vs. Apple News

As this study's national survey (N = 1156) conducted in 2021 reveals, about 75% of the respondents are active users of algorithmic news apps (use almost every day, as the survey defines). In other words, it appears that only one fourth of the public are not using such news apps on a daily basis. According to the survey, Google News and Apple News are the top two most used news apps among Americans. More than half of the respondents indicated they are active users of Google News, and about one third reported using Apple News.

The Google News app (Figure 9.2) is search giant Google's leg in the news sector. It presents users with a customized news briefing of the top five stories, updating instantly throughout the day, based on global news, local content, and user interests. The Google News app works with both Android and iOS devices. The Apple News app (Figure 9.1) comes preinstalled on Apple's iPhones and iPads, offering news stories via editor-curated feeds that are personalized to cater to the user's favourite topics. The feed learns and improves its choices based on user browsing history and reading habits.

Figure 9.1 Apple News App

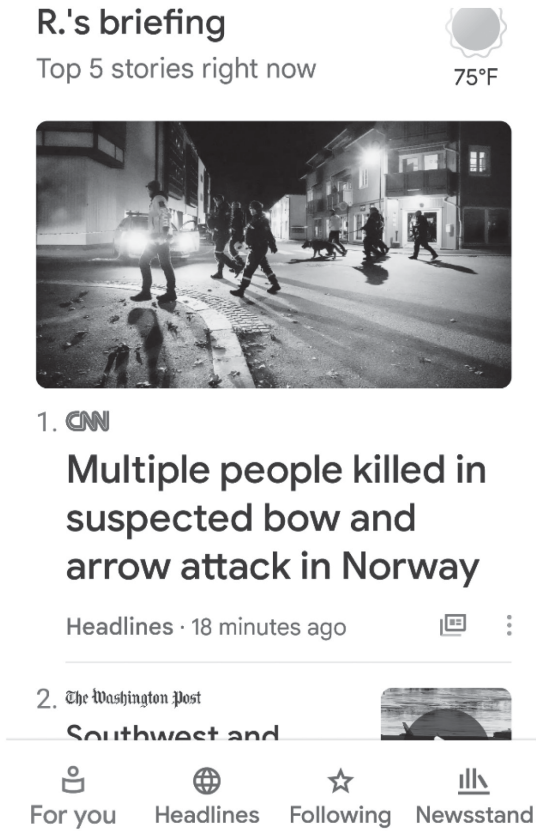

Figure 9.2 Google News App

As Google News and Apple News are the top news apps that Americans use on a daily basis, it is worthwhile examining and comparing their users. It is worth noting that some Google News users (N = 405) are exclusive of Apple News, and vice versa, while some use both apps (N = 162). Are Google News users different than Apple News users? In what way are they distinct from each other? Whose users are more appreciative of news consumption? Whose users know current events better? Whose users have higher levels of news literacy?

User Profiles

Table 9.1 presents profile information for the three groups of users: Google News (exclusive of Apple News) users, Apple News (exclusive of Google News) users, and users of both apps.

The majority of Apple News uses, some 56.3%, are female, making it unique among the three groups (Google News = 48.4% female; both news apps = 47.5% female). That is, Apple News (exclusive of Google News) users are more likely to be female than users of other apps. In terms of age, Apple News stands out again as its users tend to be younger—a larger proportion (22.5%) of its users are under 30 years old, compared to 15.6% for Google News users. As for education level, Apple News stands out as well with 27.8% of its users reporting postgraduate education, compared to 16.1% for Google News users and 23.5% for users of both apps.

Google News users, on the other hand, are unique in terms of area of study/profession. Its users are less likely to be working in the areas of business and economics (17.3%), compared to 23.2% for Apple News users and 23.0% for users of both apps. Interestingly enough, Google News users are more likely to be in the field of engineering and computer science (19.5%), compared to a mere 12.6% for Apple News users and 15.5% for users of both apps.

In terms of app consumption, those who use both news apps exhibit significantly heavier use: 35.6% of them are moderate users (1–3 hours daily), compared to 25.5% for Google News and 20.4% for Apple News; while 11.7% of them are heavy users (>3 hours daily), compared to 1.7% for Google News and 0.7% for Apple News. Overall, Google News users spend more time on the app than Apple News users.

To examine the possible differences between Google News users and Apple News users with regard to news consumption and news literacy, the study conducted a series of statistical analyses, including chi-square (cross tabulation) and ANOVA tests. Overall, the three groups of users' differences in education level and time spent using news apps are statistically significant.

Table 9.1 User Profiles

		Google News (exclusive of Apple News) N = 405	Apple News (exclusive of Google News) N = 151	Google News & Apple News N = 162
		Frequency (%)	Frequency (%)	Frequency (%)
Gender (χ2=4.85)	Male	204 (*50.4*)	63 (41.7)	81 (*50.0*)
	Female	196 (*48.4*)	**85 (56.3)**	77 (*47.5*)
	Non-binary/ Third gender Prefer not to say	3 (.7) 2 (.5)	2 (*1.3*) 1 (.7)	2 (*1.2*) 2 (*1.2*)

Table 9.1 Continued

		Google News (exclusive of Apple News) N = 405	Apple News (exclusive of Google News) N = 151	Google News & Apple News N = 162
Age ($\chi 2$=15.96)	<30	63 (*15.6*)	**34 (*22.5*)**	32 (*19.8*)
	30–39	151 (*37.3*)	54 (*35.8*)	62 (*38.3*)
	40–49	81 (*20.0*)	28 (*18.5*)	40 (*24.7*)	
	50–59	55 (*13.6*)	22 (*14.6*)	21 (*13.0*)
	60–69	43 (10.6)	9 (6.0)	6 (*3.7*)
	70 +	12 (*3.0*)	4 (2.6)	1 (*.6*)
Education (**$\chi 2$=17.93***)	Middle School (or lower)	2 (*.5*) 86 (*21.2*)	1 (*.7*) 20 (*13.2*)	1 (*.6*) 17 (*10.5*)
	Higher School College/University	250 (*61.7*)	88 (*58.3*)	106 (*65.4*)
	Postgraduate	67 (*16.1*)	**42 (*27.8*)**	38 (*23.5*)
Major/Area of Profession ($\chi 2$=15.86)	Arts & Performances	17 (*4.2*)	9 (*6.0*)	11 (*6.8*)
	Business & Economics	**70 (*17.3*)**	35 (*23.2*)	37 (*23.0*)
	Communications	15 (*3.7*)	5 (*3.3*)	6 (*3.7*)
	Education	32 (*7.9*)	15 (*9.9*)	15 (*9.3*)
	Engineering & Computer Science	**79 (*19.5*)**	19 (*12.6*)	25 (*15.5*)
	Health & Human Development	28 (*6.9*)	11 (*7.3*)	15 (*9.3*)
	Humanities & Social Sciences	44 (*10.9*)	17 (*11.3*)	20 (*12.4*)
	Natural Sciences & Mathematics	32 (*7.9*)	13 (*8.6*)	10 (*6.2*)
	Other	48 (*11.9*)	16 (*10.6*)	15 (*9.3*)
	None	40 (*9.9*)	11 (*7.3*)	7 (*4.3*)
News App Use (**$\chi 2$=52.69****)	Low (<1 hr)	302 (*72.8*)	120 (*78.9*)	88 (*52.8*)
	Moderate (1–3 hrs)	106 (*25.5*)	31 (*20.4*)	**58 (*35.6*)**
	Heavy (>3 hrs)	7 (*1.7*)	1 (*.7*)	**19 (*11.7*)**

* difference is significant at the .05 level.
** difference is significant at the .01 level.

Differences in News Literacy

Table 9.2 presents differences in news literacy for the three groups of users: Google News (exclusive of Apple News) users, Apple News (exclusive of Google News) users, and users of both news apps.

Table 9.2 *User Differences in News Literacy* (N = 1115)

Measures	Google News *N* = 405	Apple News *N* = 151	Google News & Apple News *N* = 162	*F*
Need for cognition	10.63	10.71	11.13	1.47
Need for orientation	11.67	11.67	12.09	2.06
Skepticism	12.66	12.68	12.61	.07
News appreciation	11.49	11.06	12.01	**7.79****
Media locus of control	12.01	11.91	12.33	1.73
Current event knowledge	7.82	7.76	7.78	.10
NLP news literacy quiz score	6.30	6.95	6.42	**5.22****

** difference is significant at the .01 level.

In terms of need for cognition, there is no statistically significant difference detected (by ANOVA test) among Google News users, Apple News users, and users of both apps, although users of both apps have the highest mean score, meaning that among the three groups they are the group that tends to prefer mindful thought the most (Figure 9.3).

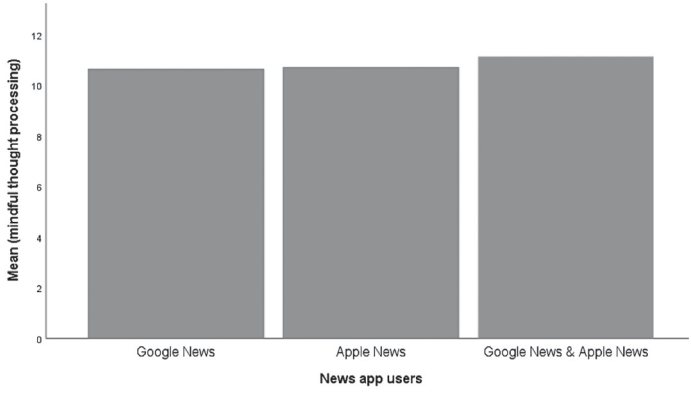

Figure 9.3 Need for Cognition

Likewise, in terms of need for orientation, there is no statistically significant difference detected among Google News users, Apple News users, and users of both apps, although the two-app group has the highest mean score, meaning that overall its members are more motivated for news consumption than those of the exclusive-user groups (Figure 9.4).

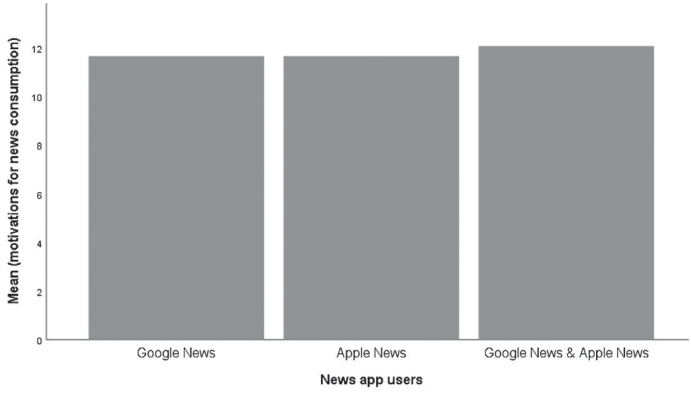

Figure 9.4 Need for Orientation

The three groups of app users appear to have about the same level of skepticism toward news media. In general, they are equally critical of news source and news credibility, although Apple News app users seem to be slightly more critical than the other groups (Figure 9.5).

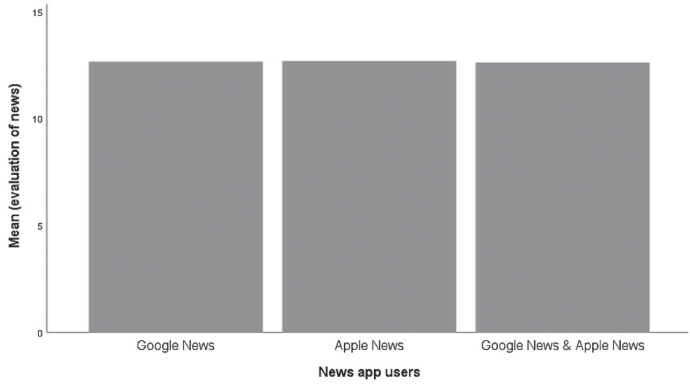

Figure 9.5 Skepticism

But the three groups of news app users do exhibit significant differences in terms of news appreciation (Figure 9.6). Users of both apps are most appreciative

of the news that they have access to consume, most likely to take news consumption as a pleasure, and most often recommend and forward news to their friends. Google news users come second in news appreciation, and Apple News users are least appreciative of their news consumption among all.

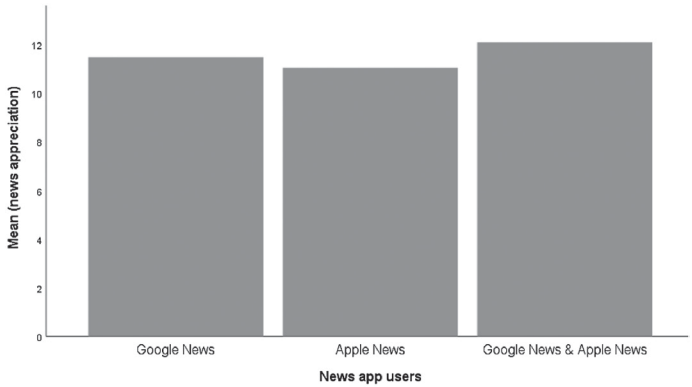

Figure 9.6 News Appreciation

Users of both news apps appear to have the highest level of media locus of control among all, although the difference is not statistically significant (Figure 9.7). Using both Google News and Apple News, they are the ones most likely to feel in control of the information they get from the news media and believe that if attention is paid to different sources of news they can avoid being misinformed. These users are also most likely to believe that they can stay informed as long as they take the right actions.

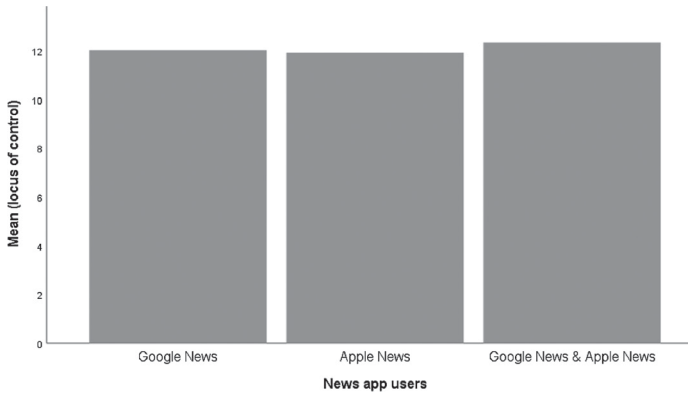

Figure 9.7 Media Locus of Control

The three groups of news app users appear to have the same level of current events knowledge, with very minimal difference (Figure 9.8). However, in the NLP (News Literacy Project https://newslit.org/) "How news-literate are you?" quiz, their scores are significantly different. Apple News users stand out as the highest scorers (M = 6.95/12), followed by users of both apps (M = 6.42/12) and Google News users (M = 6.30/12).

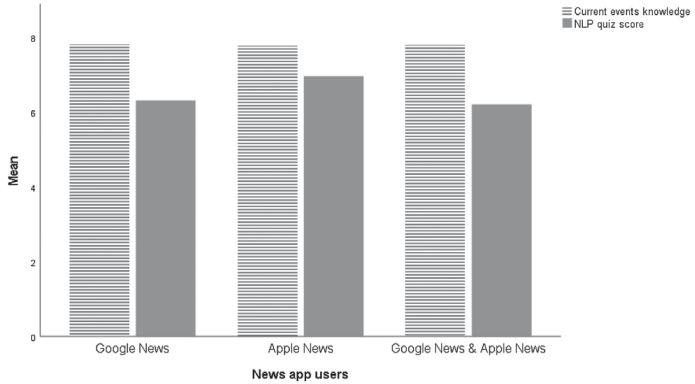

Figure 9.8 Current Events Knowledge and NLP Quiz Score

Algorithmic Literacy

Table 9.3 presents differences in algorithmic literacy for the three groups of users: Google News (exclusive of Apple News) users, Apple News (exclusive of Google News) users, and users of both news apps. Surprisingly enough, the three groups exhibit significant differences in many aspects, some striking. Overall, users of both apps appear to have higher levels of algorithm literacy than the exclusive-user groups.

Table 9.3 *User Differences in Algorithmic Literacy, Algorithm Avoidance, and Algorithm Trust* (Total N = 1115)

Measures	Google News *N* = 405	Apple News *N* = 151	Google News & Apple News *N* = 162	*F*
I know how algorithm-based technologies work.	3.64	3.57	3.86	**4.25***

(*Continued*)

Table 9.2 Continued

I am aware that news apps may recommend news based on algorithms	4.21	4.22	4.24	.06
I would avoid algorithm technologies if I can	2.65	2.64	3.01	**6.09****
I would avoid algorithm-based news apps if I can	2.77	2.68	3.13	**6.87****
I have trust and confidence in algorithm technologies	3.14	3.13	3.60	**13.89****
I have trust and confidence in news apps when it comes to recommending the news fully, accurately, and fairly	3.09	3.04	3.59	**16.59****
I am exposed to news that has source diversity and diverse viewpoints	3.72	3.69	3.93	**3.40***
I believe that news app recommendations are reliable	3.35	3.33	3.72	**10.23****

* difference is significant at the .05 level.
** difference is significant at the .01 level.

All three groups report very high level of awareness that news apps may recommend news based on algorithms, with no statistically significant difference detected (by ANOVA test). No matter which news app people use, they assume algorithm usage is a given. However, when it comes to how algorithm-based technologies work, Google News users have slightly higher levels of knowledge than Apple News users, with users of both apps being most knowledgeable in this regard (Figure 9.9).

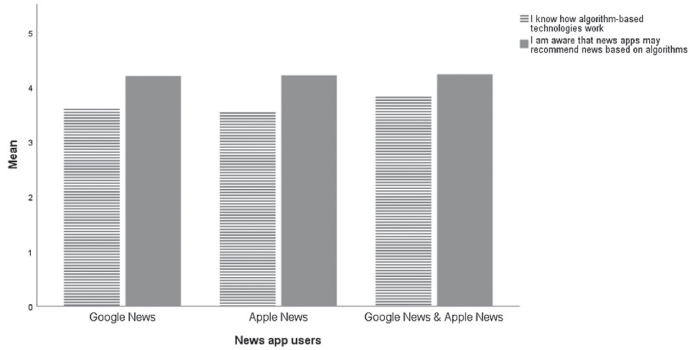

Figure 9.9 Algorithm Awareness

When asked if they would avoid algorithm technologies if they can, Google News users and Apple News users are on the negative side, indicating that they would rather not avoid algorithm technologies. Overall, users of both apps are about neutral, expressing significantly stronger likelihood than Google News users and Apple news users, who share about the same low level of avoidance. Likewise, when asked if they would avoid algorithm-based news apps if they can, the group using both apps is slightly on the positive side above neutral. Google News users and Apple news users are on the negative side, indicating they would rather live with algorithm-based news apps, with Apple News users reporting slightly less avoidance of algorithm-based news apps than Google News users (Figure 9.10).

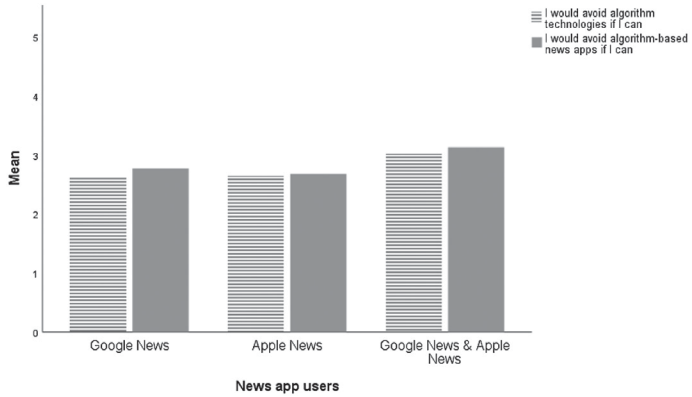

Figure 9.10 Algorithm Avoidance

People using both apps appear to have strikingly higher levels of trust and confidence in algorithm technologies (M = 3.60). Likewise, users of both apps report the highest levels of trust and confidence in news apps "when it comes to recommending the news full, accurately, and fairly" (M = 3.59). This group of users is also a lot more likely to believe that they are exposed to news that has source diversity and diverse viewpoints (M = 3.93), and to believe that news app recommendations are reliable (M = 3.72) than Google News users and Apple News users. Compared to Apple News users, Google News users have slightly higher levels of trust and confidence in algorithm technologies (Figure 9.11), and likewise are slightly more likely than Apple News users to feel exposed to source diversity and to believe in news app recommendations (Figure 9.12).

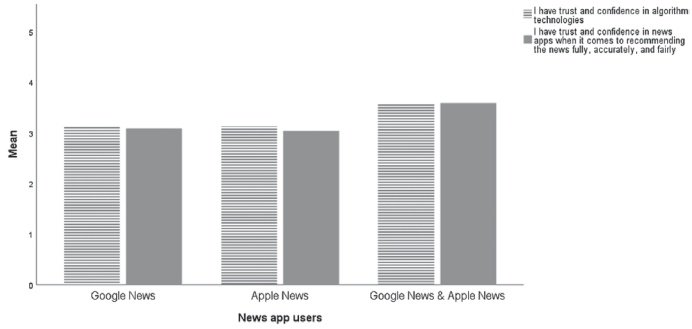

Figure 9.11 Trust and Confidence in Algorithm and News Apps

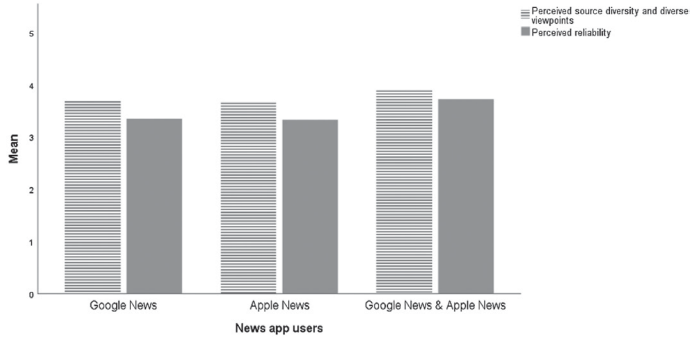

Figure 9.12 Perceived Diversity and Reliability

Appreciation of News Apps

Table 9.4 presents differences in appreciation of news apps for the three groups of users: Google News (exclusive of Apple News) users, Apple News (exclusive of Google News) users, and users of both news apps. Overall, there is no significant difference between Google News users and Apple News users, but users of both apps appear to be significantly more appreciative of news apps than the exclusive-user groups (Figure 9.13). They appear to feel a lot happier with news apps, and think that news apps make news consumption easy and enjoyable (M = 4.10). Meanwhile, compared to the exclusive-user groups, users of both apps are also more likely to think that the recommended news stories in the news apps they use reflect their personalized preferences and are a good match to their needs (M = 3.93).

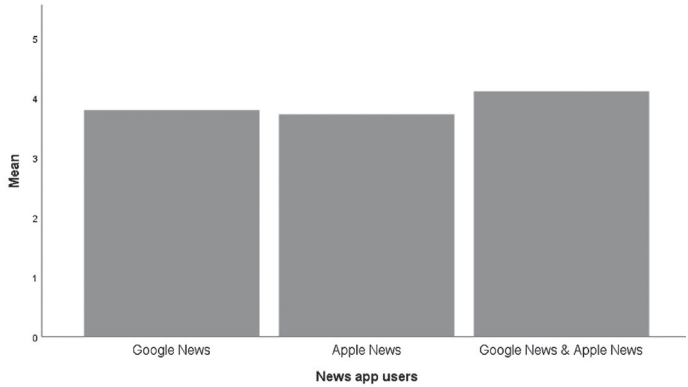

Figure 9.13 "I am happy with news apps, which make news consumption easy and enjoyable"

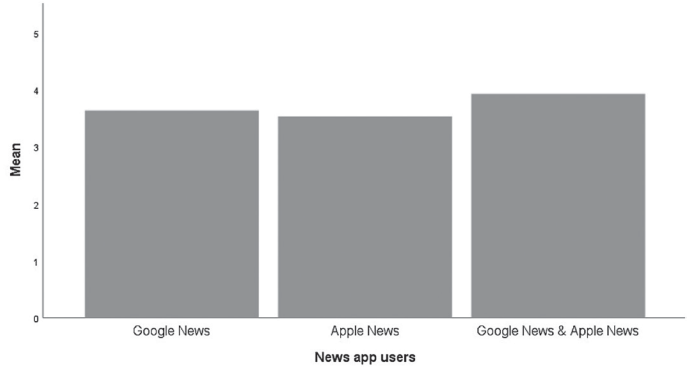

Figure 9.14 "I think that the recommended news in the news apps I use reflect my personalized preferences and are a good match to my needs"

It is worth noting that on average, Google News users appear to be slightly happier with news apps than Apple News users, although the difference is insignificant. According to users surveyed, the Google News app appears to be better at reflecting personalized preferences and to be a better match for user needs, compared to the Apple News app (Figure 9.14).

Table 9.4 *User Differences in News App Appreciation* (Total N = 1115)

Measures	Google News *N* = 405	Apple News *N* = 151	Google News & Apple News *N* = 162	*F*
I am happy with news apps, which make news consumption easy and enjoyable.	3.79	3.72	4.10	**9.83****
I think that the recommended news in the news apps I use reflect my personalized preferences and are a good match to my needs.	3.64	3.53	3.93	**7.82****

** difference is significant at the .01 level.

Chapter Summary

Taken together, the findings in this study suggest that Google News users and Apple News users share many attributes in common, while differences exist in some regards. Users of both apps are different than the two exclusive user groups in many aspects, some significant and striking.

Overall, Apple News users are relatively younger, more likely to be female, and have higher levels of education, compared to Google News users and users of both apps. Google News users are more likely to be in the engineering and computer science field, and less likely to be in business and economics. Those who use both apps tend to spend more time-consuming news on news apps than the exclusive users.

In general, Google News users are more appreciative of their news consumption on news apps than Apple News users. They appear to be slightly more knowledgeable about current events. They also seem to feel more in control of the information they get from the news media, and possess a greater belief that if attention is paid to different sources of news, they can avoid being misinformed. Google News users also possess greater belief than Apple News users that they can stay informed as long as they take the right actions.

In terms of algorithm literacy, Google News users and Apple News users largely share the same level of knowledge, awareness, willingness, trust, confidence, and belief. However, people using both news apps appear to be strikingly different. Overall, users of both apps are more knowledgeable about how algorithm-based technologies work and have more trust and confidence in algorithm technologies

and in news apps when it comes to recommending the news fully, accurately, and fairly. They are also more likely to believe that news app recommendations are reliable and that they are exposed to news that has source diversity and diverse viewpoints.

Although the difference is insignificant, Google News users appear to be slightly happier with news apps than Apple News users. The Google News app appears to be better at reflecting personalized preferences and a better match for user needs, compared to the Apple News app. Using both apps seems to lead to significantly more appreciation of news apps than using one app or the other exclusively. Users of both apps appear to feel a lot happier with news apps, and think that news apps make news consumption easy and enjoyable. They are also a lot more likely to report that the recommended news stories in the news apps they use reflect their personalized preferences and are a good match to their needs. In other words, using both Google News and Apple News seems to help achieve a healthy and balanced news diet.

CHAPTER 10

Concluding Remarks

> "Before you become too entranced with gorgeous gadgets and mesmerizing video displays, let me remind you that information is not knowledge, knowledge is not wisdom, and wisdom is not foresight. Each grows out of the other, and we need them all."
>
> – Sir Arthur C. Clarke, media futurist

In 2018, shortly after Google revamped its "Google News" app to include the "For You" section as the default interface when launched, I realized that I was spending more and more time on news, some days reading nonstop, swiping the pushed content up and down on my phone screen, mostly news on *CNN* and *The Washington Post*. Those news items were indeed of my interests. I was attracted, I have to say, to reading more and more. There were other threads of news that ended up on my phone screen which puzzled me, however, because those were none of my business. I didn't know much about Taylor Swift, and I didn't care what she was doing or selling. It turned out that my daughter, then at the age of 10, often hacked into my phone and searched for her points of interests, the top of which is Taylor Swift. Just imagine when she turned 12 years old and got her own phone and was interested in something that is not as benign as Taylor Swift and her products. It scared me.

As a former journalist, I have always believed that news media are a central institution in any society and objective news is necessary for a democracy. In the political sphere, for instance, functioning democracies depend critically on an informed public of voters who are exposed to and understand a variety of political views. When news and information flows fall under the control of artificial intelligence and are shaped by algorithms (instead of journalistic professionals) with the primary purpose of catering to individual preferences in order to maximize audience engagement, the role of the news shifts, and the democratic dimension of news media may collapse. If a personalized recommendation for dog food does no particular harm, then a personalized election news recommendation probably is consequential on a macro scale.

The change in the relationship between news media and the audience brought about by the transition to personalized news delivery may have profound consequences. As warned by scholars and technology activists (or more precisely, anti-technology activists), the algorithm represents a new type of actor that intervenes in the communication process and has the capacity to shape and impact on individual lives and beliefs. The popularity of news apps that are algorithmically personalized reminds us of the possibility for "information cocoons," "echo chambers," and "filter bubbles" effects that have been premised by Sunstein (2006, 2007) and Pariser (2011). With concerns about the formation of biased and ignorant individuals who see a distorted world because of selective exposure, these premises are plausible and compelling. At the societal level, the threat is that the choices made by individuals will add up collectively to a fragmentation of society so pervasive that the public sphere may cease to exist; at the individual level, people are exposed only to the kinds of information and opinions that they want to hear, instead of that they ought to know. If this is realized, communication technologies can threaten democracy as they play a gatekeeper role in which they filter information to tailor and cater to individual tastes and favored opinions.

These premises are so compelling that at the envisioning stage of this project, a negative effect was almost hypothesized. In hindsight, it would have been wrong to guide this research with a negative impact hypothesis. I had to remind myself over the course of this research that this study is exploratory in nature and that these premises have largely remained ones that are not empirically evidenced.

In 2016, Flaxman, Goel, and Rao published in *Public Opinion Quarterly* their study on online news consumption with a "filter bubbles" presumption. They examined Web-browsing histories of 50,000 US-located users who regularly read online news and found that social networks and search engines are associated with an increase in the ideological distance between individuals, but these same channels are also associated with an increase in an individual's exposure to materials from

their less-preferred side of the political spectrum. The researchers uncovered evidence for both sides of the debate, while also finding that the magnitude of the effects is relatively modest. Flaxman, Goel, and Rao (2016) did not address the issues regarding online news consumption specifically to an algorithmic audience. But as their study was conducted shortly before 2016, the involvement of algorithms in search engines and social networks was probably already in effect to some extent, although by that time AI-powered news apps were not of much popularity.

Now the age of algorithms has saturated almost every corner of our life and the algorithmic news apps seem to have been in full force since 2018. How, if any, have the situations changed since 2016? Are algorithms and artificial intelligence an opportunity for, or a threat to the democratic role of the media and the wellbeing of their audiences? Feezell, Wegner, and Conroy's 2021 study asked if algorithm-driven news sources have different effects on political behavior when compared to non-algorithmic news sources. Using two nationally representative surveys, one of young adults and one of the general population, the researchers uncovered that getting news from sites that use socially driven or user-driven algorithms to generate content corresponds with higher levels of political participation, but that getting news from non-algorithmic sources does not. They also found that neither non-algorithmic nor algorithmically determined news contribute to higher levels of partisan polarization.

Will algorithm technologies actually leave heavy users worse off? Does heavy use of AI-based news apps create information cocoons and echo chambers? Does algorithm news recommendation facilitate or constrain news consumption? Does the algorithm-powered news recommendation have an effect on the audience's news appreciation, news literacy, and public agenda? Does algorithmic literacy play a role in news literacy? How much do the algorithmic news consumers share traditional norms of news values? By what criteria do the audiences judge newsworthiness in news and information processing? What could be some new dimensions? Why are AI-powered news apps popular? What are the characteristics in these news apps that attract and retain users to maximize audience engagement?

In the wise words of Arthur Clarke, no, let us not pretend that we have all the answers to these questions. But yes, the questions regarding AI-based news recommendation are certainly worth discussing.

Takeaway 1: Algorithmic Media Use Seemingly Has No Negative Impact on News Literacy

By and large, the use of algorithmic news apps does not seem to have a significant negative impact on an individual's news literacy. In general, this research did not find significant empirical evidence to support an information-cocoon argument, except that heavy users of algorithmic news apps are found to have slightly lower knowledge of current affairs than their moderate and light user counterparts with the difference not statistically significant.

The most striking finding from our pilot study of a convenience sample of college students and from our national survey of a general sample, is that, contradictory to our prediction, the use of algorithmic news media does not seem to be taking its toll on the news literacy of the news audiences. Instead, generally speaking, these AI-based and tailored news recommendation systems appear to be facilitating news consumption and adding to news literacy. Moderate level of use, in particular, seems to have the strongest positive impact. Surprisingly enough, results from the surveys show that moderate algorithmic news app users are more likely than low users to prefer mindful thought processing, are more motivated towards news consumption, and even have a higher level of media locus of control relative to their light-user peers. This finding is at odds with some previous research, which has found that the use of a personalized news recommender system has a negative direct effect on knowledge gain.

As much as Sunstein's "information cocoons" and "echo chambers" concepts are appealing, our research finds no empirical evidence to support such arguments. I am sure such findings will spark controversies. Scholars and anti-technology (specifically anti-algorithm) activists and the like may be disappointed in our findings. If there is anything found in this exploratory study that is agreeable with the "information cocoons" concept, it is the test results (non-significant) with regards to skepticism towards news media and current event knowledge. In terms of access and skepticism towards news media, heavy algorithmic news app users have a lower level of skepticism towards news media relative to their light-user peers; in terms of current event knowledge, heavy users score lower than both light users and moderate users.

Takeaway 2: Possible Curvilinear Effect

The results with regards to need for cognition and need for orientation also convey useful information for us to understand the phenomenon. There could be a curvilinear pattern in AI-based news consumption – that is, moderate use of algorithmic news media may help with news literacy in general. Once the use goes up to a certain high level, however, it starts to constrain news consumption and impair news literacy. Specifically, use of algorithmic news apps to a heavy extent may hinder effective and mindful thought processing, leading to a tendency of automatic laziness in thought processing and inability to think deep and hard; in addition, heavy exposure to algorithmic news recommendations may also cause a debility to stay properly informed.

Takeaway 3: Positive Impact on News Appreciation

What's not so striking is that these personalized algorithmic news apps appear to be doing a good job in enhancing news appreciation – in general, the more people use AI-based news apps, the more appreciative of news consumption they are. People who use more algorithmic news apps are more likely to find the news interesting, easy to understand, important, and objective. As we expected, these news app users are also more likely to find pleasure in consuming news and more likely to often recommend or forward news to friends. Such a finding regarding news appreciation is in line with previous research on tailored communication and customization, which overall maintains that customized messages have certain advantages over non-customized ones, such as being more persuasive and memorable, and thus more appreciated.

Takeaway 4: Personalization is Key to Appreciation and Gratification

Uses and gratification theory focuses on how users deliberately choose media that will satisfy given needs and allow a person to enhance knowledge, relaxation, social interactions/companionship, diversion, or escape. Key to algorithmic news recommendation systems, personalization fulfills some of these gratifications for news consumers. Uses and gratifications theory can certainly explain the increasing popularity of algorithmic news apps.

Participants in our qualitative study commonly exhibit a sense of comfort, appreciation, and gratification with news apps' personalized news feeds, calling the use of news apps a pleasant and satisfactory experience. Personalization appears to be the key in uses and gratifications. The majority of the participants appear appreciative of personalization and tend to associate happiness and satisfaction with it. While participants in general report a less-active information-searching behavior after using news apps, ironically, many participants believe that they are more informed and knowledgeable now that they have the news apps in hand, citing accessibility, relevance, and timeliness as the primary merits that news apps bear to allow such possibility.

Results from our study attest to a new dimension of newsworthiness – personalization. Newsworthiness has been core to news media. Traditionally, journalism scholarship has defined newsworthiness with several dimensions, or elements. As noted earlier, over time, even the textbooks emerged from a multimedia or convergence media landscape, bear basic definitions of news values that are essentially the same as in the old days since the early 1900s – timeliness, proximity, prominence, magnitude, unusualness, conflict, human interest, and impact, remain as resilient consensus values and have been largely stable. These definitions of news values come primarily from a traditional content-producer's viewpoint. As the era of Web 3.0 matures and the age of algorithms emerges, it is probably time to redefine newsworthiness with the addition of a new dimension of personalization. In a rapidly evolving media market that is increasingly algorithmic, achieving personalization – that is, giving the audiences the news they want and are interested to consume (instead of "ought to consume"), is perhaps an unavoidable trend for media outlets and news aggregators seeking to maintain market share.

Takeaway 5: Refraining from Algorithmic News Consumption Does Not Seem to Help

Our experiment subjects were appealed to the idea of taking a one-month break from news apps and social media news, which are mostly algorithmic nowadays. The experiment, in which participants were instructed to refrain from consuming recommended news, found no significant effect of doing so on overall news literacy. In other words, refraining from consuming recommended news does not appear to contribute to better news literacy when compared to not refraining. Refraining from algorithmic news consumption and instead actively searching for news, however, do seem to be associated with higher news appreciation. Compared

to before the experiment, these people find news overall more interesting, objective, important, and easier to understand.

After the experiment period ended, many participants reinstalled the news apps that they uninstalled at the beginning of the study, although those who did not reinstall the apps expressed that they had realized through the experiment period that they did not really need those apps. After one month of minimum consumption of recommended news, some realized that they could actually live without AI-based news apps. Those who chose to reinstall the apps cite convenience, immediacy, and personalization as the primary reasons.

Takeaway 6: Algorithmic Literacy Plays a Role

A key discovery of our national survey is the role of algorithmic literacy in news literacy. Our study finds that algorithmic literacy appears to have a strong influence on news literacy. It appears that algorithmic awareness, in conjunction with algorithmic knowledge, can serve as strong predictors of algorithmic literacy, which plays a significant role on news literacy. Our findings suggest that a considerable part of the variation in news literacy can be explained by algorithmic literacy, which is understandable under the circumstances of a nearly algorithm-ubiquitous media landscape. In other words, understanding what the algorithm is and how it works is crucially important nowadays for one to be a savvy news consumer.

Takeaway 7: Heavy Users May Be Agenda-Resisting

Our analysis of the public agendas among light and moderate users of news apps against heavy users unveils a public agenda difference. As expected, the public agenda among the heavy users is different than the rest. This group are the heavy users of AI-based news apps who reported three or more hours of news app use daily. It is alarming that these heavy users of recommended news had zero mention of climate change as a most significant problem facing the country, whereas it is the very topmost significant problem identified by the moderate and light users. These heavy users seem to have been heavily exposed to news of conflicts and violence, and are short of vision on other significant problems facing the nation. These findings seem to evidence a possible agenda-resisting effect of heavy consumption of personalized recommended news.

Takeaway 8: Demographics Matter in News Literacy

Demographic factors appear to make differences in news literacy. Gender matters in certain aspects of news literacy – Men and women exhibit significant differences in need for cognition, need for orientation, and current event knowledge. It seems men are more likely than women to prefer mindful thought processing and have stronger motivations for news consumption. Moreover, men appear to be more knowledgeable about current events than women. As well as gender, age appears to play a role in certain aspects of news literacy. Overall, age is positively associated with current event knowledge. That is, older people seem to exhibit a higher level of news literacy in general, which is not surprising. Positive associations are evident between education level and news literacy – people with higher level of education tend to prefer more mindful thought processing; they are also more likely to appreciate the news that they have access to and find pleasure in consuming news. Not a surprise, they also tend to have better knowledge of current events. Professional background (or major of study) also appears to have an effect on an individual's news literacy. The effects specifically lie in the aspects of mindful thought processing, motivations for news consumption, news appreciation, as well as in current event knowledge.

Takeaway 9: Google News Users and Apple News Users Have Differences

According to our national survey, Google News and Apple News are the top two most used news apps among Americans. More than half of the respondents indicated they are active users of Google News, and about one third reported using Apple News. Differences exist between users of the two most used apps in some regards, although the two groups share some attributes in common.

In general, Apple News users are relatively younger, more likely to be female, and have a higher level of education, compared to Google News users. Google News users are more likely to be in the engineering and computer science field, and less likely to be in business and economics.

In terms of news literacy, Google News users tend to be more appreciative of their news consumption on news apps than Apple News users and appear to be slightly more knowledgeable about current events. They also seem to feel more in control of the information they get from the news media, believe more that if attention is paid to different sources of news, they can avoid being misinformed.

Google News users also believe more than Apple News users that they can stay informed as long as they take the right actions. Overall, it seems Google News app users are of a higher level of news literacy than users of the Apple News app.

As for algorithm literacy, Google News users and Apple News users largely share the same level of knowledge, awareness, willingness, trust, confidence, and belief. However, people using both news apps appear to be strikingly different. Although the difference is insignificant, Google News users appear to be slightly happier with news apps than Apple News users. Google News app appears to be better reflecting personalized preferences and a better match to user needs, compared to Apple News app.

Generally speaking, users of both Google News and Apple News apps are more knowledgeable about how algorithm-based technologies work, have more trust and confidence in algorithm technologies and in news apps when it comes to recommending the news fully, accurately, and fairly. They are also more likely to believe that news app recommendations are reliable and that they are exposed to news that has source diversity and diverse viewpoints. Using both apps seems to lead to significantly more appreciation of news apps than using one app or the other exclusively. Users of both apps appear to feel a lot happier with news apps, and are also a lot more likely to report that the recommended news in the news apps they use reflect their personalized preferences and are a good match to their needs. These findings suggest that triangulating news consumption by using multiple apps, instead of sticking to one app exclusively, contributes to overall positive user experience and user wellbeing.

Takeaway 10: Users Have an Ambivalent Bond with News Apps

According to our national survey, most users are aware that the news apps they use are algorithm-based, although many of them have no idea about how exactly algorithms work. Some users appear nonchalant about how it works, as long as they receive relevant information and news of their particular interests, exhibiting a sense of resignation to convenience and pleasure.

A profound ambivalence was observed in our qualitative study. The majority of the participants appear appreciative of personalization and tend to associate happiness and satisfaction with it. Overall, many participants' user experience with news apps is pleasant, and they feel more satisfied consuming news now that they have news apps in hand compared to before when they did not, thanks

to the convenience and personalization made possible by the catering algorithms. Some users, however, are not short of concerns about the creepiness of algorithms. These users expressed concerns of source bias and the catering nature of news apps. Some participants realized that they had definitely become more biased with all the personalized news consumed over a period of time. A few participants pointed out that the news app they used zeroes in on what they like and starts to only show things that it thinks interest them, in which case they are concerned that they are not exposed to diverse views. A small number of app users express their reservations towards personalized news recommendation and consumption, pointing out that such consumption is addictive, because it makes it more likely that the next story will be of interest and more likely to be clicked on, and so on and so forth. Fear of missing out (FOMO) is another reason for reservation. As much as they appreciate the convenience and pleasure that personalization brings to them, they are concerned about missing out on important and challenging viewpoints, as well as their privacy.

Implications and Recommendations

Algorithms, as technologies, are not inherently good or bad agents per se. The effects of algorithms depend largely on who develops the programming and for what purpose, what they are programmed to do, how users interact with them, and most sensitively, what they do with the personal data they feed on. To that end, the involvement of algorithms can be a double-edged sword. Algorithm-based news recommendation systems themselves are neither good nor bad. It is simply a way used by institutions to compete for attention and retention in a Web 3.0 media market. Involving algorithms in news recommendations creates threats and opportunities. Algorithmic news consumption can therefore be a blessing or a curse to the wellbeing of individuals and the society as a whole.

As algorithmic news recommendation itself is such a fledgling concept, research on algorithmic news consumption is still sporadic, not to mention the lack of more specific research on its impact on the audience. Much of the research on algorithmic news recommendation has been conducted from a technical perspective by computer scientists in both the academia and the industry sectors, ignoring the potential effects of algorithmic news consumption on users, socially and personally. Meanwhile, the only limited amount of discussion, likely among people in the mass communication and information law fields, that addresses the impact of algorithmic news consumption on the audiences seems to suffer from a lack of empirical evidence. The scanty previous research on the application of algorithms in

the journalism context is largely limited to the content production and distribution process. Insufficient scholarly attention has been paid to its impact on the audience. This study represents a substantive effort within the mass communication research field to relate tailored communication, news appreciation, algorithm literacy, and news literacy to the recent phenomenon of algorithmic news apps from an audience's perspective. As warned by some scholars, algorithm technologies have the capacity to shape and impact individual lives. Sunstein's "information cocoons" premise, with concerns about the formation of biased and ignorant individuals who see a distorted world, remains compelling, though this current study finds no significant empirical evidence to support the argument. Compelling as it may be, a negative impact presumption seems judgmental and overbearing.

This current research suggests that algorithmic news consumption may not be as dangerous as presumed and warned. In reality, AI-based news apps may facilitate news consumption and enhance news literacy, although the findings in this study also caution against the addictive nature of personalized algorithms and the excessive use of algorithmic media, which may turn positive effect into the negative direction, in which case news consumption may be severely constrained and an information cocoon may be formed to the disadvantage of an individual.

While the consumption of algorithmically recommended news was found in this current study having no significant impact on the user's news literacy, algorithm literacy, however, seems to play an important role and can be used to explain news literacy. In the age of algorithms with a media landscape that is virtually algorithm-ubiquitous with a growing number of AI-based personalized news providers, having a basic understanding of what algorithms are and do may be of utmost importance. As revealed in this current study, some algorithmic news audiences, likely those who actively curate their news apps' recommendation, tend to trust the recommended content and do not worry about missing out information beyond what's available in the apps used. Others, likely those who demonstrate a higher level of understanding for the backstage algorithm, are more vigilant of the potential threats and are aware that they may become biased with the consumption of all of the personalized news pushed to their fingertips. A small group of the participants appear to be able to take ownership of their news consumption by going above and beyond recommended news. These people tend to conscientiously perform fact-checking, alternative sourcing, and perspective countering. All in all, as many users find AI-powered news apps too useful and convenient to abandon and refraining from using them is not quite realistic, one important area that can be worked on is to improve algorithm literacy by all means, self-education, school-education, family-education, or otherwise possible.

The importance of catering to the audience's personal preferences warrants a reassessment of the relationship between media-centered and audience-centered news values. This research also reveals that, in the age of algorithm, the traditional self-centered definition of news values from a content-producer perspective needs to be updated. Seeing from an audience-centered perspective, personalization, convenience of access, shareability, entertainment/enjoyment, and usability are all important factors and should be included in the renewed conceptualization of newsworthiness.

Like most technologies, news recommendation algorithms are neutral per se. Whether they are good or bad depends on the values with which they are imbued and the purpose for which they are used. Algorithmic news recommendation systems can go wrong in many ways if misused. The effects of algorithmic news recommendation are unyieldingly dependent on how media organizations, news aggregator platforms, and the society at large implement such tools. To minimize the potential danger of algorithmic news consumption, news outlets, independent stand-alone organizations such as *The Washington Post*, NPR, and Fox, or aggregators such as Google News, Apple News, News360, should expand coverage on algorithm technologies while being transparent about their own practices. Adding a disclosure statement to the recommendation system of the news app would be a fair and good practice. On the technocrats' end, adopting a hybrid approach (Feng, Khan, Rahman, & Ahmad, 2020 that is diversity-aware and value-sensitive in developing a personalized news recommendation system would be a better practice that safeguards algorithmic justice and journalistic DNA (Bastian, Helberger, & Makhortykh, 2021). That is to combine two things in the algorithm: (1) "ought to know" – broad information offer of news on mainstream media and trending news from the social media public timeline, and (2) "want to know" – personally relevant news that caters to user profile based upon personal interests and preferences. Although achieving a balance between a broad information offer and personal relevance is bound to be a challenge for recommendation system designs, but it is utmost important to both understand user experiences and distribute media content to support a well-functioning public sphere. News recommendation algorithms should allow a clear view of the world as it is, not just as the user wants it to be. Instead of for the sake of maximum engagement for profit generation, algorithmic news recommendation should be used to build media credibility, promote journalistic authority, show respect to the public's right to access information, and cultivate interest in quality journalism (Bodó, 2019; Helberger, 2019). On the policy-maker's end, governmental regulatory bodies and the like should develop policies and legislations to ban manipulative practices (Raza &

Ding, 2021) and regulate the operation of algorithmic news recommendations to ensure fairness, accountability, and transparency.

Traditionally, the term "audience" implies the passive reception of news and information. "Active audience" is used to indicate a reactive, responsive, and even participatory type of audience. With the rise of new technologies and social media, recasting of the notion of the "audience" is necessary. Media theorist Jay Rosen (2006) proposed a new media maxim, "people formerly known as the audience," to articulate the profound new direction in the relation between media and its "audience," signifying the fundamental shift in the model of communication. But it seems neither "active audience" nor "people formerly known as the audience" is adequate to label users of algorithmic news apps. AI-based news recommendation systems hold tailored communication processes, which are neither "one-to-many" nor "many-to-many." Users of such recommended news are to some extent involved in a one-to-one communication process and are probably best described as members of an "algorithmic audience." The concept of algorithmic audience, proposed by Anderson (2011), conveys an entirely new notion of the communication process that is revolutionizing the relationship between media and its "audience." As such, it warrants updated considerations in the communication theories of newsworthiness, selective exposure, tailored communication, gatekeeping, agenda-setting, and uses and gratifications. This volume calls for a research agenda that contemplates new forms of media effects, and a renewed conception of the active audience paradigm in the age of algorithms.

Although this current research yielded significant findings in examining the effects of using personalized algorithmic media, the results should be interpreted with caution, as they come with certain limitations. The pilot study sampled college students as participants. This sample is homogeneous in terms of education level and age. Those results may not be generalizable to explain other demographic groups such as teenagers or older adults. The national studies used Amazon Mechanical Turk workers as research subjects. That expanded the sampling scope to a national scale that is more representative in terms of geographic location, education level, and age. This national sample, however, is limited to people who are computer and Internet savvy, and who know how to handle a Web-based task with an Amazon account. In other words, this sample is associated with a relatively higher level of education. News app users who are uneducated or technologically inexperienced may have different perceptions and experience and the effect of algorithmic media use on them may not be the same as the people included in our study. All these limitations should be deliberated when interpreting the findings generated from this current research project. Although this research finds no empirical evidence to buttress an "information cocoons" argument, such concerns

should not be taken lightly as the stakes may indeed be high for a particular segment of the population.

This current study aims to elucidate the renewed relationship between news media and news consumers. Taking a first step in the field to relate news appreciation, customization, algorithm literacy, news literacy, newsworthiness, gatekeeping, agenda-setting, and uses and gratifications to the recent phenomenon of algorithmic news consumption, this study represents a substantive effort to develop this research line. As we head deeper into the age of algorithms, people are increasingly exposed to algorithmically curated information and news that match their personal interests. Research on the critical role and profound impact of algorithms and artificial intelligence on the public is crucial for understanding the future of journalism, the future of the media industry, and, perhaps most importantly, the future of the civic society. More scholarly attention must be paid to the renewed relationship between media and audience with algorithmic processes.

Our surveys of algorithmic news app users, in combination with the qualitative analyses in the current study, suggest that the context of algorithmic media and algorithmic audience in the age of artificial intelligence poses a rich opportunity to expand our theoretical horizons. This research highlights the importance of the currently under-studied topic of algorithmic news consumption. While this book was meant to be an exploratory analysis of the effects of news app use, it can serve as a launching point for further future investigations of algorithmic news consumption at large. Much more research is needed to generate deeper insights into this new territory. Looking forward, I hope this study sets out promising prospects for scholarly investigations for this new frontier in the field of mass communication to establish solid knowledge about the role of algorithms in news consumption and its implications. Such knowledge is essential for the wellbeing of both individuals and the society as a whole.

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