International
Communication
Association

OXFORD

Metrics in action: how social media metrics shape news production on Facebook

Subhayan Mukerjee [1], **Tian Yang** [2], **Yilang Peng** [3,*]

[1]Department of Communications and New Media, National University of Singapore, Singapore
[2]School of Journalism and Communication, , The Chinese University of Hong Kong, Hong Kong, China
[3]Department of Financial Planning, Housing and Consumer Economics, University of Georgia, Athens, Georgia, USA
*Corresponding author: Yilang Peng. Email: yilang.peng@uga.edu

Abstract

Social media metrics allow media outlets to get a granular, real-time understanding of audience preferences, and may therefore be used to decide what content to prioritize in the future. We test this mechanism in the context of Facebook, by using topic modeling and longitudinal data analysis on a large dataset comprising all posts published by major media outlets used by American citizens ($N \approx 2.23M$, 2015–2019). We find that while the overall effect of audience engagement on future news coverage is significant, there is substantial heterogeneity in how individual outlets respond to different kinds of topics. A handful of right-wing media outlets are more likely to respond to audience engagement metrics than other outlets, but with partisan politics topics and not with entertainment-oriented content. Our research sheds new light on how social media platforms have shaped journalistic practices and has implications for the future health of journalism in the United States.

Keywords: audience engagement, Facebook, metrics, news production, partisan media, social media

Social media have become a major source of news and information for American citizens (Walker & Matsa, 2021) where journalists monitor public opinion and popular trends (Tandoc Jr & Vos, 2016), and newsrooms try to attract audiences and traffic (Wojcieszak et al., 2021). One important way in which social media have changed journalism lies in the use of engagement metrics: these metrics, such as the number of likes, reactions, shares, collectively signal what audiences demand, and may, in turn dictate news organizations' priorities in content production (Christin, 2020; Tandoc Jr & Vos, 2016). The incorporation of social media metrics in news production may give citizens more voice in determining news agenda, but this trend might have harmful ramifications for the political processes of democracies. By adopting the logic of virality, news outlets may shift away from covering topics of public importance to publishing more entertaining, attention-grabbing "soft news" to boost engagement metrics, and subsequently revenue (Lamot, 2022). Media outlets may also choose to cover more divisive, toxic, or outrage-provoking hyper-partisan topics to attract audience engagement and appeal to avid partisans, as such content are often associated with social media virality (Brady et al., 2017; Crockett, 2017; Hasell, 2021; Kim et al., 2021; Rathje et al., 2021). Understanding how social media metrics influence content production of newsrooms is therefore crucial for promoting and sustaining a healthy information environment, that is normatively considered to be a prerequisite of a functioning democracy.

There is therefore growing scholarly interest in communication research that examines whether and how social media metrics, as well as other forms of audience metrics (such as web traffic) shape news production. Observations of newsrooms frequently show that journalists and editors incorporate audience metrics in their newswork routines to respond to audience demand (Christin, 2020; Tandoc, 2014; Tandoc & Ferrucci, 2017; Vu, 2014). On the other hand, journalists also express resistance and uncertainty toward the adoption of metrics in news production and frequently cite professional norms to counter this transition (Nelson & Tandoc Jr, 2019; Welbers et al., 2016). Moreover, while some empirical research shows that web traffic-based considerations could shape content production and placement of news (Lamot, 2022; Lee & Tandoc Jr, 2017), there appears to be substantial variation in how different news organizations and practitioners use metrics for different news topics (Christin, 2020; Lamot & Van Aelst, 2020). Given that about 50% of American citizens get their news from social media (Walker & Matsa, 2021), the role that social media metrics play in this process is also relatively understudied. More specifically, what is missing is a comprehensive appraisal that quantifies the extent to which social media metrics shape the topics and issues that news organizations cover, as well as understands which news organizations are most responsive to audience demand, as signaled by these metrics.

In this study, we focus on how audience engagement metrics shape news organizations' content production on Facebook, a platform that two-thirds of U.S. adults report using and one-third report regularly getting news from (Walker & Matsa, 2021). We leverage a dataset of over 2.2 million Facebook posts published by 29 outlets over a 5-year period. This set, which includes all English language outlets from Pew's 57th wave of the American Trends Panel (Pew,) comprises a relatively comprehensive list of ideologically diverse media that are among the most prominent in the United States. It allows us to conduct a holistic appraisal of the dynamic between engagement metrics and news production, as well as investigate between-outlet heterogeneities.

We use this large-scale longitudinal dataset to design a measure to quantify media responsiveness to audience engagement signals by combining topic modeling and longitudinal data analysis techniques. We estimate the effect of audience engagement on Facebook on subsequent news production, while controlling for several covariates including those that reflect news value. Our work provides valuable insights into how social media metrics empirically affect journalistic production on Facebook and the implications that have for our news environment. By doing this, we also demonstrate the application of a novel computational approach to capture the impact that the audiences exert on content production, which in turn could be extended to other domains and platforms.

Media responsiveness and journalistic newsroom practice

Engagement metrics on digital media platforms provide a feedback pathway for audiences that is faster ("real-time"), automatic, scalable, more public (Lee & Tandoc Jr, 2017), and baked into the platform itself, compared with other audience feedback mechanisms that existed in the predigital era. Scholarly observations of newsroom practices have documented how these metrics have dramatically affected news industries and journalism. This has notably played out in three interrelated ways: first, audience metrics have changed journalistic cultures, values, and norms (Belair-Gagnon et al., 2020; Christin, 2020; Ferrer-Conill & Tandoc Jr, 2018; Tandoc Jr & Foo, 2018); second, they have functioned as an important factor in disciplining journalistic labor processes (Petre, 2021); and third, they have shaped journalistic practices (Ferrucci, 2020; Lamot, 2022; Lee et al., 2014; Tandoc, 2014; Welbers et al., 2016; Zamith, 2018).

Our study quantitatively investigates one critical aspect of journalistic practices: that of news content production. Audience metrics have potentially changed the balance between two conflicting models of news production: the Trustee Model, in which journalists rely on professional judgements to determine the importance of a news story based on whether it is essential for the public to know, and the Market Model, in which journalists, driven by economic incentives, provide news content catering to the preferences of their audience (Schudson, 2003). Audience metrics function as "unambiguous signals of market forces" (Christin, 2020, p. 11), which amplify the dynamics of economic motivations and may potentially push journalism towards the direction of the Market Model. Tandoc (2014) highlights a theoretical framework of how audience metrics affect journalistic practices, which in turn affects journalists' information access, story selection, news processing and editing, news distribution, and interpretation of their work. Driven by market forces, journalists may rely on metrics to find stories and decide which news items can be published. These dynamics suggest that audience metrics should shape the output of the news organization, or at least, the news content they produce.

A survey of prior work shows broadly two major approaches that scholars have adopted for empirically answering this question. Some studies (e.g. Ferrucci, 2020; Tandoc, 2014), based on self-reports of journalists, have supported the notion that audience metrics drive news coverage: journalists find stories and topics from those trending on social media, chase news topics that garner more traffic online, and also determine the placement of the stories based on these

metrics. On the other hand, there is also some evidence suggesting that journalists in some newsrooms *resist* such a move: that they do not let metrics fully decide their content production strategies (Christin, 2020; Petre, 2021; Walters, 2021). Others studies have used quantitative content analyses to provide valuable empirical insights. Lamot (2022), for example, focused on soft/hard news categories of five Belgian outlets and found that outlets respond to the metric data, which leads to a "softer" news supply on Facebook. Similarly, Welbers (2016) looked at five Dutch newspapers and found that these outlets significantly responded to the web viewing metrics: they increasingly reported follow-up stories of articles which were viewed the most.

While studies have largely focused on web-based audience metrics, engagement metrics on social media have been supposed to play an increasingly prominent role in journalistic practices, given the steady rise in importance of social media platforms in mediating people's access to news. Previous studies have shown that news production on social media is similarly affected by social media metrics (Tsuriel et al., 2021) and that social media managers tend to follow the same social media logic that is used to gauge virality and spot "trends." For example, they count the number of "Likes" to check whether certain posts were "successful." Moreover, a recent study by Neilson and Gibson (2022) found that social media editors did not simply function as mediators between various institutions in the news organization, but that they also incorporated data from audience metrics to affect the whole news production process. In parallel, the adoption of social media as platforms of news circulation has made these engagement metrics even more central in shaping news content production. García-Perdomo (2021) gives the example of TV journalists making videos exclusively for social media to demonstrate how the "logic of social media" dominates outside social media platforms as well. This leads us to propose our first hypothesis about the relationship between audience metrics and news content production on social media. Given the fact that audience engagement measures are the most accessible audience metrics on social media, we hypothesize:

> **H1:** *Engagement metrics on social media affect news content production. News topics that attract greater engagement are increasingly covered in subsequent time periods on Facebook.*

Media responsiveness by different topics

While we expect that social media metrics exert an overall effect on media outlets' subsequent production, it is likely that such an effect varies by content domain. The high choice political information environment likely poses many challenges to the healthy functioning of democracy, such as the decline of news quality and the growing polarization (Van Aelst et al., 2017). Driven by the normative implications of social media metrics, we attend to the following two types of content.

Entertainment-oriented topics

Political news is generally considered to be an important part of a citizen's media diet as it informs them about public affairs and in turn, enables them to fulfill their civic duties in a democracy (Otto et al., 2017). Yet, scholars worry that as the news industry caters to audience preferences and market

incentives, newsrooms could shift from covering important hard news topics about public affairs and policy issues to more attention-grabbing or entertaining content, and that this could result in a "softening of news" (Lamot, 2022; Van Aelst et al., 2017). Such concerns predate digital platforms and are reflected in phenomena such as tabloidization (i.e., the news industry adopting characteristics of tabloid newspapers and commercial broadcasting to grow their audiences) (Otto et al., 2017; Van Aelst et al., 2017). In light of these considerations, we investigate whether news outlets are particularly responsive to signals of audience preference for entertainment-oriented content. By entertainment-oriented content, we refer to categories that are typically considered to be soft news in prior research (e.g., lifestyle, celebrities, travel) as well as emerging entertaining content on digital platforms, such as funny videos and life hacks. Although prior research has theorized the hard/soft news binary as a multidimensional concept that includes not just topic and content but also presentation styles and timeliness in news production (Reinemann et al., 2012), we note that the topic or content continues to be the most commonly used criteria (Reinemann et al., 2012) that is used to determine whether a piece of news is hard or soft. That is also how we operationalize entertainment-oriented content in this study (see the "Method" section for details).

From an audience demand perspective, we expect entertainment-oriented topics to be more popular than hard news topics. The low level of political interest and knowledge among the American citizenry (Delli Carpini & Keeter, 1996) would suggest that audience members heavily consume popular culture and entertainment content as opposed to political content. Following this logic, scholars have argued that many people prefer entertainment over public affairs news and will consume an abundance of entertainment in a high choice environment (Prior, 2005). Analysis of digital trace data corroborates this fact: political news consumption constitutes only a small percentage of overall information consumption and most people consume nonpolitical content such as entertainment, sports, and lifestyle topics (Wojcieszak, de Leeuw, et al., 2021). Analysis of social media data also suggests that entertainment-oriented topics indeed get more audience engagement than hard news topics (Garcia-Perdomo et al., 2018; Kalsnes & Larsson, 2018; Lamot, 2022). Relatedly, studies of Twitter have shown how non-political content is far more popular than political content among ordinary American users on the platform (Mukerjee et al., 2022).

We propose the following two mechanisms to explain why newsrooms maybe particularly responsive to audience engagement with entertainment-oriented content. First, journalists and editors following the Trustee Model often cite professional judgment and journalistic norms to reject the lure of metrics and the pressure to cater to audience demand (Welbers et al., 2016). However, this logic more often applies to hard news topics instead of soft news (Lamot, 2022; Nelson & Tandoc Jr, 2019). In other words, journalists are more likely to follow audience demand and reject journalistic norms when reporting on entertainment-oriented news.

Second, it is possible that the production of entertainment-oriented content is cheaper and easier compared to the production of hard news. As a result, newsrooms are potentially able to adjust the volume of such content more easily to respond to audience engagement on social media. In prior research on hard and soft news, scholars have argued that publishing hard news involves a disruption of daily routine that necessitates urgent reporting. In comparison, soft news does not require such urgency and newsrooms have greater flexibility in publishing them on a more ad-hoc basis (Shoemaker & Cohen, 2012).

Indeed, some empirical evidence affirms that media outlets adopt this entertainment logic, thereby "softening" the supply of news. In one experiment, journalists were more likely to place news items with better (worse) audience metrics more (less) prominently on a website, but this differentiation only occurred for soft news items, not for hard news items (Lamot & Van Aelst, 2020). A study of five Belgian media outlets reveals that on Facebook, soft news topics such as lifestyle, travel, and entertainment generally receive more views than hard news topics such as politics, environment, and social affairs (Lamot, 2022). Furthermore, news outlets are more likely to publish soft news articles on Facebook than on their websites (Lamot, 2022). Observations of journalistic practices also corroborate the fact that newsrooms are responding to online viewers' preferences for entertaining content and actively incorporating such content to boost audience attention and manufacture online traffic. It has further been reported that Buzzfeed writers intentionally craft emotion-laden, sensationalist, or extravagant headlines that grab attention in social media news feed (Berman, 2021). Another study observed that reporters strategically increased coverage of entertainment-related topics to increase audience subscriptions (Hanusch, 2017).

Partisan politics topics

The second type of news content that we investigate in this study is that of partisan politics. This is driven in part by a normative concern about the growing polarization among American citizens and the rise of partisan media outlets that aim to attract audiences of specific ideological orientations, thereby widening the political divide in the country. Scholars have argued that partisan media brand themselves by appealing to specific ideological segments in the citizenry by either publishing ideologically extreme content or framing political news through an ideological lens (Nelson, 2018). The past decades have therefore witnessed the rise of various partisan media outlets that aim to cater to these partisan audiences with specific ideological orientations (Jamieson & Cappella, 2008). The advent of social media platforms has seemingly accelerated this trend (Sunstein, 2018).

In the previous section, we described why news consumers in the United States largely prefer entertainment-oriented or non-political news to political news (Mukerjee et al., 2022; Prior, 2005; Wojcieszak, de Leeuw, et al., 2021). However, we expect that U.S. audience may demand one specific type of political content in their media diets: *partisan politics*. We define partisan politics as any news content that bears close associations with the partisan identities and affiliations with the two major ideological camps, and operationalize it as content that involving figures from the two political parties as well as highly polarized political issues. Studies have shown that individuals tend to both select and share content that is consistent with their ideological views (Mukerjee & Yang, 2021; Shin & Thorson, 2017) and also that partisan outlets publish slanted content that is consistent with their ideological views (Peng, 2018). Furthermore, partisan news contains content attributes that are often associated with virality: for instance, partisan news is more likely to evoke emotions such as anger and anxiety (Hasell, 2021), and emotional arousal is a

key driver of content virality on social media (Berger, 2011). Partisan news also likely contains references to morality, often using content tactics to provoke moral violations, which in turn have been shown to receive greater audience engagement (Brady et al., 2017; Valenzuela et al., 2017; Xu et al., 2020). Finally, partisan news often involves the attacking and mocking of political opponents and studies have shown how messages featuring attacks of political outgroups tend to receive more audience engagement on social media (Rathje et al., 2021; Stromer-Galley et al., 2018).

Similar to entertainment-oriented content, we expect that news outlets may be particularly responsive to audience engagement with partisan politics topic due to professional values and norms as well as reasons rooted in production cost and flexibility. First, the journalistic norms surrounding political topics, which have traditionally been to inform the public about public affairs and hold authorities accountable, may be changing, particularly among right-wing outlets. For example, the founder of Breitbart, Andrew Breitbart, views politics as a cultural combat and aims to use news as a weapon to fight back against "political correctness" and "multiculturalism" from liberal media (Beauchamp, 2016). Right-wing outlets are also more likely to cover identity-related political topics, such as abortion, immigration, and Islam (Kaiser et al., 2020). While these issues have been traditionally classified as hard news that citizens should be informed about, their coverage by right-wing outlets is potentially more motivated by their desire to connect with their audience's white nationalist identities. Furthermore, from a production-cost perspective, it may also be relatively easy for news outlets to produce stories that emphasize the competition or conflict between the two political camps. There is a long tradition of "horse race journalism" in the United States that treats politics as a game in which politicians and parties gain and lose points (Aalberg et al., 2012; Dunaway & Lawrence, 2015). Journalists adopt a "game frame" approach to political coverage as such stories are easy and cost-effective to produce and replicate, and portable across news cycles (Dunaway & Lawrence, 2015).

In summary, this discussion leads us to examine the specific topic categories for which we expect media outlets to be especially responsive to audience metrics. We acknowledge that while there have been multiple empirical studies showing that newsrooms respond to audience preferences for entertainment-oriented content (Hanusch, 2017; Lamot, 2022; Lamot & Van Aelst, 2020), previous research has yet to empirically test whether news outlets are responding to partisan politics topics. Therefore, we propose a hypothesis:

> H2: *Media outlets are more likely to respond to audience engagement with partisan politics topics (H2a) and entertainment-oriented topics (H2b) compared to other topics.*

Media responsiveness of liberal and conservative outlets

In addition to possibly being conditioned by content, responsiveness to audience engagement is potentially contingent on newsroom practices of the various media outlets (Christin, 2020; Ferrucci, 2020; Petre, 2021) as well. We posit that conservative outlets are likely to be more responsive to audience engagement than liberal outlets for the following three

reasons. First, conservative outlets in the United States have historically created a niche for themselves by claiming the existence of a "liberal media bias" (Hemmer, 2016). As Benkler et al. (2018) write, the "... insistence that mainstream newspapers were biased and that it was necessary to produce media that were objective, but not impartial, was a basic tenet of conservative media" since the 1960s. According to Jamieson and Cappella (2008), "conservative media not only frame the political world but reframe the content and identity of non-conservative media, one way in which they do this is by attaching the labels 'liberal' and 'bias' to them and then arguing that they employ a 'double standard'" (p. 151). Therefore, conservative outlets have historically sought to create their own niche audiences by riding on a wave of public opinion that has framed mainstream media as "biased".

Second, these dynamics have been exacerbated with the deregulation and subsequent proliferation of cable networks, and the eventual rise of digital media which has resulted in a general trend of media becoming increasingly more tuned to their audiences, actively catering to their needs, instead of being indifferent to them. Jutel calls this phenomenon "affective media production" (Jutel, 2018) and describes how conservative American media outlets chase click bait and exploit "free labour" from audiences and users on social media to connect with them and create a brand identity. Using the right-wing broadcaster Glenn Beck as a case-study, Jutel shows how Beck's Fox News program played an instrumental role in "cementing the network's brand strategy of 'craft[ing] intensive relationships with their viewers'" (p. 378). He goes on to write that "... in aiding, promoting and even staging Tea Party events, Fox reinforces its brand community, engendering a loyal and active audience whose free labour creates the very spectacle of protest Fox covers. These viewers do not merely follow Fox as a trusted media source but as an authentic voice in the populist struggle." (p. 378).

Third, by distancing themselves from mainstream media outlets, conservative media outlets also express an implicit rejection of traditional journalistic values. Some studies show right-wing media adhere to different journalistic norms (Nadler & Bauer, 2019; Nadler et al., 2020). As mentioned earlier, research shows that one important factor that journalists use to resist being influenced by metrics is their commitment to these norms (Christin, 2020). Therefore, given conservative media's espousal of a different set of norms, it is possible that they are more likely to cater to audience demand than liberal outlets. This allows us to formalize H3:

> H3: *Responsiveness of outlets to topics will be associated with their ideological slants: right wing outlets are more likely to respond to audience metrics than left-wing outlets.*

Next, it is possible that this asymmetry of responsiveness to audience preference may be especially prominent for partisan content. For example, some studies have found that right-leaning outlets are more successful than left-leaning outlets in garnering audience engagement on digital platforms, such as Twitter (González-Bailón et al., 2022) and Facebook (Hiaeshutter-Rice & Weeks, 2021). This is potentially owing to differences in journalistic practices in their newsrooms. As Nelson observes (2018), modern newsrooms differ substantially from legacy (or pre-digital) newsrooms in how they strategize in building strong ties with their audiences. On the

right, this has resulted in a media landscape, anchored by Fox News and radio talk shows that have continued to court right-leaning news seekers, by offering them partisan news that is framed in line with their ideological predispositions.

As reasoned in H3, conservative media are more likely to respond to audience preferences: first, they differentiate themselves by claiming the existence of a "liberal bias" in the media ecosystem and producing content that appeals to conservative audiences. This is especially pertinent in the domain of partisan news topics given that "bias" is implied in the context of partisan political coverage and conservative media feel compelled to produce content that caters to their audiences. Second, by distinguishing themselves from other media outlets, they also imply that they reject traditional journalistic values. This rejection of journalistic standards again, may specifically apply to partisan news topics as conservative outlets need to produce content that reflects their priority to appeal to their conservative audiences. In summary, since these outlets distance themselves from the rest of the media ecosystem primarily in their coverage of partisan news, we expect them to be more likely to respond to audience engagement *specifically* with partisan topics on social media. This line of reasoning allows us to formalize H4:

> **H4:** *Responsiveness of outlets to audience engagement with partisan topics will be associated with their ideological slants: right-wing outlets are more likely to respond to audience metrics received by partisan news posts than left-wing outlets.*

Finally, we look at responsiveness to entertainment-oriented topics through the lens of outlet partisanship as well. As discussed in the previous section, and formalized in H2b, we expect outlets to respond to audience engagement with entertainment-oriented content. However, given the limited evidence substantiating its relationship with partisanship, we propose a research question:

> **RQ1:** *How is the responsiveness of an outlet to audience engagement with entertainment-oriented topics related to its ideological slant?*

Methods

Data
We focused on 29 ideologically diverse media outlets which were chosen based on the 57th wave in Pew Research Center's American Trends Panel Survey (Pew).[1] Our dataset, obtained from CrowdTangle, comprised all posts ($N \approx 2.23$ million) published by the Facebook pages of these outlets between January 1, 2015 and December 31, 2019, and the engagement (reactions, shares, comments) they received.

Topic modeling
We divided the entire 5-year time-frame into 60 1-month periods of analysis, and analyzed each period individually to identify meaningful topics in an unsupervised manner. For each period of analysis, we built a topic model using the textual content of all the posts published in that period. In the CrowdTangle data, this included the four columns named "Message," "Link Text," "Image Text," and "Description."

We used Non-Negative Matrix Factorization (NMF), an algorithm particularly suited for short pieces of text (such as social media posts) (Chen et al., 2019; Sharaff & Nagwani, 2016), to identify a total of 1,005 topics over the 60 periods. For each period, we determined the number of topics by doing a coherence analysis. Details of the topic modeling exercise, as well as validation of the topics identified, are reported in the Supplementary Appendix.

The goal of topic modeling in this case, was to identify co-occurring word clusters in the news published in each period of analysis, which could, in theory, be used as heuristics for the audience to choose to engage with news on social media. These engagement signals could then be monitored in news rooms, and be used to inform the prioritizing of what to publish next. The "topics" are therefore, not as broad as issues; nor are they as specific as news stories. They represent abstract conceptualizations of semantically related words that are frequently used together in news headlines and posts on social media. If the length of a period of analysis is made longer, the "topics" become more diffused and broader. If the length of a period of analysis is shortened, the "topic" become more focused and specific. While we use 60 1-month periods for our primary analysis, we report additional analysis using 10 longer 6-month periods (which produced a total of 197 topics) in the Supplementary Appendix.

Classifying topics
H2, H4, and RQ1 required the classification of every topic into two categories (partisan politics and entertainment-oriented topics). We undertook two manual coding tasks to do this classification, the first to decide whether the topic was related to partisan politics or not, and the second to decide whether it was related to entertainment-oriented content or not. We developed a codebook and two of the authors classified each of the 1,005 topics using the top 20 words as well as representative posts for that topic.

For the first classification task, topics that discussed the two parties (i.e., Democratic and Republican), politicians from the two parties, highly polarized issues (including but not limited to gun control, school shootings, abortion, climate, tax, racial justice, immigration, healthcare, accusation of fake news, mass shootings, and police brutality), political scandals (e.g., the Muller report), election-related activities (e.g., presidential debates), and nomination controversies were coded as partisan topics (Krippendorff's $\alpha = 0.842$). An example of a partisan topic identified by our topic model for December 2019 corresponded to the following (stemmed) words: "impeach," "vote," "articl," "democrat," "hous," "presid," "power," "abus," "congress," and "district".

For the second classification task, we defined entertainment-oriented topics as those that discussed non-politician celebrities, sports, movies, TV shows, music, award ceremonies, holidays, life hacks, health tips, funny and inspiring stories, travel, shopping, crime news (such as murder, but not related to political issues such as school shootings and protests), and popular science and technology (Krippendorff's $\alpha = .835$). An example of an entertainment-oriented topic identified by our topic model for December 2019 corresponded to the following words: "christma," "holiday," "gift," "tree," "famili," "santa," "season," "eve," and "time."

After classification, we observed that there was no overlap between partisan politics and entertainment-oriented topics. All the topics not classified as partisan politics and

entertainment-oriented, were treated as "other" topics in the analysis. An example of such a topic identified by our December 2019 model included the following words: "people," "errupt," "zealand," "volcano," "island," "miss," "dead," "crash," "white," and "kill."

Measures of media bias

Several established measures of media bias exist in the literature. For our study, we repurposed two such existing measures to test H3, H4, and RQ1. The first was an audience-centric measure derived from survey data ($N = 12,043$) that was collected between October 29 and November 11 in 2019, from the 57th wave of Pew's American Trends Panel (Pew). This measure attributes an ideology score to each outlet depending on the aggregated self-reported ideological composition of those respondents who reported to consuming news from that outlet: 1 and 5 indicating most liberal and most conservative, respectively. The second measure of media bias that we used was provided by Ad Fontes and unlike the Pew measure, was content-based; Ad Fontes used expert analysts from across the ideological spectrum to manually code individual news articles published by that outlet (Ad Fontes, n.d.). The fact that both measures were sourced independently and used different approaches to estimate ideological bias, yet had a significantly high correlation coefficient ($r = 0.93; p = 10^{-13}$) indicated their high reliability. While our primary analysis is based on the Pew scores, we report supplemental analysis using the Ad Fontes scores in the Supplementary Appendix. A scatter-plot showing their correlation is also provided in the Supplementary Appendix.

Estimating responsiveness

For each period of analysis, we pooled the data so that each row in the aggregated dataset captured the engagement signal and topic proportion for each media outlet, on each day, for each topic (in that period). These individually aggregated datasets for each period were then combined into one large dataset on which all subsequent analysis were run.

We next designed a measure to estimate the responsiveness of outlets to audience engagement by means of rigorous longitudinal data analysis, using fixed-effects models with a lagged-dependent variable. We were interested in the effect that engagement with posts of a certain topic published by an outlet, has on the future coverage of that topic by that outlet. So, we defined the independent variable in our model, *engagement signal* or $ES_{i,m,t-1}$ as the weighted average engagement received by posts of topic i, published by outlet m at time $t-1$, relative to the average engagement received by all posts published at time $t-1$. Engagement was defined as the sum of the number of comments, shares, and reactions ("Like," "Love," "Wow," "Haha," "Sad," "Angry," and "Care"). A higher engagement signal implies that the topic received greater engagement relative to posts focusing on other topics in that period, and should therefore predict higher coverage of that topic in the next period t, if the outlet m did respond to the metrics. The mathematical formulation of our independent and dependent variables is explained in the Supplementary Appendix. Because engagement metrics are always highly positively skewed, we used log transformed values of $ES_{i,m,t-1}$ in our model.

Our dependent variable was the frequency of the topic i published by outlet m in the subsequent time window t i.e., $Freq_{i,m,t}$. Crucially, we controlled for "news value" of each

topic by including as covariates, the coverage of the same topic by the same outlet i.e., $Freq_{i,m,t-1}$ (the Augmented Dickey–Fuller Test suggested that this sequence is stationary, $p < .01$) and the coverage of the same topic by all outlets $Freq_{i,t-1}$ in the previous window $t-1$. This is because we expect news value of any news topic to be a confounding variable that will determine the coverage of that news topic in the media. We further controlled for the engagement signal received by the posts of the same topic published by all outlets in the previous window ($ES_{i,t-1}$), as well as fixed effects at the outlet level ξ_m, topic level ζ_i, and at the time period level λ_t. The model is shown in equation 1.

$$Freq_{i,m,t} = \beta_0 + \beta_1 \log(ES_{i,m,t-1}) + \beta_2 Freq_{i,m,t-1} + \beta_3 Freq_{i,t-1} \\ + \beta_4 \log(ES_{i,t-1}) + \zeta_i + \lambda_t + \xi_m + \epsilon$$

(1)

We defined *responsiveness* as β_1, or the coefficient of $\log(ES_{i,m,t-1})$. Our main analysis used 1 day as the unit of time t and a lag of 1. Thus, our primary findings identify the effect of engagement signal on topic coverage in the *very next day*, i.e., we use a "response window" of 1 day. We also report results with response windows varying from 2 to 14 days.

Results

Our results using 1,005 topics obtained from 60 1-month periods of analysis are described in the main text. The Supplementary Appendix reports findings using 197 topics obtained from 10 6-month periods.

Overall responsiveness

Table 1 shows the regression estimates under various model specifications. All models, implemented using the R package lfe, controlled for outlet, time, and topic level fixed effects, and used robust standard errors that accounted for clustering based on outlet and time. The findings indicate that engagement signal (ES) received by an outlet for a specific topic (at time $t-1$) has a significant effect on future coverage (i.e., at time t) of the same topic by the same outlet. In other words, H1 is supported. Specifically, Model 3 shows that even after we control for the average engagement signal received by all outlets for that topic at time $t-1$, as well as the prevailing news value of that topic (i.e., the frequency of the topic across all outlets at $t-1$) the effect of engagement signal remains significant: a twofold increase in engagement signal, for example, leads to an average increase of topic frequency by the same outlet by 0.02 standard deviations on the very next day. As the response window is progressively increased from 1 day to 14 days, we find that the effect diminishes over time, and no longer remains significant after Day 4 (see Figure 1). All subsequent results use the responsiveness score estimated using Model 3 (i.e., with all covariates and fixed effects) and a response window of 1 unless otherwise specified.

Figure 2A shows the responsiveness of each of the outlets in our dataset to the audience engagement signals received on Facebook. While there is substantial heterogeneity in the extent to which media outlets respond to audience engagement, there is a significant correlation between their responsiveness values and ideological slant scores ($r = 0.412$, $p < 0.05$) (panel B). H3 is, therefore, supported. Nevertheless, an

Table 1. OLS regression estimates under various model specifications Clustered standard errors in parenthesis.

	DV: Frequency of topic at time t in media m			
	Model 1	**Model 2**	**Model 3**	**Model 4**
ES[a] with topic for media m at $t-1$	0.0022**	0.0019**	0.0019**	0.0017**
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Covariates				
Frequency of topic at $t-1$ in media m	0.6563***	0.6555***	0.6658***	0.6657***
	(0.0309)	(0.0313)	(0.0365)	(0.0365)
Avg. ES with topic for all outlets		0.0053	0.0098***	0.0098***
		(0.0039)	(0.0024)	(0.0024)
Freq. of topic across all outlets at $t-1$			−0.0666	−0.0665
			(0.0404)	(0.0403)
Fixed effects for media	Yes	Yes	Yes	Yes
Fixed effects for time	Yes	Yes	Yes	Yes
Fixed effects for topic	Yes	Yes	Yes	Yes
Interactions				
ES with topic for media m at $t-1$ × partisan topic				0.0000
				(0.0005)
ES with topic for media m at $t-1$ × entertainment topic				0.0009
				(0.0007)

[a] Engagement Signal (log transformed) as defined in the text.
+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
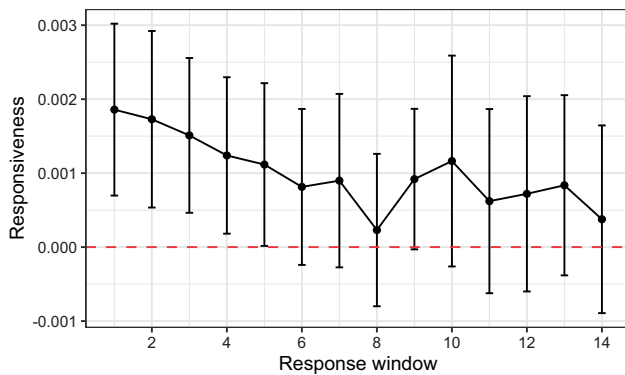
Figure 1. Point estimates for responsiveness scores (and 95% confidence intervals) for response windows ranging from 1 day to 14 days.

Note: Media outlets are, on average, more responsive to engagement signals picked up over short periods of time, than to those aggregated over several days.

inspection of the scatterplot indicates that this correlation is largely driven by only a handful of data points on the right side, including Breitbart and Washington Examiner. For example, Breitbart, the most responsive outlet in our dataset, increases their topic frequency by 0.07 standard deviations the very next day, when the engagement with that topic doubles.

Topic-level responsiveness

Next, we recoded every topic using two binary dummy variables: "partisan topic" (which was 1 if it was classified as "partisan topic" by the coders and 0 otherwise) and "entertainment-oriented topic" (which was 1 if it was classified as an "entertainment-oriented topic" by the coders and 0 otherwise). We used "partisan topic" and "entertainment-oriented topic" as two separate interaction variables (interacting them individually with the main IV—engagement signal) to

estimate the moderating effect of the topic type (i.e., using "other topic" as the baseline). Model 4 in Table 1 shows the results. The lack of any significant interaction effects indicates that the type of the topic does not moderate the overall responsiveness, and thus neither H2a nor H2b is supported.

Outlet-level responsiveness: partisan topics

We next reran the same models but subset the data to include partisan topics only, to test H4, we estimated the correlation between their responsiveness to partisan topics and their ideological scores. Figure 3A shows the results. We find that the correlation is statistically significant ($r = 0.477$, $p < 0.05$): in other words, conservative outlets are significantly more likely to respond to audience engagement signals, but only to partisan topics. But again, this pattern appears to be largely driven by a small set of extreme outlets on the conservative end of the spectrum, such as Sean Hannity, Breitbart, and Washington Examiner.

Outlet-level responsiveness: entertainment-oriented topics

Finally, we reran the models to only include entertainment-oriented topics. This gave us the individual responsiveness scores to entertainment-oriented topics, for each of the 29 outlets in our dataset. To answer RQ1, we estimated the correlation between this responsiveness score and their partisan slant (Figure 3B). The lack of any significant correlation ($r = 0.09$, $p = 0.623$) answers RQ1 in the negative.

Robustness

We conducted robustness tests by changing the length of our period of analysis from 1 month to 6 months. Thus, we divided the whole time-frame into 10, 6-month periods of analysis, and identified 197 topics in total. Our results, reported in the Supplementary Appendix, largely supports the findings reported in the main text. In other words, our findings were robust to the level granularity used for defining
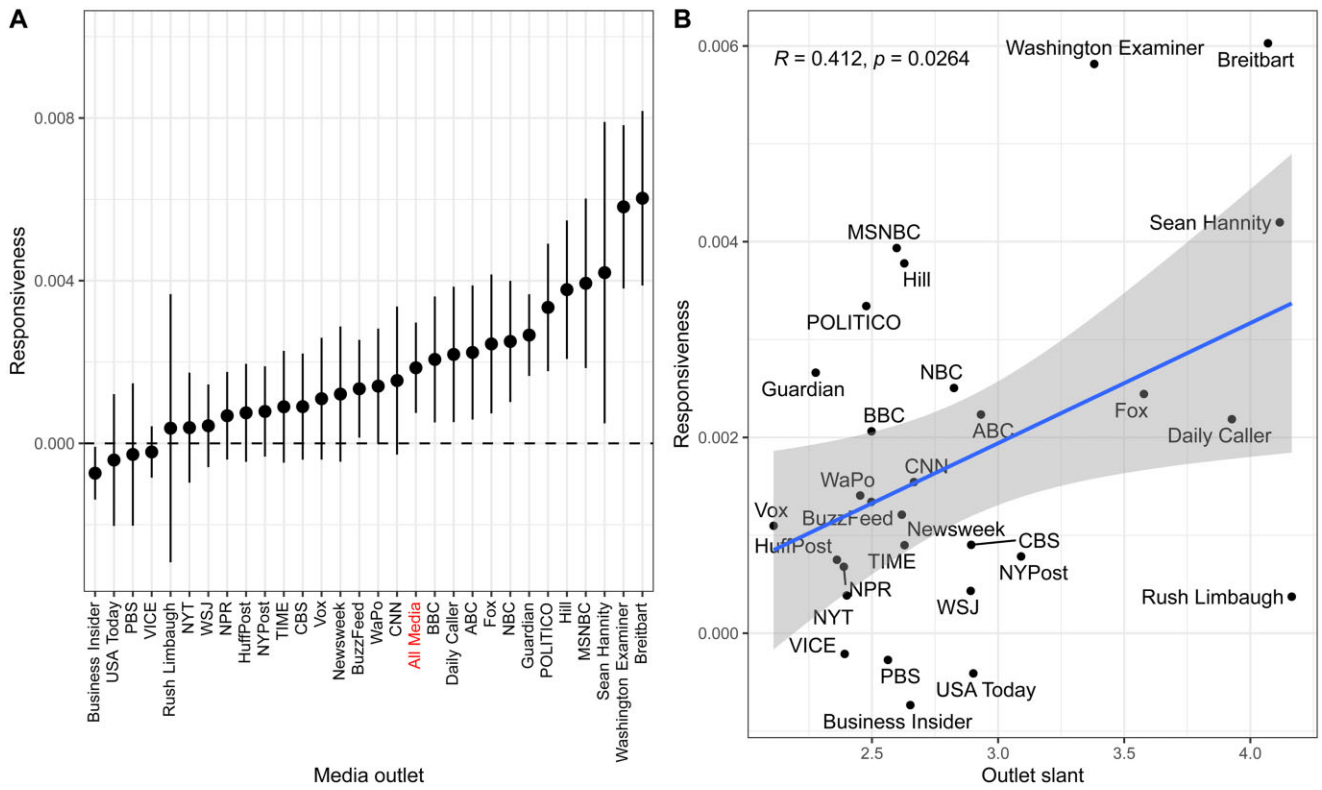
Figure 2. Responsiveness scores for individual outlets (**A**) and scatterplot showing correlation between responsiveness and ideological slant scores (**B**).
Note: Conservative outlets are significantly more likely to respond to audience engagement signals than liberal outlets.
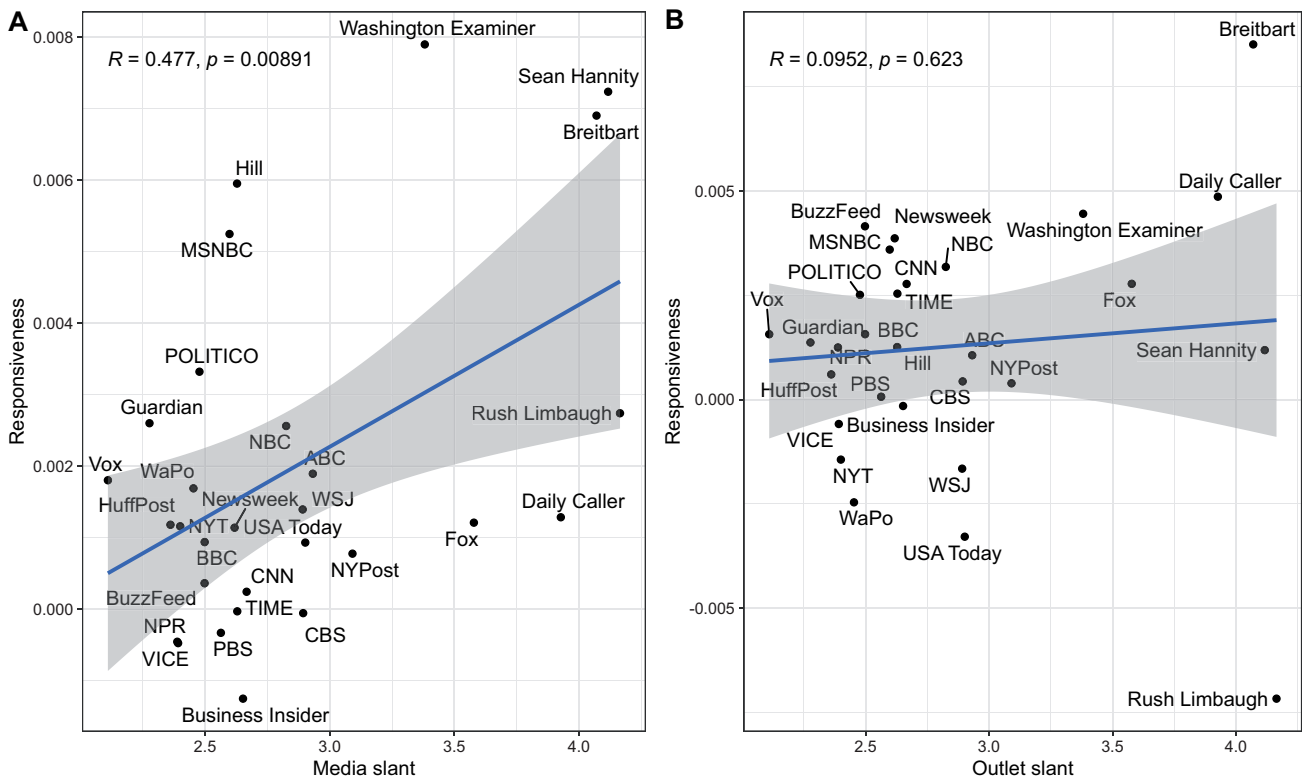
Figure 3. Correlation between ideological slant scores and responsiveness values to partisan topics (**A**) and entertainment-oriented topics (**B**).
Note: Conservative outlets are significantly more likely to respond to audience engagement signals than liberal outlets, but only to partisan topics.

"topics." The only difference between the main results and the results from the robustness analysis related to H2b (i.e., Model 4), which was supported in the latter, but not in the former.

Next, in order to assess the robustness of our findings regarding the ideological slant of the media outlets, we redid Figure 2B and Figure 3 with slant scores obtained from Ad Fontes media (Ad Fontes, n.d.). These figures are provided in the Supplementary Appendix, and convey findings that are qualitatively similar to the results reported in the main text.

We did additional robustness tests where we added a quadratic term to the model, redid the analysis only with the number of shares (i.e., without the number of likes, comments, and reactions), and added outlet ideology as an interaction term in order to test H3 even more rigorously. Our conclusions passed all these tests, yielding findings that were qualitatively similar. All robustness results are provided in the Supplementary Appendix.

Taken in sum, the results of our analyses paint a picture where engagement metrics have a complicated relationship with news production on Facebook: while the overall effect is statistically significant, substantial heterogeneity exists, both at the outlet-level as well as at the topic-level.

Discussion

This study provides a comprehensive examination on how audience engagement metrics shape content production on Facebook. By leveraging large-scale content analysis and longitudinal data analysis, we find that in general, audience metrics for news content in a certain time window, exert a significant but modest effect on news content in a future time window. This effect varies across various outlets, and shows an interesting association with the ideological slant of the outlet, an association seemingly driven by a few hyper-partisan outlets on the right. While we do not find an overall significant difference related to partisan politics and entertainment-oriented topics regarding outlets' responsiveness to audience engagement metrics, outlets do individually vary in how they respond to these two kinds of topics. For entertainment-oriented topics, the responsiveness of an outlet is not related to its partisan slant, while for partisan topics, their responsiveness is correlated with their ideological slant. This pattern appears, once again, to be driven by a handful of extreme right-leaning outlets being very responsive to audience engagement metrics.

The complicated relationship between audience metrics and news production

There is a debate in the literature on whether audience metrics influence news production and the extent to which these signals are picked by newsrooms when producing news. On the one hand, observations of newsroom practices indicate a substantive effect of audience metrics on news production (e.g., Lamot, 2022; Tandoc, 2014; Welbers et al., 2016). On the other hand, studies have shown that while audience metrics provide a clear market signal, journalists can develop alternative interpretations of these metrics or use professional values to resist the lure of audience demand. This suggests a limited effect (e.g., Christin, 2020; Petre, 2021; Walters, 2021) (also see Zamith, 2018). Our findings help contextualize this debate: we do see a significant effect in the overall media landscape but this effect is modest at most and highly heterogeneous across outlets. Because our approach examines a variety of news outlets together and accounts for multiple dynamics working in tandem, our findings illuminate how journalistic practices are being affected by the emergence of audience metrics. Moreover, these findings somewhat help disentangle the many counteracting factors that may be at play.

Our results suggest that audiences on Facebook can, to some extent, collectively affect news agenda for outlets. While our findings can be interpreted with optimism to indicate that these metrics are democratizing information flows, allowing audiences to collectively affect the news that journalists produce, there does remain reasons to be skeptical and exercise caution. Journalism's transition towards a majoritarian Market Model may further threaten the health of the information environment, and consequently, undermine the democratic process where all voices are heard, represented, and paid attention to. Journalists may prioritize catering to what readers want to consume over providing news content that is needed for preparing citizens for participating in democratic politics. Still, we also see that a number of newsrooms resist audience metrics in news production and show little responsiveness to audience metrics. This suggests that many journalists and editors are still following the traditional Trustee Model. How to nudge journalism in the direction of a Trustee Model remains an important topic for both researchers and media professionals to consider and study, going forward.

Drawing on an organizational approach, we show that outlets vary in their responsiveness towards audience metrics. Our results show that the trend towards a media system that is responsive to its online audience is not inevitable but contingent on several contextual factors. Thus, our study goes beyond naive technological determinism and possibly indicates that interventions by institutional actors may mitigate this trend of journalistic dysfunction. The finding also suggests that digital technologies do not, at least by themselves, dictate the news production process. This in turn demonstrates the connection between the scholarship on media production (e.g., Lamot, 2022; Welbers et al., 2016) and research on journalistic culture, values, and norms (Christin, 2020; Ferrer-Conill & Tandoc Jr, 2018).

An organizational approach looks at "structures, strategies, and processes that contribute to organizational performance and survival in this industry" (Evans, 2016, p. 281) and takes into consideration organizational identity, organizational culture, and especially, how organizations adapt to technological disruptions. The application of computational methods here allows us to empirically investigate a pool of major news outlets in view of such an approach. The manner in which these outlets adapt to audience metrics highlight how various organizational cultures affect the impact of digital technologies. Future research can replicate this attempt while expanding to a multi-interactionist framework to consider multiple factors to understand how they collectively shape the effects that audience metrics may have on journalistic practices.

The ideologically asymmetrical landscape of American media

One important finding is the asymmetry between the left and the right-leaning media landscape: we find that right-leaning outlets are more likely to respond to audience engagement

metrics; specifically, they respond to metrics of news content of partisan topics more than left-leaning outlets. Even though this pattern is driven by a handful of outlets on the right (e.g., Breitbart, Washington Examiner), it does have implications for how American citizens consume news. Given the fact that liberals and conservatives exhibit an asymmetry in selective exposure to news (Benkler et al., 2018), differences in their news consumption experiences may be playing a significant role in precipitating the observed findings. More importantly, the interplay between selective exposure to partisan news and the right-wing outlets' responsiveness to audience metrics of partisan news content may exacerbate each other, engendering a hyper-partisan information ecosystem for Republicans. Many prior studies have documented the difference in news ecosystems of these two partisan groups (Benkler et al., 2018; Guess et al., 2019), and reasoned how the differences are largely based on differential consumption patterns. Our findings enrich this line of scholarship on the ideological asymmetry of the American media landscape by further characterizing the differences in news *production* on social media. These results align with the claim that the two information ecosystems differ in their journalistic principles and standards, as suggested by Benkler and colleagues (2018). Other dynamics accounting for the asymmetry, especially those from the supply side, can be further examined in future research.

The aforementioned asymmetry, however, dissipates when we investigate the responsiveness of outlets to entertainment-oriented topics. This finding concurs with what Lamot (2022) suggests: that metrics facilitate a softer supply of news on Facebook. The dynamic of chasing traffic from entertaining content may undermine the civic value of news, as journalists may not cover those stories important for citizens to know. This is especially true for certain outlets, such as Breitbart and TIME, but not for others, especially for legacy newspapers including *The New York Times* and *The Wall Street Journal*. However, the factors that explain the (lack of) responsiveness to engagement with entertainment-oriented content are not clear, and this can be tackled in future research.

The asymmetry in the United States we documented, however, may be contingent on its particular media history and context. Whether our findings are relevant to other contexts outside the U.S. needs further investigation. In many western democracies (e.g., Sweden, Denmark), scholars have identified similar ideological asymmetry where right-wing outlets distinguish themselves from the rest of the media ecosystem (Heft et al., 2020). But how this asymmetry manifests in how media outlets respond to their audiences remains an open question that future studies can explore. In addition, our study only provides a snapshot of an otherwise continuously evolving news landscape. In response to increasing audience demand for hyper-partisan content, scholars have observed the rise of several hyper-partisan media on the left (Bhatt et al., 2018). These outlets may function in a manner similar to that of the hyper-partisan conservative media that we see in our study. This, however, remains an empirical question that needs further investigation.

Methodologically, we combine large-scale automated content analysis and longitudinal data analysis to provide a holistic appraisal of the effect of audience metrics on news content production. By extending our primary model, we provide a more fine-grained analysis of the responsiveness of different outlets to different kinds of topics. The method introduced here opens the door to capture the effects that audience

metrics have on content production, in a direction that is in contrast to what we typically find in traditional media effects scholarship. The pipeline developed here paves the way for future research that can help investigate other mechanisms of pressing concern. The responsiveness of media outlets to audience metrics with several other categories of news content can be gauged. For instance, the extent to which fringe outlets respond to audience metrics to amplify disinformation, or niche outlets chase audience metrics to manufacture their own media agenda may be tested using this approach.

An important limitation of the study that warrants our attention is that we are unable to test the specific mechanisms leading to the observed patterns. The holistic approach characterized here, while accounting for multiple causal mechanisms together, cannot pinpoint the exact dynamics that account for our findings. For example, it is possible that social media editors pay more attention to traffic metrics while journalists still cover news stories largely based on the Trustee Model. It is also possible that editors and journalists are still monitoring web-traffic data but inadvertently tapping into social media popularity through general web traffic data—a dynamic that we are unable to tease out. In future research, comparisons between the web versions of media outlets (by analyzing website traffic) and their social media accounts can provide insights into this matter, and these mechanisms may be isolated. Future studies can leverage methods like ethnography and field experiments, which are better at characterizing individual dynamics to identify these pathways. For example, our results suggest that certain conservative outlets such as Breitbart are more likely to respond to audience engagement for partisan politics topics. Field work in hyperpartisan outlets might be a promising research area to understand how they think about the role of political coverage in democracy.

Relatedly, the Crowdtangle data collected at any point in time only provide a "snapshot" of the media environment—and not an evolving picture of the patterns in it. Therefore, it is possible that some posts were deleted by the media outlets or censored by Facebook due to violation of their terms of use, and so were not available at the time of data collection. In addition, while Crowdtangle does provide academic researchers with relatively easy access to public Facebook data, questions hang over its future. Meta, Facebook's parent company that owns CrowdTangle, has recently announced plans to shut down the service (Lawler, 2022); therefore, it remains to be seen if such data remain accessible to researchers in the future.

Another limitation is that this study only examines one platform, Facebook. Nevertheless, we may expect that the role of audience metrics in organizing content production would also apply to other social media platforms where audience metrics are accessible and salient. For example, on Twitter, users who receive positive social feedback on their expressions of moral outrage are more likely to show moral outrage in subsequent content (Brady et al., 2021). Still, it is likely that the magnitude of the metrics' impacts is contingent on user/producer characteristics, content cultures, and algorithms associated with each platform. For example, given that a larger proportion of Twitter users report getting news than Facebook users (Walker & Matsa, 2021), one might expect that the dynamics relating to political content are even more strongly manifested on Twitter than on Facebook. Future studies can explore such between-platform differences to

paint a more holistic picture of how audience metrics affect news production in the digital era.

Yet another limitation is platform drift (Salganik, 2019, p. 33), or the idea that systems and platforms change all the time either because the people using them change (for example, they mature), the manner in which people use them change (for example, they use it less or more because of other platforms), or their design itself changes (for example, Facebook changing their interface to allow reactions and not just likes). These systemic changes in platforms can influence the dynamics observed on those platforms as well. Because our dataset spans five years, it is possible that the responsiveness of media outlets to audience engagement changed over this time period following Facebook's platform drift.

In view of the limitations listed above, we recognize that our modeling results necessitate a careful and nuanced interpretation. Moreover, our study only speaks to content production on one channel: *social media platforms*. Given the increasingly prominent role that social media play in news circulation (Walker & Matsa, 2021; Wojcieszak et al., 2021), we speculate that the logic of news production for social media platforms may result in spillover effects, thereby affecting news production on other channels as well. For example, García-Perdomo (2021) finds that the same "virality logic" used to chase audience metrics on social media changed the programming of television news due to increasing incorporation of "shareable" videos that were made for social media, into television programs. How the dynamics we document here go beyond social media platforms is an open question that remains to be tested.

Data availability

The raw data used in this study can be obtained upon request from CrowdTangle. The derived data and scripts to reproduce the results can be accessed at https://osf.io/htve7/.

Supplementary material

Supplementary material is available at *Journal of Communication* online.

Acknowledgments

Notes

1. We excluded the only non-English outlet from this list because topic models assume semantic uniformity for robust topic identification, an assumption that the inclusion of a single non-English outlet undermines.

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