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Polarization of news diets over time: longitudinal evidence from a data-donation study

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Scholars and public observers increasingly worry that digital media environments promote the growth of massive online echo chambers. This rising political polarization is feared to erode a shared factual baseline and ultimately threaten democratic stability. To examine these pressing concerns, this study uses data donation to analyze how online news diets and audience segregation change over a five-year period. Our findings show that reading digital news remains a minor part of daily online activity, and intense interest in politics is limited to a small group of users. While moving from general news to political content increases ideological segregation, this selection mechanism remains weak and does not create closed echo chambers. Over time, online audience polarization shows a stable equilibrium rather than a runaway spiral toward fragmentation. This unique data donation framework allows us to overcome the short observation windows and self-reporting errors that usually limit research in this field. By collecting five years of retrospective individual trace data, this method offers a new way to separate temporary, event-driven reactions from long-term structural changes in browsing behavior. Ultimately, this dataset provides a fresh empirical tool to show that, within Google browsing activity, real-world online media choices appear to be shaped by stable habits rather than continuous fragmentation.

KEYWORDS

asymmetric polarization, data donation, digital trace data, ideological segregation, longitudinal analysis, selective exposure

1 Introduction

Over the past two decades, news consumption has fundamentally shifted toward the online world, transforming how citizens encounter and engage with political information (Newman et al., 2025; Mitchell et al., 2016). In today's "high-choice" digital media environments, audiences have moved away from traditional broadcast and print media, increasingly relying on web browsers, search engines, and online news portals as their primary gateways to public affairs (Van Aelst, 2017; Castro et al., 2022). Consequently, the centralized curation characteristic of the broadcast era has been largely replaced by a highly fragmented, user-driven ecosystem characterized by a virtually infinite abundance of informational choice (Bennett and Iyengar, 2008; Prior, 2007).

This migration to the digital sphere has amplified longstanding democratic concerns regarding selective exposure and political polarization. Because the architecture of the open web provides users with unprecedented agency to tailor their media

diets, scholars have heavily debated whether this environment inherently encourages users to retreat into ideologically congruent echo chambers and filter bubbles (Pariser, 2011; Sunstein, 2017). Such ideological segregation is feared to erode the informational foundations of democracy by fragmenting the public sphere, increasing susceptibility to misinformation, and undermining the shared factual baseline required for meaningful civic deliberation (Garrett, 2009; Iyengar and Hahn, 2009). Despite widespread anxieties regarding selective exposure, empirical findings strongly contest the extent to which like-minded content actually dominates individual news diets (Bakshy et al., 2015; Barberá et al., 2015; Cardenal et al., 2019; Dubois and Blank, 2018; Flaxman et al., 2016; Gentzkow and Shapiro, 2011; Guess, 2021; Guess et al., 2021; Muise et al., 2022; Wojcieszak et al., 2021). Online audiences predominantly expose themselves to a broad, mainstream media mix. Within this wider ecological context, overtly partisan news sources account for only a fractional and peripheral share of their total information intake (Mangold et al., 2024).

It's advantageous for democracies to have informed citizens, who are able and willing to appropriately weigh the competing viewpoints and update their perspective when confronted with relevant information (Guess, 2021). The online media environment's affective polarization is feared to challenge citizens' ability to see opposing viewpoints by only exposing users to congenially aligning news (Yarchi et al., 2021).

Despite the ongoing focus on partisan news exposure, the field lacks sufficient longitudinal analysis to determine if political polarization in news consumption is a persistent structural shift or merely an episodic response to certain high-salience events (Van Aelst, 2017). The vast majority of existing studies are cross-sectional or structurally limited to short observation windows, typically capturing audience behavior over a few weeks or months surrounding highly salient political events, such as national elections or referendums (Wojcieszak et al., 2021; Garimella and Weber, 2017; Guess, 2021; Yarchi et al., 2021). There is some evidence from the US that polarization increased on Twitter (Garimella and Weber, 2017) and may intensify around electoral periods (Guess, 2021), yet other studies report null findings whether tracking longitudinal web browsing (Wojcieszak et al., 2021) or examining specific platforms like WhatsApp and Facebook in non-U.S. contexts (Yarchi et al., 2021).

This study addresses this gap by leveraging long-term longitudinal digital trace data from a large-scale data-donation project conducted in Hungary. We use individual-level Google browsing histories from 618 participants to examine longitudinal changes in their news consumption patterns and characteristics of their news diet. Political news consumption is measured by tracking data in most studies, which enables the collection of digital traces from the time period the tracking software is installed. The data-donation-based approach we use in this paper enables us to track users' online behavior retrospectively, thereby allowing us to observe a longer time period. Leveraging the advantages of this data collection approach, our study is among the first to map a five-year timespan of political news consumption on an individual level. This long timespan supports the study of long-term dynamics and the effects of special events on polarization, which have been largely overlooked in the literature.

2 Partisan news diets and selective exposure

The rapid expansion of online news consumption has profoundly intensified democratic anxieties regarding the fragmentation of the public sphere. At the core of these concerns lies the psychological mechanism of *selective exposure*, i.e., the tendency to actively seek out information that reinforces preexisting beliefs while systematically avoiding dissonant or challenging viewpoints (Festinger, 1957; Klapper, 1960; Stroud, 2010). In today's high-choice digital media ecology, this psychological drive is hypothesized to manifest as a skewed partisan news diet, wherein individuals deliberately curate their daily information intake to rely on ideologically congruent sources (Prior, 2013). When this ideological self-selection reaches its extreme, scholars warn of the formation of *echo chambers*: self-reinforcing informational environments where dissenting voices are structurally excluded and shared partisan narratives are continuously amplified by the users themselves (Jamieson and Cappella, 2008; Sunstein, 2017). Furthermore, these user-driven architectures of isolation are feared to be compounded by the invisible mechanics of the web, creating algorithmic *filter bubbles* in which automated curation and search engine personalization restrict a user's exposure to cross-cutting perspectives without their conscious consent (Pariser, 2011).

Nevertheless, a robust body of counter-arguments suggests that the threat of echo chambers is systematically exaggerated, functioning more as a technological "moral panic" than an accurate model of human behavior (Bruns, 2017; Nelson and Webster, 2017). First, informational intermediaries like search engines, web portals, and social media platforms frequently act as "general-interest intermediaries" that drive serendipitous, incidental exposure to cross-cutting viewpoints rather than strictly filtering them out (Guess, 2021). Second, some scholars draw a sharper analytical distinction between selective exposure and selective avoidance, arguing that while audiences exhibit selective exposure by favoring ideologically congenial content, they do not engage in strong selective avoidance of cross-cutting news sites (Garrett et al., 2013; Weeks et al., 2017). Third, media choice is often dictated by factors entirely divorced from partisan ideology. Selectivity based on general political interest has proven to be a far more powerful driver of behavior than ideological sorting, suggesting that many disconnected citizens are simply "news avoiders" opting for entertainment rather than ideologues trapped in partisan bubbles (Prior, 2013; Skovsgaard et al., 2016). Additionally, "news avoiders" are large in number, according to Wojcieszak et al. (2024), whose results showed that the online diet comprises 3.4% news sites, of which around 14%–36% is political news. They also found that the majority (66%) of news consumption came from non-news sites. Moreover, patterns of attention in digital media systems are also structured by popularity cues and cumulative advantage dynamics: audiences disproportionately gravitate toward a small number of highly visible, mainstream outlets, producing a "persistence of popularity" that concentrates exposure rather than fragmenting it into ideologically insulated niches (Gentzkow and Shapiro, 2011; Nelson and Webster, 2017).

Against this debate, studies utilizing behavioral trace data generally find limited empirical support for widespread echo chambers or filter bubbles. Observational research consistently indicates that the modal internet user obtains political information from a diverse array of mainstream sources, resulting in substantial overlap in news exposure among citizens with differing ideological leanings (Bakshy et al., 2015; Barberá et al., 2015; Cardenal et al., 2019; Dubois and Blank, 2018; Flaxman et al., 2016; Gentzkow and Shapiro, 2011; Guess, 2021; Guess et al., 2021; Muise et al., 2022; Wojcieszak et al., 2021). For example, utilizing large-scale browsing and viewing data, Muise et al. (2022) found that algorithmic and platform-driven partisan audience segregation affects only a restricted subset of the population, with approximately 4% of Americans maintaining an isolated, partisan-segregated news diet online. This overall lack of segregation is largely driven by a general scarcity of news consumption. As Skovsgaard et al. (2016) demonstrated in the Swedish context, *political interest* is a far stronger driver of media choice than partisan ideology. Consequently, explicitly political and partisan news accounts for a remarkably small fraction, often less than 1% to 4%, of the average user's overall web browsing (Mangold et al., 2024; Wojcieszak et al., 2021; Guess, 2021). However, when users do actively engage with political content, ideological sorting becomes highly pronounced. Mangold et al. (2024) noted that exposure to political news displays markedly stronger partisan and ideological bias than exposure to nonpolitical news content. A Google Search-based trace study added that partisan skew is lower in algorithmic exposure than in subsequent clicks, indicating that users' active engagement is more ideologically aligned than the search results they are initially shown (Robertson et al., 2023). Furthermore, even when users do consume cross-cutting information, breaking out of these silos does not guarantee ideological moderation; utilizing digital tracking, Tóth et al. (2023) found that exposure to a more diverse news diet actually intensified anti-immigrant attitudes and populist support.

Stemming from these findings, we hypothesize (H1) that ideological segregation will be more pronounced when analyses are restricted to political news consumption compared with aggregate news consumption.

3 Temporal dynamics and event-driven polarization

Against the backdrop that affective polarization has deepened across contemporary democracies (Iyengar et al., 2019; Reiljan, 2020), partisan animosity may increasingly structure citizens' media repertoires, leading to more ideologically selective patterns of news exposure. First, as the sheer volume of available partisan outlets grows, it fundamentally lowers the transaction costs of finding ideologically congruent news (e.g., Prior, 2007; Gentzkow and Shapiro, 2011; Flaxman et al., 2016). Over time, as users become more adept at navigating the digital landscape, they can more efficiently filter out unwanted perspectives, theoretically leading to stricter audience segregation. Second, the economic imperatives of the attention economy drive platforms

to deploy engagement-optimized algorithms that structurally favor emotionally resonant and ideologically extreme content, potentially nudging even moderate users toward more polarized information horizons over time (Brady et al., 2017; Tufekci, 2015; Wu, 2016). Third, drawing on the *reinforcing spirals model* (Slater, 2007), researchers posit that the psychological discomfort of encountering dissonant views increases as affective polarization intensifies, creating a feedback loop where hostile feelings toward political out-groups drive stricter selective exposure, which in turn further hardens partisan identities (Settle, 2018; Suhay et al., 2018). Fourth, the emergence of asymmetric media ecosystems, particularly those characterized by a self-referential network of hyper-partisan outlets, actively facilitates a departure from mainstream sources; by institutionalizing distrust toward "legacy" media, these ecosystems encourage audiences to progressively sever ties with centrist information, leading to a sustained, aggregate increase in dietary polarization over time (Benkler et al., 2018).

However, patterns of news consumption may not exhibit a steady, linear trajectory toward greater polarization, but instead fluctuate over time, with shifts in ideological composition driven by specific political or non-political events. In this view, echo chambers represent temporary informational retreats activated by high-salience political events rather than permanent fixtures of the media diet. Skovsgaard et al. (2016) argue that the *opportunity structures* for selective exposure change based on the political environment. During "routine" political periods, citizens may default to low-effort, mainstream, or centrist media habits. However, during high-salience events, such as national elections, supreme court appointments, or civil unrest, the psychological "utility" of partisan news increases. This may cause a temporary surge in ideological sorting as users seek out specific interpretations of the event to reduce uncertainty or validate their reactions. As Prior (2007) notes, for the majority of "accidental" news consumers who prioritize entertainment, echo chambers may represent temporary informational retreats during "high-salience periods" rather than permanent fixtures of their daily media habits.

Only a handful of studies examined temporal dynamics in the polarization of news diets. Muise et al. (2022) conducted a massive longitudinal analysis comparing the partisan news diets of traditional television viewers against web audiences over several years. They found that while online ideological segregation is generally low and highly transient, it visibly spikes during periods of high political salience; for instance, the proportion of Americans consuming strictly partisan diets surged during the November 2016 presidential election and the 2018 midterm elections before subsiding during routine political periods. Testing a similar episodic polarization hypothesis, Guess (2021) utilized large-scale behavioral data to compare the online media consumption of Americans during a relatively routine period in 2015 against the high-salience environment of the 2016 presidential election. His analysis revealed that while the overlap between the media diet distributions of Democrats and Republicans was a substantial 65% in 2015, this shared exposure contracted to 50% in 2016. While Guess (2021) demonstrates that events like presidential elections temporarily deepen ideological segregation among partisans, Swedish panel data from Skovsgaard et al. (2016) shows that interest-based segregation is a more powerful dynamic; such events

primarily widen the gap between political information seekers and news avoiders, rather than simply dividing audiences along partisan lines. By combining panel surveys with digital trace data to track users' actual web browsing histories across a 12-month period in 2018 and 2019, Wojcieszak et al. (2021) found that even during a highly politicized period, real-world exposure to partisan news online did not exacerbate users' affective or attitude polarization over time. Beyond news consumption, research examining active political engagement on social media suggests that these over-time temporal trends are highly platform-dependent, with interactional polarization aggravating on networks like X/Twitter (Garimella and Weber, 2017) but actually depolarizing on others like WhatsApp (Yarchi et al., 2021). In sum, longitudinal evidence indicates that polarization in digital media does not follow steady growth, but fluctuates episodically, often remaining stable even during high-salience periods, with dynamics shaped by political interest and platform affordances.

Building on the premise that opportunity structures for media exposure shift in response to the political environment, we hypothesize (H2) that high-salience events, including national elections and exogenous shocks such as the COVID-19 pandemic or the outbreak of the Russia-Ukraine war, will lead to a significant increase in the overall volume of online news consumption, as the psychological utility of information surges to reduce uncertainty during times of elections or crisis.

While the literature converges on this volume-based expectation, predictions regarding the ideological consequences of such periods are markedly more divided. The reinforcing spirals framework (Slater, 2007; Settle, 2018; Suhay et al., 2018) and event-driven sorting accounts (Muise et al., 2022; Guess, 2021) predict that such periods intensify partisan selective exposure, whereas alternative perspectives emphasize that crises may instead trigger pragmatic surveillance behavior that pulls audiences toward mainstream, fact-oriented sources (Skovsgaard et al., 2016; Zoizner et al., 2022), or produce no detectable shift at all (Wojcieszak et al., 2021; Yarchi et al., 2021). We test the first of these predictions as our third hypothesis. Specifically, we hypothesize (H3) that high-salience periods will trigger temporary spikes in ideological polarization, as users actively seek out partisan interpretations to validate their reactions during these acute episodes. This episodic polarization is expected to be markedly more pronounced when refining the analysis specifically to political news consumption compared to the aggregate news diet. Whether the data support this directional prediction, fail to detect any shift, or instead reveal a depolarizing pattern carries direct theoretical implications for adjudicating between these competing frameworks.

Finally, regardless of the direction of short-term event-driven fluctuations, longitudinal evidence consistently indicates that digital media polarization does not follow a steady, cumulative growth trajectory (Muise et al., 2022; Wojcieszak et al., 2021; Guess, 2021). Building on this convergent finding, we hypothesize (H4) that any episodic shifts in segregation, whether upward or downward, will not translate into a sustained directional trend; consequently, the overall levels of ideological polarization in both general and political news diets are expected to remain stable across the entirety of the 5-year observation period.

4 Materials and methods

4.1 Data collection

To capture digital traces, we implemented a data donation framework (Breuer et al., 2023; Boeschoten et al., 2022) that allows participants to share their Data Download Packages (DDPs). These packages theoretically provide a comprehensive record of the digital activities tracked by various platforms. The data were gathered through a study conducted in Hungary from February to June 2023, with participants recruited via NRC, the country's largest non-probability online panel. Within this panel, individuals from major cities and those with higher educational attainment are typically overrepresented relative to the national average.

The participation process followed a three-step structure: first, a screening questionnaire to determine eligibility and secure informed consent; second, the technical process of downloading and uploading social media data to a secure project portal; and finally, a 30-minute topical survey. Recruitment materials, including the invitation letter and project goals, were developed based on findings from a prior vignette experiment (Kmetty et al., 2025).

Eligible donors (defined as monthly users of both Google and Facebook) were directed to a dedicated website containing step-by-step instructions and video tutorials for five platforms: Google, Facebook, Instagram, Twitter, and TikTok. Participants were instructed to upload their raw data archives without modification or extraction. While Google and Facebook data were mandatory, respondents received approximately 25 euros for their participation, with the total incentive increasing to 35 euros for those who chose to donate additional datasets from Instagram, TikTok, or Twitter. Comprehensive documentation of the collection protocol is available via the project's OSF page: <https://osf.io/7uybr/>.

Following the data upload, participants completed a final survey covering news consumption habits, political leanings, leisure activities, and social status. The study concluded with 755 fully completed cases, representing a 16 percent completion rate among those who initiated the donation process.

To account for potential sampling biases, we utilized individual weights to align the sample with the active internet user population across five key socio-demographic dimensions: age, gender, education level, geographic region, and settlement type. The weights were constructed by raking (iterative proportional fitting) the sample to the marginal distributions of these five dimensions. We derived the reference margins from Hungarian Central Statistical Office (KSH) census microdata accessed in the KSH secure research environment, restricted to the population of active internet users, which is the target population of the data-donation study. This corrects the online panel's known over-representation of urban and highly educated respondents. For a detailed discussion of sample distribution and bias, see Kmetty and Stefkovics (2025) and Chen et al. (2025). The data donation study was conducted with the IRB approval of the Center for Social Sciences Ethical Board (1-FOIG/130-37/2022) and with the informed consent of the participants.

In this paper, we analyze the browsing records contained in each participant's Google *My Activity* search archive, the activity

log produced by Google's *Web & App Activity* setting. This log is recorded at the account level across all of a participant's signed-in devices rather than being tied to a single device; from it we use the visited-page records (URLs and their timestamps) from 01/01/2018 to February 2023. Because the log is account-level, it is not restricted to desktop use: over 6 percent of recorded visits carry explicit mobile markers and mobile browsing is near-universal across participants, so mobile use is well represented in the data. Activity is nonetheless recorded only while a participant is signed in with the setting enabled, so browsing conducted while signed out, in incognito mode, or within other browsers, in-app webviews, or native mobile applications is not captured. The final sample of this study consists of respondents with browsing records from the Google DDPs. As described above, the donation of Google data was mandatory in the research. In the data request, we list three Google DDPs: Location data, YouTube data, and Google My Activity (search and browsing history). We accepted the data upload if any of these DDPs have been included in the uploaded ZIP. Thus not all the respondents had to upload their My Activity data. 618 respondent had My Activity browsing data. There was no difference in party preference or political interest between those with browsing history data and those without. Education was the only characteristic associated with the availability of browsing history data. Respondents with secondary or higher education were more likely to have browser history available in the donated DDPs (see [Supplementary Table S1](#)).

Not all respondents with browser history had data for every year between 2018 and 2023. 64 percent of respondents with browsing history had at least 30 page visits per year. Again, this was only correlated with education level; those with secondary education were more likely to have data for all years than those with primary education (see [Supplementary Table S1](#)). We use the sub-sample of respondents with data for every year as a robustness check in our analysis to control for potential sample biases in temporal analysis. The socio-demographic distribution of the final sample (unweighted/weighted) is available in [Supplementary Table S2](#). The number of contributing respondents and the volume of page visits for each observation year and for each high-salience event window are reported in [Supplementary Tables S3, S4](#).

4.2 Domain and content categorization

The identification and classification of news content were conducted through a multi-stage process involving machine learning, manual verification, and expert coding to ensure high data reliability.

To identify the news sites, we first standardized domain names and excluded those with only a single registered page visit. The remaining domains were classified using a Sentence Transformer model. The input for this model consisted of concatenated title page names. To manage the resulting embeddings, we applied the Hierarchical Nearest Neighbor Embedding (h-NNE) dimension reduction algorithm. This process yielded 152 clusters, which were manually organized into 26 broader categories. One specific cluster identified through this method contained news-related sites. We

enriched this list through three systematic steps. First, we integrated a proprietary domain collection from a previous study focusing on the 2022 Hungarian general elections. Second, we conducted a manual review of all domains exceeding 1,000 visits to identify potential news outlets. Finally, we excluded domains with fewer than 10 total clicks, a threshold that accounted for merely 2.8% of the total potential news consumption.

The final list comprised 2,420 domains. The identified domains were categorized based on their potential to host political or public affairs content. We conceptualized politics broadly, encompassing both party politics and public policy in our classification logic. Our analysis focuses exclusively on Hungarian domestic political content; consequently, international news outlets (e.g., BBC, CNN) and Hungarian-language sites based outside of Hungary (e.g., Transtelex) were not classified as news domains. Furthermore, news aggregators were excluded from the news domain category, as user interactions with these platforms typically redirect to the original native website. To ensure validity, two independent coders reviewed this list to confirm whether each site could host political news. The inter-coder reliability was 0.72 (Krippendorff's α), with the lead researcher resolving any discrepancies.

Following the identification of news domains, we categorized them based on their political orientation. In the Hungarian context (specifically the 2018–2022 period), a traditional left/right or liberal/conservative axis is less descriptive than a pro-government vs. opposition distinction. Consequently, we sorted the domains into four distinct categories, namely pro-government (Fidesz-KDNP), opposition, politically neutral, and far-right or conspiracy outlets.

Each news site was independently coded by two researchers. Inter-coder reliability for this classification was moderate (Krippendorff's $\alpha = 0.68$). To distinguish between general news and specifically political content, we analyzed individual links from the identified domains. The respondents of the study visited 183,088 unique URLs from the news domains in the observed period, of which 86% were successfully downloaded and parsed. A random sample of 680 news items was manually coded by the research team as “political” or “non-political”. Each item was processed by two coders, achieving a high inter-coder reliability (Krippendorff's $\alpha = 0.92$). The lead researcher served as the final arbiter for non-matching codes. This manually coded dataset served as the labeled data for a classifier based on huBERT, a Hungarian-language BERT model, which was given the full parsed body text of each news item as input. We partitioned the labeled data into training and test sets using a 90/10 split and evaluated the model on the held-out test partition that was not seen during training; on this out-of-sample data the classifier achieved an F1 score of 0.80, indicating balanced precision and recall across both categories. The fitted classifier was then applied to the entire corpus of downloaded news items to categorize the content for the analysis. To ensure the reliability of our political media consumption analysis, we applied a data-driven filter to exclude domains where the share of political news was below 2 percent of their parsed content. This step guaranteed that platforms primarily functioning as lifestyle or thematic magazines with high ‘soft news’ traffic did not distort the examination of political dynamics.

4.3 Analytical approach

We structured our analysis into two primary stages: a macro-level content analysis, followed by an individual-level user analysis. The central concept of our paper is to investigate longitudinal changes in information consumption and to evaluate the specific impact of high-salience events on the audience. To operationalize this temporal investigation, we developed a systematic delimitation strategy that distinguishes between high-salience event periods and routine baseline consumption.

The core of our temporal logic lies in the distinction between active and cooldown phases. We defined the active phases of institutional political events, such as national and international elections, using a standardized window centered on the election date. For these periods, the active phase encompassed the three weeks preceding the election day and the one week immediately following it, capturing both the peak of the campaign and the interpretative aftermath. To establish a robust counterfactual, we identified cooldown periods as the baseline references immediately surrounding these active windows. We applied a similar categorization to exogenous shocks, including the onset of the COVID-19 pandemic and the beginning of the Russo-Ukrainian War. This systematic approach ensured methodological transparency and allowed us to contrast behavioral shifts during high-salience periods with the consumption patterns characteristic of more stable periods (see [Table 1](#)). A particular methodological challenge arises from the temporal proximity of the Russo-Ukrainian War (active phase: 2022-02-17–2022-03-12) and the 2022 Hungarian parliamentary election (active phase: 2022-03-13–2022-04-10), whose active windows are immediately adjacent and whose informational effects plausibly overlap throughout late February and March 2022. To minimize cross-contamination in the baseline comparisons, we anchored the cooldown reference for the war exclusively to the pre-war period (2022-01-01–2022-02-16), and the cooldown for the 2022 election exclusively to the post-election period (2022-04-11–2022-05-10). Despite this design choice, we retain the two events as analytically distinct categories in the aggregated event-shift estimates; we revisit the interpretive consequences of this overlap in the Limitations section.

4.3.1 Content level

To capture the multi-layered structure of information seeking, we operationalized our dependent variables using a nested proportional logic. We first calculated the daily share of general news consumption as the ratio of news-related page visits to the total daily web traffic volume. To isolate specifically political engagement, we defined the share of political news exclusively within the subset of general news consumption. This metric represents the proportion of explicitly political articles among all news items visited on a given day, allowing us to distinguish specific political interest from broader fluctuations in general news attention.

To model the longitudinal fluctuations in information attention, we applied a locally estimated scatterplot smoothing procedure to the daily shares of general and political news.

This nonparametric approach enabled us to capture underlying temporal trends while accounting for inherent noise in daily digital trace data. To identify specific days with exceptional news interest, we calculated residuals for each observation by subtracting the predicted trend value from the actual daily share. We defined extreme outlier days as those where the absolute residual exceeded 2.5 times the standard deviation of all residuals within the observation period.

To test for significant differences in consumption volumes between the active phases and their corresponding cooldown periods, we employed a cluster-robust bootstrapping procedure. We computed the absolute difference in the mean share of news and political content between the active and baseline phases for each event category. To construct 95% confidence intervals and assess the statistical significance of these shifts, we ran a simulation with 1,000 bootstrap iterations. During each iteration, we resampled the dataset at the respondent level with replacement.

Furthermore, we examined the ideological composition of these news diets by quantifying the aggregate daily proportion of pro- and anti-government media exposure. We calculated these alignment ratios for the overall news diet and the political news subset, and applied locally estimated scatterplot smoothing to the daily aggregated shares to model their temporal evolution.

To quantify ideological segregation among news audiences, we use established audience-based measures of media slant. Following the methodological framework of [Flaxman et al. \(2016\)](#), we first estimate the baseline governing-party (Fidesz-KDNP) share across the overall sample, and then the governing-party share for each unique news domain. To evaluate the relative ideological slant of individual news websites, we compute an ideological alignment score. Consistent with recent cross-national web-tracking research by [Mangold et al. \(2024\)](#), this metric is calculated as the difference between an outlet's specific audience composition and the panel's baseline ideological mean. A value of zero indicates that a news website's audience perfectly mirrors the general online population. Positive values indicate a pro-government audience slant, while negative values indicate an oppositional slant, effectively isolating each outlet's ideological displacement. To measure systemic polarization across the broader media environment, we aggregate these outlet-level scores into an Audience Polarization Index (API). Concretely, for each news website we take the absolute value of its alignment score, that is, how far its audience's partisan composition departs from the overall online population in either direction, and we then average these absolute deviations across all news websites, weighting each website by its share of news traffic. The index approaches zero when news websites draw audiences that mirror the general online population, and grows larger as websites increasingly attract distinctively partisan audiences (stronger audience sorting). This index serves as a proxy for the extent of individuals' ideological self-segregation and is conceptually grounded in the isolation index used by [Gentzkow and Shapiro \(2011\)](#). By systematically comparing the API across the general news diet and the political news subset, we determine whether consuming explicit political content exacerbates ideological segregation. To validate these macroscopic shifts, we generate 95% confidence intervals at the respondent level using a cluster-robust bootstrap with 1,000

TABLE 1 Temporal delimitation of active and cooldown phases for high-salience events.

Event name	Type	Active phase	Cooldown phase
2018 Parl. election	Election	2018-03-18–04-15	Pre: 2018-02-18–03-17 Post: 2018-04-16–05-15
2019 EP election	Election	2019-05-05–06-02	Pre: 2019-04-05–05-04 Post: 2019-06-03–07-02
2019 Mun. election	Election	2019-09-22–10-20	Pre: 2019-08-22–09-21 Post: 2019-10-21–11-20
COVID-19 pandemic	Shock	2020-03-01–04-30	Pre: 2020-02-01–02-29
Russo-Ukrainian War	Shock	2022-02-17–03-12	Pre: 2022-01-01–02-16
2022 Parl. election	Election	2022-03-13–04-10	Post: 2022-04-11–05-10

resampling iterations, mirroring the procedure established in our volume analysis.

To investigate the temporal dynamics of this systemic polarization, we extended the index to a longitudinal framework. To prevent daily fluctuations in the user base from artificially distorting the metric, we anchored the calculation to a fixed global baseline, defined as the mean ideological composition of the active panel over the entire 5-year observation period. Using this constant reference point, we computed the daily polarization index separately for general news and political news consumption, and modeled the long-term evolutionary trend in these daily segregation levels using a locally estimated scatterplot smoothing algorithm. Because daily domain-level alignment scores are estimated from a small number of interactions and are therefore noisy, we assess the long-term trend across two resolutions, using the smoother monthly-aggregated series to characterize the overall trajectory and the daily series to detect sharp, event-localized deviations. Furthermore, to test the episodic polarization hypothesis, we evaluated whether high-salience events trigger temporary spikes in systemic segregation. We applied our cluster-robust bootstrapping procedure to estimate the shift in the polarization index during high-salience periods. Specifically, we calculated the absolute difference in the index between the active phases and their corresponding cooldown periods for both institutional elections and exogenous shocks. Using 1,000 resampling iterations, we statistically assess whether the audience's ideological isolation temporarily intensifies during periods of high political salience. Given the sample size and the modest number of interactions within individual event windows, these bootstrap tests have limited statistical power to detect small event-driven shifts; we therefore interpret non-significant event effects as an absence of a detectable change rather than as positive evidence of no change.

To ensure the longitudinal reliability of our findings and to control for potential panel attrition, we replicated all bootstrap-based significance tests on a restricted, robust sub-sample. This sensitivity analysis focused exclusively on respondents who provided consistent digital trace data for every year of the five-year observation period. We present the detailed outcomes of these robustness checks alongside our primary findings in the section 5.

4.3.2 User level

To transition from the macro-level dynamics to the individual-level analysis, we aggregated the digital trace data at the respondent

level. First, we established the baseline individual consumption metrics by calculating each user's overall news ratio, defined as the proportion of news site visits relative to their total web traffic, and their political news ratio, measured as the share of explicitly political content within their general news diet. To determine whether high-salience periods inherently alter individual browsing habits, we isolated the respondents' consumption volumes during the active phases of macro-sociological events and their corresponding cooldown periods. We then computed the individual-level ratios of news and political news consumption separately for these designated temporal windows. To statistically evaluate the magnitude and direction of attention shifts during high-salience events, we applied paired *t*-tests.

To assess ideological asymmetry and polarization in individual media diets, we assigned a directional article score to each classified news item. This score was not coded article by article; instead, each item inherited the political orientation of the news website it came from, as established by our manual outlet-level classification described above (two independent coders, Krippendorff's $\alpha = 0.68$). Articles originating from pro-government domains received a score of 1, opposition content was scored as -1 , and neutral news was anchored at 0. We omitted the small number of far-right news from this measure. By calculating the intra-individual mean of these scores, we constructed a continuous measure of user-level media slant (Mangold et al., 2024), where positive values indicate pro-government bias and negative values indicate an oppositional lean. To measure the user's absolute ideological segregation, we computed an extremity score as the absolute value of the slant metric. We computed these indices separately for the general news diet and the political news subset to isolate explicit partisan information seeking from routine media habits.

To map the structural distribution of ideological self-selection across the electorate, we analyzed the density functions of these slant scores across four distinct political preference groups: left-wing opposition, governing party supporters, radical right voters, and unaligned or uncertain respondents. We visually and statistically compared the overlap and divergence of these density distributions between the general news and political news contexts. Building on this cross-sectional analysis, we investigated the temporal dynamics of media slant within each political camp. We calculated the phase-specific slant and extremity scores for the active and cooldown periods of institutional elections and exogenous shocks. Using paired *t*-tests, we systematically evaluated whether specific political groups retreat into more extreme partisan

echo chambers or expand their information horizons during periods of high political salience.

Finally, to further test the impact of high-salience events on news diet extremity while controlling for unobserved time-invariant individual heterogeneity, we estimated a series of individual-level fixed-effects panel regression models (Allison, 2009). In these models, the user's news diet extremity served as the dependent variable. We interacted the binary indicator of the active phase with the respondents' categorical party preference. This modeling strategy allowed us to isolate the precise effect of exogenous shocks and election campaigns on the ideological isolation of different voter groups, ensuring that our estimates remain robust against static differences in political interest, media literacy, or socio-demographic background.

5 Results

5.1 Content level

We structure our empirical analysis by first establishing the temporal baseline of digital information engagement across historical event phases before investigating the structural patterns of ideological sorting. Logically, evaluating systematic fluctuations in the overall volume of news attention (H_2) must precede the analysis of directional audience segregation (H_1), as the scope and magnitude of dietary polarization can only be meaningfully interpreted within the broader macro-context of shifting public attention.

In the first step of the analysis, we establish the baseline levels of digital information engagement. Over the 5-year observation period, the weighted mean share of general news consumption in total web traffic was 4.6 percent. Within this news diet, explicitly political content accounted for an average of 46.8 percent, indicating that, while news represents a relatively small fraction of overall browsing, political news consumption constitutes a substantial portion of news content.

To examine how these patterns fluctuate over time, we modeled the longitudinal dynamics of news attention (see Figure 1). The locally estimated scatterplot smoothing trend indicates that while news consumption remains relatively stable during routine periods, it exhibits sharp, episodic surges coinciding with high-salience events. To test H_2 , which posits that high-salience events significantly increase online news consumption, we used a cluster-robust bootstrapping procedure to compare active phases to their respective cooldown periods. Our results provide strong empirical support for H_2 : the aggregate share of news consumption was significantly higher across all identified event windows than in baseline routine periods, with an estimated shift of 1.92 percentage points. This expansion of attention is equally evident across different event categories. Both institutional elections and exogenous shocks triggered statistically significant surges in general news interest, with estimated increases of 1.3 and 2.4 percentage points, respectively. Furthermore, these periods of high intensity also catalyzed a marked intensification of political focus within the news diet (see Figure 2). The share of political news within the overall news mix expanded by an average of 16.5 percentage

points during active events. This positive shift was held for both elections and exogenous shocks. Our residual-based outlier detection further validated these findings, identifying statistically extreme consumption peaks that align with critical historical moments, such as the national lockdown in March 2020 and the final weeks of the 2022 parliamentary campaign. Finally, to ensure that these trends were not artifacts of changing panel demographics, we replicated the analysis on a robust sub-sample of long-term participants (see Supplementary Figure S1). The results from this stable cohort remained consistent with our primary findings, confirming that the observed dynamics reflect genuine shifts in information-seeking behavior across the digital public sphere. Building on the observed shifts in attention volumes, we turn to the ideological composition of these news diets to identify structural patterns in audience exposure. Our analysis indicates that the overall weight of pro-government content slightly increased during the five-year period, a trend particularly observable within the general news diet (see Supplementary Figure S2). However, we also identified continuous and significant fluctuations in media alignment throughout the entire observation window, suggesting that the digital news ecosystem remained highly volatile despite this gradual shift in dominance. This systematic response confirms that salient exogenous shocks and institutional events fundamentally reshape digital attention, validation that allows us to accept H_2 . Consequently, our findings demonstrate that high-salience periods not only expand the total volume of news consumption but also systematically drive the political intensification of the digital public sphere.

To examine the behavioral foundations of news selection, we first analyzed the cross-tabulation of party preference and media alignment (see Supplementary Table S5). Our results indicate that while partisan alignment influences general news diets, this relationship intensifies significantly when users engage with specifically political content. The association between political preference and source selection, measured by Cramer's V, increases from 0.077 for general news to 0.121 for political news. This shift suggests that political commitment becomes a more salient driver of information seeking in high-stakes informational contexts.

Notably, the share of politically neutral content also rises in the political subset (from 13.0% to 20.7%). This shift is descriptive of the traffic composition rather than directly indicative of user-level orientation, and several mechanisms could produce it. Furthermore, while explicitly far-right news domains constituted a marginal fraction of the overall web ecosystem, given that such fringe content predominantly circulates on social media platforms rather than traditional news sites, the data clearly reveals that radical-right voters (Mi Hazánk) consumed these portals at a distinctly higher rate than any other political group. This individual-level partisan selection is closely intertwined with the structural distribution of the digital media environment. The domain-level alignment scores validate our manual categorization and reveal a significant market dynamic: high-reach domains predominantly cluster in the moderate center, while ideological extremity is concentrated among smaller, niche outlets. Quantifying this through the Audience Polarization Index (API) provides robust support for H_1 . As shown in Figure 3, political news consumption shifts toward higher isolation values compared to aggregate news diets, both at the

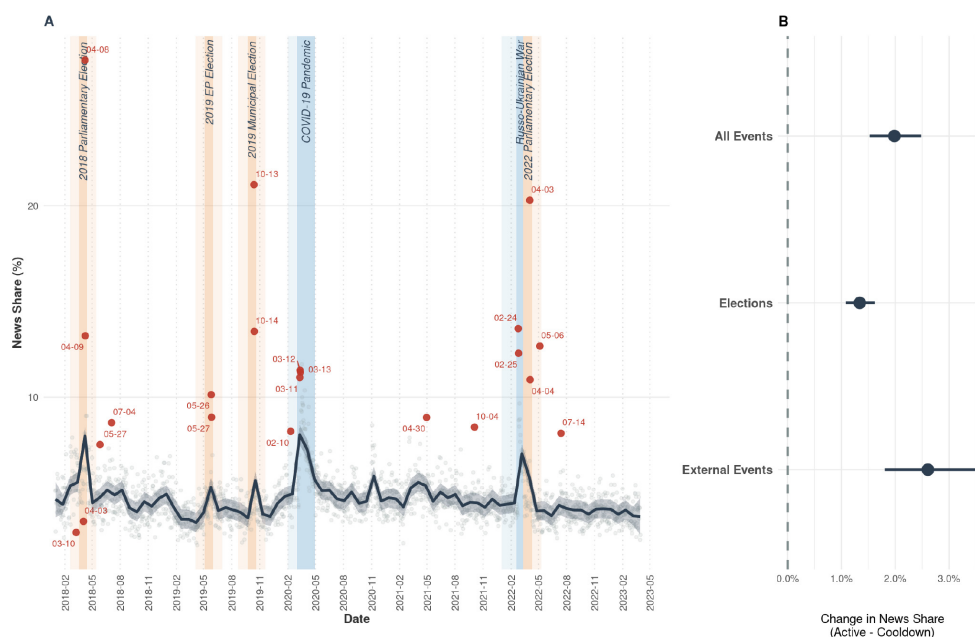


FIGURE 1

Daily news share and event-driven attention shifts. **(A)** Daily news share (visits to news domains/total daily web traffic) with a LOESS smoother (95% CI band). Red dots mark outlier days where $|\text{residual}| > 2.5 \times \text{SD}$ of all residuals over the observation period. Orange bands denote the active phases of elections; blue bands denote exogenous shocks (COVID-19, Russo-Ukrainian War). **(B)** Mean difference in news share between active and cooldown phases with 95% bootstrap CIs (1,000 iterations, resampled at the respondent level).

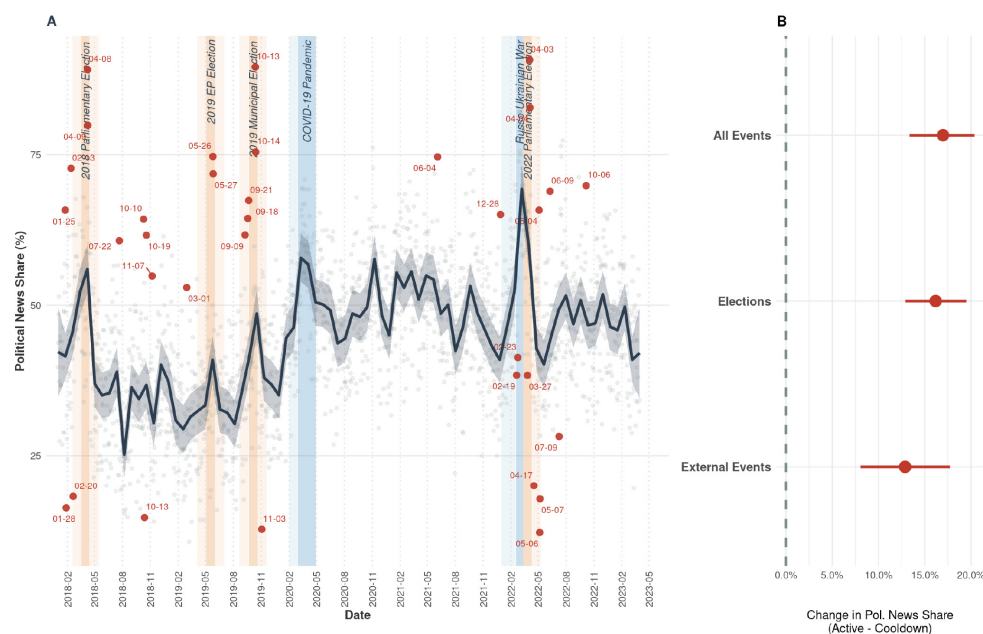
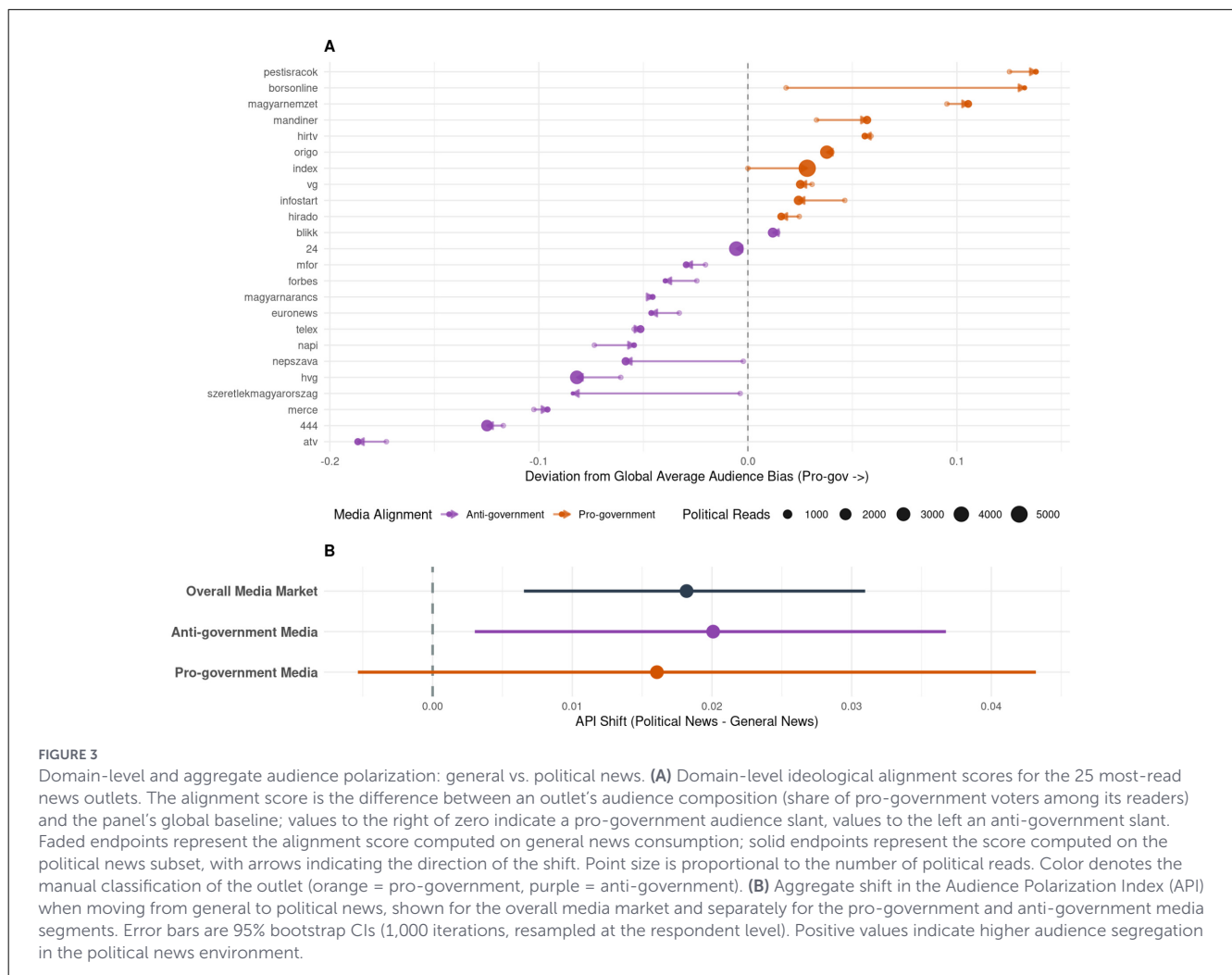


FIGURE 2

Daily political news share and event-driven attention shifts. **(A)** Daily share of political news within the news diet (visits to political news items / total visits to news domains) with a LOESS smoother (95% CI band). Red dots mark outlier days where $|\text{residual}| > 2.5 \times \text{SD}$ of all residuals over the observation period; outliers appear in both directions, reflecting days of unusually high and unusually low political focus within news consumption. Orange bands denote the active phases of elections; blue bands denote exogenous shocks (COVID-19, Russo-Ukrainian War). **(B)** Mean difference in the political news share between active and cooldown phases with 95% bootstrap CIs (1,000 iterations, resampled at the respondent level).

level of individual domains (Figure 3A) and in the aggregate market index (Figure 3B). For the overall media market, the bootstrapped mean difference between the political and general

news environments was 0.018, confirming that active political information seeking inherently embeds users in more segregated audience environments. However, this transition from general



to political news exhibits a notable partisan asymmetry. The intensification of audience segregation is statistically significant within the anti-government media segment, with a mean increase of 0.020. In contrast, while the shift for pro-government media is positive, it does not reach statistical significance at the 95% confidence level.

Turning to the episodic dynamics of audience segregation (H3), we examined the event-driven shifts in the polarization index during high-salience periods. Contrary to the expectation that political events inevitably deepen echo chambers, our bootstrapped event-shift analysis finds no evidence that active phases increase audience segregation (see Figure 4B). For explicitly political news, the point estimate of the aggregate shift across all high-salience events leans negative (−0.031), but the broad 95% confidence interval includes zero, so no directional effect can be established. The negative point estimates for both elections and exogenous shocks within the political news subset are likewise non-significant. We therefore find no evidence that high-salience periods increase structural segregation; given the limited power of these tests (see Section 4), this null is best read as an absence of a detectable event-driven increase rather than as positive evidence of stability. Despite the lack of significance in the aggregated event blocks, the

daily longitudinal data (Figure 4A) provides important contextual insights. The smoothed trend reveals a sharp, significant local minimum in polarization at the onset of the COVID-19 pandemic. Notably, however, this depolarization was ephemeral: as the initial uncertainty subsided, the polarization index rapidly reverted to its pre-existing structural baseline. To verify the reliability of these temporal dynamics, we conducted a robustness check restricted to a balanced panel of users with continuous data across all observed years (see Supplementary Figure S3). The results from this strictly longitudinal subset showed no significant deviation from the full dataset, indicating that the absence of a detectable event-driven increase, together with the transient COVID-onset dip, is not an artifact of compositional changes in the sample over time.

Finally, the longitudinal analysis of the API provides a critical methodological insight into the stability of the digital public sphere. While the daily metrics (see Figure 4) exhibited high volatility with no discernible long-term trend, the monthly aggregated data reveals a distinct, non-linear trajectory (see Figure 5). Because daily estimates rely on a much smaller volume of interactions and are correspondingly volatile, we evaluate the trend across both resolutions; at the

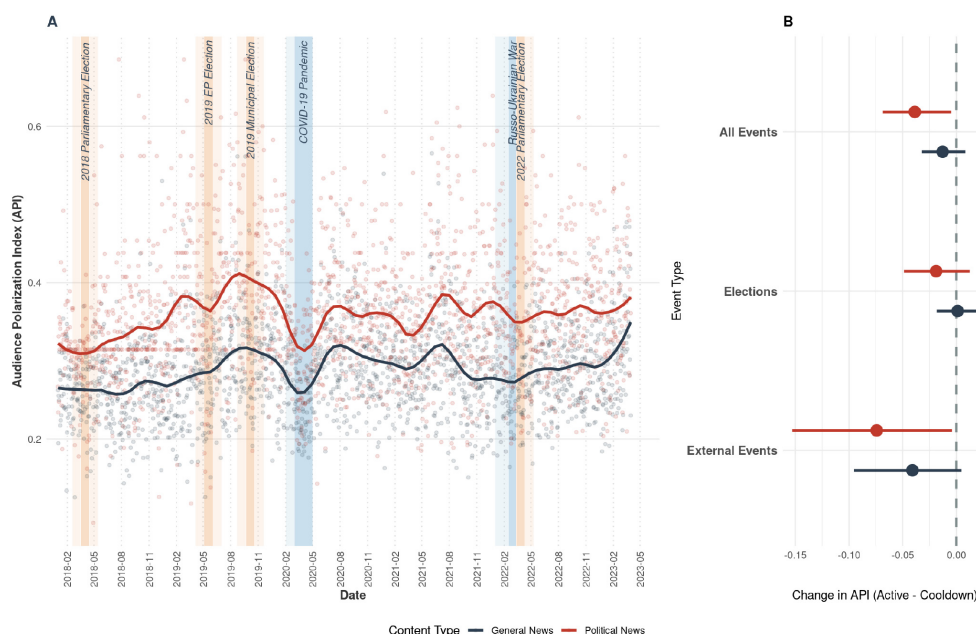


FIGURE 4

Dynamics of audience polarization over time and during events. **(A)** Daily Audience Polarization Index (API) over the 5-year observation period, computed separately for general news (dark blue) and political news (red). The API is the traffic-weighted mean absolute deviation of domain-level audience alignment scores from a fixed global baseline, defined as the mean ideological composition of the panel over the entire observation period. Solid lines are LOESS smoothers. Orange bands denote the active phases of elections; blue bands denote exogenous shocks (COVID-19, Russo-Ukrainian War). **(B)** Aggregate shift in the API between active and cooldown phases, shown separately for general news (dark blue) and political news (red) and disaggregated by event type. Error bars are 95% bootstrap CIs (1,000 iterations, resampled at the respondent level). Negative values indicate lower audience segregation during active event phases relative to the baseline cooldown periods.

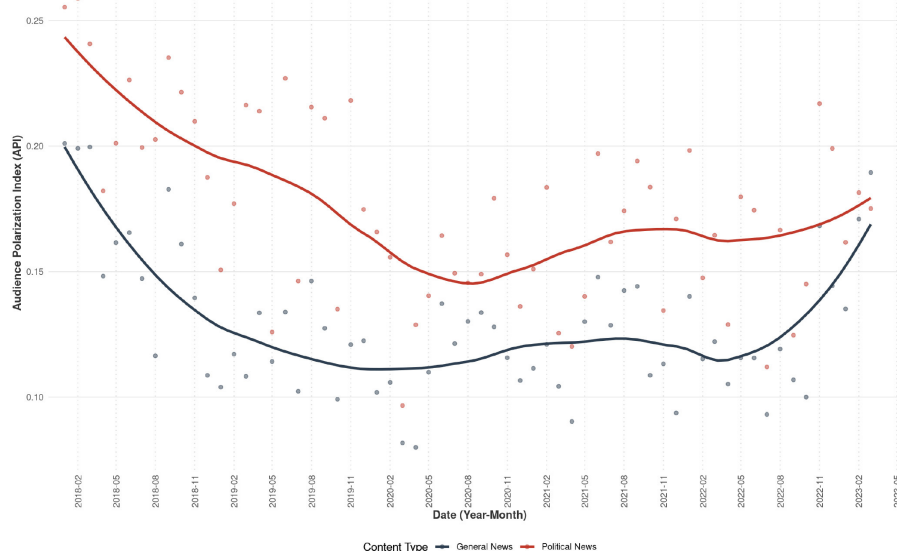


FIGURE 5

Monthly dynamics of audience polarization over time. Monthly aggregated Audience Polarization Index (API) over the 5-year observation period, computed separately for general news (dark blue) and political news (red). Each dot represents one calendar month; solid lines are LOESS smoothers fitted to the monthly series. The API is the traffic-weighted average of the absolute deviations of each news website's audience alignment score from a fixed global baseline, defined as the mean ideological composition of the panel over the entire observation period.

monthly resolution the index follows temporary, bounded fluctuations rather than a cumulative, runaway process, indicating that systemic isolation moves between bounded

historical phases rather than along a unidirectional, permanent path toward fragmentation. These macro-level dynamics support H4.

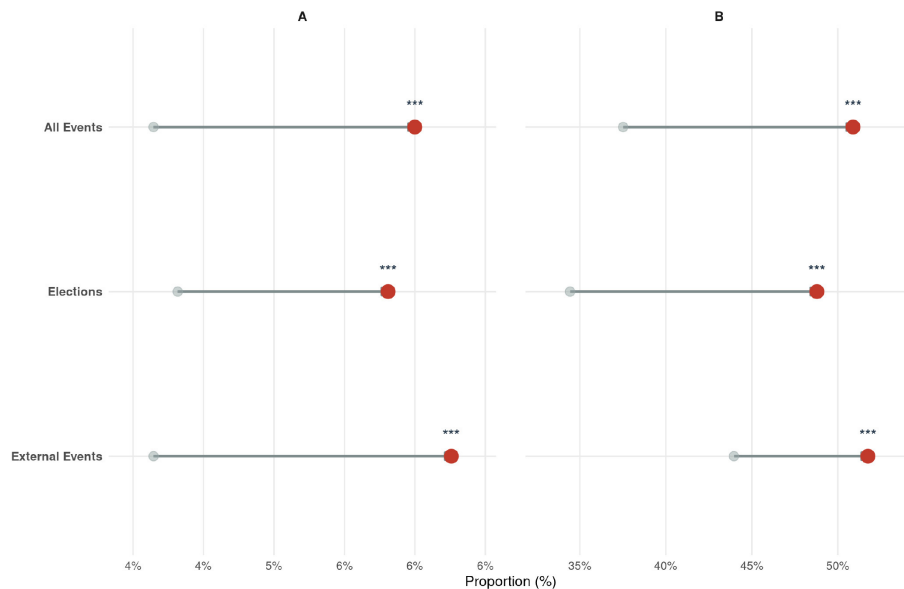


FIGURE 6

User-level attention shifts during high-salience events. Each row shows the mean of the individual-level proportions across respondents in the cooldown phase (faded gray) and the active phase (red), connected by a line; positive horizontal distance indicates higher attention during the active phase. (A) Share of news domain visits in each user's total web traffic. (B) Share of political content within each user's news diet. Significance levels from paired *t*-tests comparing within-user means between active and cooldown phases (****p* < 0.001).

5.2 User level

Shifting the analytical focus from systemic polarization to individual-level behavior, descriptive statistics highlight the generally marginal role of news within the broader content consumption. On average, news domains account for only 4 percent of users' total online content consumption. When calculated as an individual user-level average, explicitly political content accounts for only 28 percent of their news diet, compared to the 46.8% aggregate traffic volume identified at the macro level, highlighting that heavy political news consumption is highly concentrated among a smaller segment of highly active users. However, baseline engagement is heavily structured by partisan alignment. Unaligned or uncertain voters consume significantly less general news and allocate an even smaller fraction of their attention to political news compared to committed supporters of either the governing party (Fidesz-KDNP) or the opposition.

These low-intensity baselines are drastically disrupted by macro-sociological events (H2). As illustrated in Figure 6, high-salience periods lead to a marked increase in user attention. During active phases, driven by both institutional elections and exogenous shocks, users significantly expand the share of general news within their overall digital traffic (Figure 6A). The proportion of political content within overall news consumption also surges significantly during these high-salience periods (Figure 6B).

Beyond the sheer volume of attention, examining the ideological slant of users' news diets (H1) reveals that, while partisan differences exist, they do not translate into extreme echo chambers. As visually corroborated by the density distributions (see Figure 7), the majority of users across all political camps maintain a relatively mixed media diet that clusters around the neutral center (zero value). Extreme, highly isolated partisan diets remain

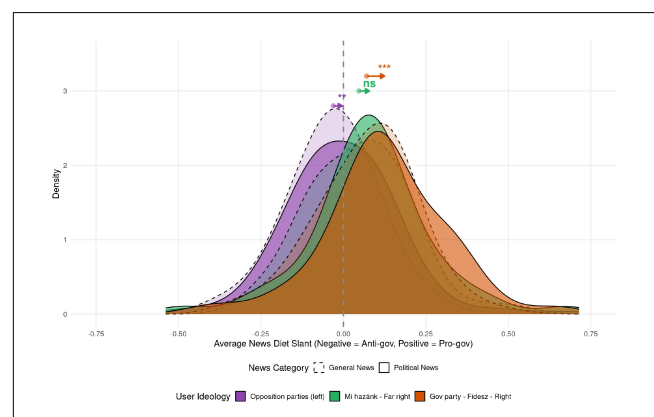


FIGURE 7

User-level shift in news diet slant from general to political news. User-level distribution of news diet slant by political preference group, computed separately for general news (dashed lines, faded fills) and the political news subset (solid lines, saturated fills). Each user's slant score is the within-individual mean of directional article scores (+1 for pro-government, -1 for opposition, 0 for neutral; far-right content is excluded from this measure). Negative values indicate an anti-government, positive values a pro-government media diet. Arrows show the shift in the group mean from general to political news consumption; significance levels are from paired *t*-tests (***p* < 0.01, ****p* < 0.001, ns, not significant). Unaligned/uncertain voters are omitted from the figure for visual clarity.

comparatively rare. Nevertheless, baseline ideological leanings are clearly discernible in general news consumption: opposition voters consume slightly more anti-government media (negative slant), whereas governing party (Fidesz-KDNP) supporters lean toward pro-government sources (positive slant).

Importantly, the transition from general news reading to political news consumption alters these consumption patterns.

For Fidesz-KDNP voters, the shift to political news triggers a highly significant shift further right, deeper into the pro-government media ecosystem. In contrast, opposition voters also exhibit a statistically significant shift to the right. Because their baseline is negative, moving toward the positive side brings their mean closer to the neutral zero value. Meanwhile, supporters of the radical-right Mi Hazánk party generally maintain a slightly pro-government-leaning diet, with their shifts between general and political news contexts remaining statistically non-significant.

To evaluate whether high-salience events increase these baseline divisions (H3), we analyzed phase-specific shifts in the ideological slant of users' news diets during active political events. As illustrated by the event-driven density distributions for both general news (see Figure 8) and political news (see Figure 9), the most striking finding is the structural resilience of individual consumption patterns. Contrary to the expectation that crises and campaigns trigger a flight to extremes, the vast majority of within-group shifts between cooldown and active phases are statistically non-significant across all event types. Where significant movement does occur, it predominantly points toward depolarization rather than polarization. For instance, during active phases, the political news diet of governing party (Fidesz-KDNP) supporters shifts significantly downward (-0.16 , $p < 0.05$), indicating a slight move away from the pro-government extreme toward the neutral center. Similarly, in the general news environment, opposition voters exhibit a significant positive shift (0.105 , $p < 0.05$) during exogenous shocks, effectively pulling their average slant closer to zero.

To rigorously test how individual-level news consumption changes in these periods of high political salience while controlling for unobserved time-invariant individual heterogeneity, we estimated a series of fixed-effects panel regressions predicting user-level news diet extremity (see Table 2). In the general news diet (Panel A), active phases produce no statistically significant shifts in extremity across any partisan group, confirming the stability observed in the density plots. Moreover, within the explicitly political news subset (Panel B), the models reveal a depolarizing tendency. Specifically, during exogenous exogenous shocks, ideological extremity significantly *decreases* among the opposition baseline (Coefficient = -0.073 , $p < 0.05$). While institutional elections produce a directional decrease across the board, it does not reach strict statistical significance. These panel models explain only a small share of within-person variance (within- R^2 between 0.008 and 0.033); our inference therefore rests on the absence of significant positive (polarizing) shifts rather than on the magnitude or fit of these coefficients, and the single marginally significant estimate ($p < 0.1$) should be treated as suggestive only.

6 Discussion

Our empirical findings regarding the marginality of digital news consumption contextualize the broader systemic debate on online echo chambers. We found that general news domains account for merely 4 percent of users' total online web traffic. This pattern aligns well with international observations utilizing automated

tracking methods, which consistently demonstrate that the absolute share of news consumption remains minor within individuals' broader online media repertoires (Flaxman et al., 2016; Guess, 2021). This low-intensity baseline exhibits a severe methodological and conceptual tension when moving to the political news subset. While on the macro level explicitly political content comprises 46.8 percent of aggregate news traffic, individual-level aggregation reveals that the specific political news ratio for the median user is only 28 percent. This substantial discrepancy underscores that intense digital engagement with political public affairs is not a widespread societal practice but rather highly concentrated among a small, hyperactive segment of the online population (Prior, 2013).

When narrowing our analytical lens from aggregate dietary volume to explicit source selection, our findings yield support for our first hypothesis (H1), demonstrating that ideological segregation increases when users transition from general news to specifically political public affairs content. However, it is crucial to emphasize that this sorting mechanism is far from absolute or dramatically strong. We captured this intensification structurally by cross-tabulating self-reported political preferences with domain-level exposure, where the behavioral association, as measured by Cramer's V, strengthens only modestly when users move from the general news diet to the political news subset (see Section 5). This nuanced alignment indicates that while partisan commitment functions as a primary psychological selection mechanism when the informational context carries high-stakes political relevance, the absolute magnitude of this ideological sorting remains weak. This behavior is structurally reflected in our domain-level metrics, as the computed Audience Polarization Index (API) shows a statistically significant but highly bounded shift toward higher segregation values within the political news environment. This stability aligns with contemporary computational communication research indicating that despite platform-specific concerns or stark experimental divides (Iyengar and Hahn, 2009; Stroud, 2010), real-world online news consumption is heavily characterized by moderation, with systemic echo chambers and hermetic filtering being largely overstated in everyday browsing practices (Garrett, 2009; Messing and Westwood, 2014; Guess, 2021; Bruns, 2017).

Our results reveal a micro-macro decoupling in how audience segregation and individual media slant manifest during the transition from general to political news. At the domain level, the intensification of audience segregation is significant only within the anti-government media segment, while pro-government domains remain stable; at the user level, individual slant shifts uniformly rightward, with governing-party supporters moving deeper into pro-government content and opposition voters moving from their negative baseline toward the neutral center.

We read this joint pattern as most consistent with a compositional account: when opposition voters turn to explicit political content, they are structurally drawn toward the high-reach pro-government and neutral mainstream hubs that dominate public affairs coverage, leaving anti-government outlets with a comparatively more concentrated, committed-opposition audience, while the centralized pro-government block absorbs this cross-cutting traffic and its composition remains mixed (Mangold et al., 2024). We treat this as a hypothesis-generating interpretation rather than a demonstrated mechanism. The same

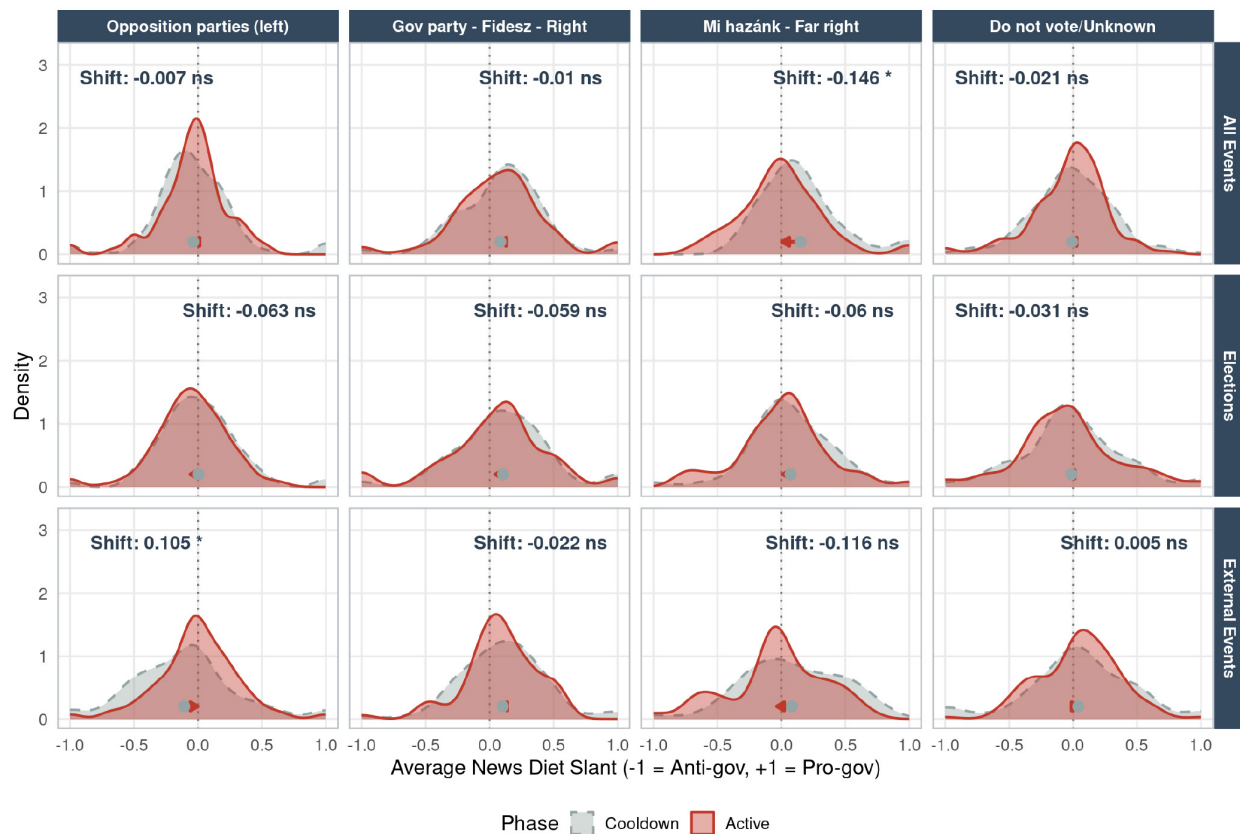


FIGURE 8

Event-driven shifts in general news slant by political preference group. Each panel shows the kernel density of users' average slant scores (within-individual mean of directional article scores: +1 for pro-government, -1 for opposition, 0 for neutral; far-right content excluded) computed separately for the cooldown phase (gray dashed, faded fill) and the active phase (red solid). Columns denote party preference groups; rows denote event types (all events combined, elections only, exogenous shocks only). The annotated "Shift" value reports the active-cooldown difference in group means; arrows indicate the direction of the shift. Significance levels are from paired *t*-tests within respondents who have observations in both phases (**p* < 0.05, ns, not significant).

aggregate signature could arise either from a dynamic sorting process, in which moderate or unaligned readers withdraw from niche opposition outlets once content becomes explicitly political (Prior, 2013; Skovsgaard et al., 2016), or from baseline compositional differences in who reads anti-government political content; distinguishing the two would require finer within-domain audience-turnover data and greater statistical power than retrospective donation traces currently afford. The decoupling nonetheless underscores the value of reading individual-level traces alongside aggregate domain-level indicators when mapping asymmetric polarization.

Beyond the institutional cross-sectional asymmetries, our 5-year individual-level digital trace data provides critical insights into the temporal dynamics of online news environments, allowing us to evaluate whether audience isolation follows a cumulative trajectory or fluctuates in response to external real-world shocks. Our bootstrap analysis yields robust support for our second hypothesis (H2), demonstrating that high-salience periods fundamentally expand the digital public sphere's informational volume. We found that the aggregate share of general news consumption expands by a statistically significant 1.92 percentage points during active phases compared to

baseline cooldown periods, a surge driven by both institutional election campaigns, which show a 1.3 percentage point increase, and exogenous shocks, which trigger a 2.4 percentage point expansion. This attention shift is accompanied by a pronounced political intensification of the news diet, as explicitly political content within the general news mix expands by 16.5 percentage points during active event windows, with extreme consumption residuals clustering around historically critical moments such as the March 2020 national lockdown in Hungary due to the outbreak of Covid-19. These findings confirm that during acute high-salience periods or societal crises, the psychological utility of information surges as citizens actively turn to digital traces to navigate systemic uncertainty (Zoizner et al., 2022).

However, contrary to hyperpartisan spiral theories predicting that campaigns and shocks inevitably deepen ideological silos (H3), our event-shift analysis finds no evidence that these high-salience periods exacerbate aggregate systemic polarization; if anything, the content-level point estimates lean toward temporary depolarization during active phases, though the aggregate event shifts do not reach significance. On the daily level, the longitudinal data reveals a sharp, significant local minimum in the polarization index at

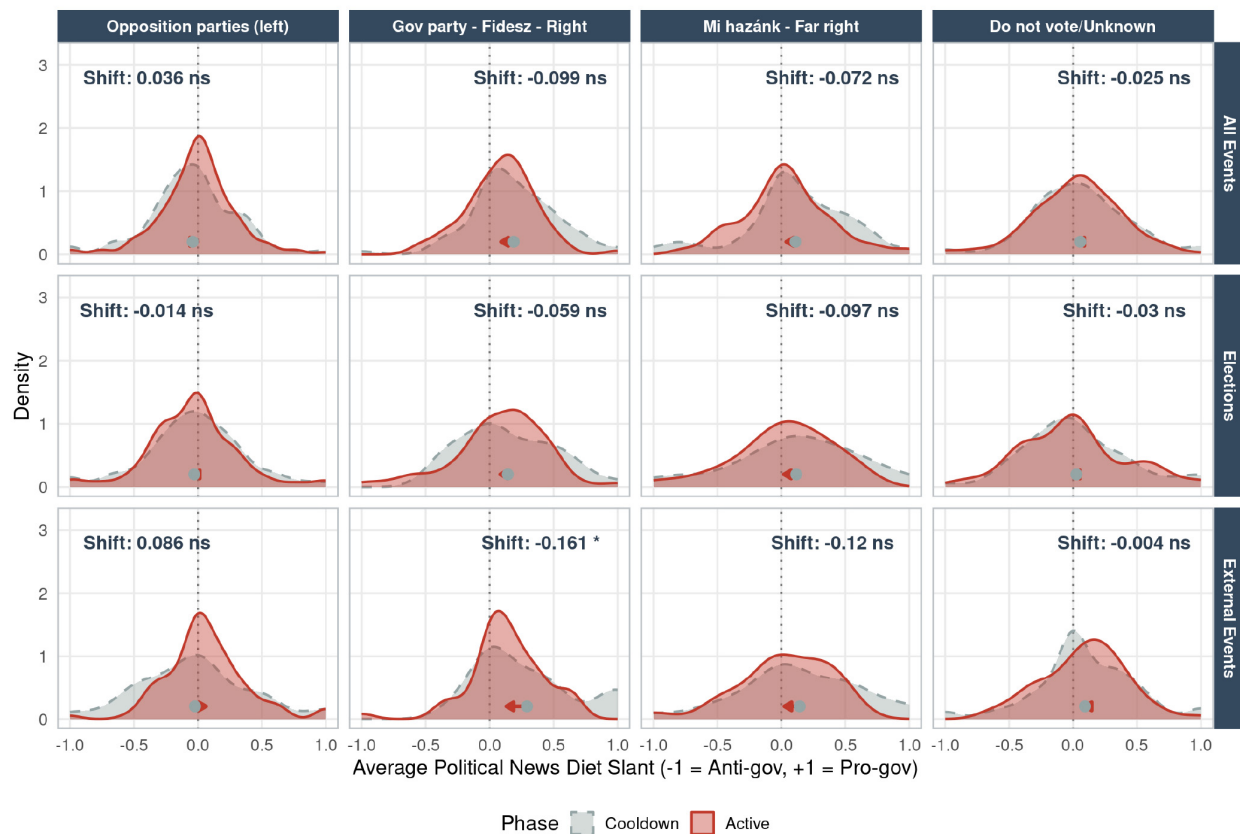


FIGURE 9

Event-driven shifts in political news slant by political preference group. Each panel shows the kernel density of users' average slant scores, computed within the political news subset (within-individual mean of directional article scores: +1 for pro-government, -1 for opposition, 0 for neutral; far-right content excluded), separately for the cooldown phase (gray dashed, faded fill) and the active phase (red solid). Columns denote party preference groups; rows denote event types (all events combined, elections only, exogenous shocks only). The annotated "Shift" value reports the active-cooldown difference in group means; arrows indicate the direction of the shift. Significance levels are from paired *t*-tests within respondents who have observations in both phases (**p* < 0.05, ns = not significant).

the immediate onset of the COVID-19 pandemic. This episodic depolarization is structurally illuminated by the information utility framework established in comparative European research, which demonstrates that acute health and economic anxieties over a sudden exogenous threat cause the pragmatic need for environmental surveillance, threat monitoring, and behavioral guidance to override traditional partisan selective avoidance (Zoizner et al., 2022). During the initial stages of such a crisis, highly concerned citizens consciously seek alternative viewpoints and diverse accounts of policy measures to handle the threat and reduce baseline uncertainty, shifting the general audience toward centralized, fact-based mainstream sources before the initial shock subsides and the index reverts to its pre-existing baseline (Zoizner et al., 2022). This temporary moderation is further corroborated at the individual level by our fixed-effects panel regression, which shows that during exogenous shocks, absolute ideological extremity significantly contracts among the opposition baseline (see Section 5). This pattern suggests that real-world crises can temporarily decouple online news selections from underlying affective polarization trends, and provides no support for the episodic polarization hypothesis, although the aggregate event nulls reflect an absence of detectable polarization

rather than positive proof of its absence (Wojcieszak et al., 2021).

Finally, our long-term temporal tracking supports our fourth hypothesis (H4), indicating that online audience segregation fluctuates within bounded parameters rather than following a unidirectional, runaway spiral toward fragmentation. While the daily alignment metrics exhibit substantial volatility with no discernible linear trend, our monthly aggregated calculations filter out this short-term informational noise to reveal a cyclical, non-linear trajectory. Systemic isolation moves between distinct historical phases, remaining structurally stable across the entire 5-year observation window. This macro-level equilibrium directly challenges deterministic filter bubble and echo chamber narratives (Pariser, 2011; Sunstein, 2017), fitting instead within the boundary conditions of the reinforcing spirals framework, which posits that institutional environments, cross-cutting intermediaries, and shared mainstream media experiences limit total divergence and sustain a common informational baseline over time (Slater, 2007; Guess, 2021; Muise et al., 2022).

While our longitudinal data donation framework offers unprecedented advantages for tracking long-term individual-level dynamics retrospectively, we must acknowledge several

TABLE 2 Fixed-effects panel regressions: impact of events on ideological extremity.

Predictors	Dependent variable: extremity		
	M1: all events	M2: elections	M3: exogenous shocks
Panel A: General news			
Active phase (Opp. baseline)	–0.022	–0.012	–0.024
	(0.021)	(0.024)	(0.026)
Active × unknown/other	–0.009	0.015	0.015
	(0.030)	(0.035)	(0.037)
Active × Fidesz	0.048	0.027	0.013
	(0.034)	(0.040)	(0.043)
Active × Mi Hazánk	0.019	0.019	–0.016
	(0.043)	(0.051)	(0.053)
Observations	1,010	870	792
Within R ²	0.008	0.001	0.005
Panel B: Political news			
Active phase (Opp. baseline)	–0.045 ⁺	–0.036	–0.073*
	(0.025)	(0.033)	(0.033)
Active × unknown/other	0.012	0.040	0.090 ⁺
	(0.036)	(0.051)	(0.051)
Active × Fidesz	0.010	0.017	0.020
	(0.043)	(0.060)	(0.057)
Active × Mi Hazánk	–0.027	–0.064	–0.041
	(0.053)	(0.078)	(0.074)
Observations	816	630	554
Within R ²	0.020	0.011	0.033
User fixed effects	Yes	Yes	Yes

Standard errors in parentheses. Baseline category for events: Cooldown.

Baseline category for interactions: Opposition voters.

⁺ $p < 0.1$, * $p < 0.05$.

methodological limitations inherent to this emerging data collection mode (Boeschoten et al., 2022; Breuer et al., 2023). First, our participants were recruited from a non-probability online panel that systematically overrepresents urban and highly educated respondents relative to the national average. Although we applied individual raking weights to align the sample with the active internet user population across key socio-demographic dimensions, the absolute generalizability of our findings remains constrained. This sampling bias is compounded by a low completion rate of 16 percent among those who initiated the donation process, suggesting that data donors may systematically differ from average web users regarding technical literacy, privacy concerns, or institutional trust in scientific research. Furthermore, because the technical protocol accepted uploads if any requested archive was present, we face missing browsing history data for 21 percent of our participants who chose to share only location or YouTube packages. This specific missingness is positively correlated with secondary or higher education levels, creating an observed educational gap that could introduce systematic selection bias into our behavioral indicators.

Second, although the Google My Activity log is recorded at the account level and thus captures cross-device browsing, including a substantial volume of mobile traffic (see Section 4.1), our observation window is bounded to activity that Google associates with a signed-in account. Browsing conducted while signed out or with the setting disabled, through browsers or in-app webviews not linked to the Google account, in incognito sessions, or within native mobile applications is not captured. Because a considerable share of news consumption occurs within native and in-app environments, this coverage gap should be borne in mind when interpreting our estimates. Third, a critical interpretative challenge emerges from the severe temporal overlap in early 2022 between the outbreak of the Russo-Ukrainian War and the final, high-salience weeks of the 2022 Hungarian parliamentary election campaign. Although our delimitation strategy anchors the cooldown references of the two events to non-overlapping pre- and post-windows respectively (see Section 4.3 and Table 1), the informational environment during the active phases themselves cannot be cleanly disentangled: the war-related news surge and the election-related campaign content reached audiences simultaneously between mid-February and mid-March 2022. Consequently, the event-shift estimates pertaining to

this active phase reflect a joint shock to information consumption, and disentangling the independent contributions of the two events would require a research design with sharper temporal or experimental identification than retrospective trace data permits.

A further consideration concerns statistical power. Our sample size and the modest number of interactions within individual event windows afford limited power to detect small, event-driven shifts in polarization. Accordingly, the null event effects we report are best interpreted as the absence of a detectable increase in segregation rather than as positive evidence of perfect stability, and our stability claims rest primarily on the bounded long-term trajectory (H4) rather than on the individual event nulls.

Finally, our measurement strategy relies on survey-based, self-reported party preferences rather than purely behavioral tracking data, which aggregates a substantively heterogeneous group of unaligned or uncertain individuals into a single non-voter category. Relatedly, our continuous media slant index completely excludes explicitly far-right or conspiracy outlets, a programmatic choice that means the unique digital reading habits of radical-right voters are inherently underrepresented within this specific structural measure.

Despite these limitations, our study offers one of the first long-term, individual-level views of online news consumption based on retrospective digital trace data, showing that the data donation framework can extend behavioral observation windows well beyond the short windows that have constrained the field. Our findings suggest that the digital public sphere in a polarized European democracy is shaped less by runaway fragmentation than by a bounded equilibrium, in which stable browsing habits and mainstream attention dynamics continue to anchor a shared informational baseline even during acute high-salience periods. A particularly important next step is to extend this design to a multi-platform setting, as the divergent findings in the existing literature may partly reflect that polarization dynamics differ substantially across platforms, and only a combined view of browser-based and platform-specific behavior can reveal whether the equilibrium we observe holds across the broader digital media environment.

Data availability statement

The survey data and digital trace data supporting the findings of this study are archived in the Research Documentation Centre of the Centre for Social Sciences (TK KDK) under the title “Digital Data Collection through Data Donation”. Due to strict data protection regulations and privacy constraints, the raw digital trace data are entirely omitted from the repository and remain unavailable for direct public download. Researchers seeking access to the processed, anonymized, or aggregated versions of these digital indicators must directly contact the corresponding authors to establish a formal data-sharing agreement. Other documentation, including the survey questionnaires and general data sheets, is hosted under the persistent identifier doi: 10.17203/KDK629 and can be accessed via the repository URL (<https://openarchive.tk.mta.hu/629/>) following standard registration procedures.

Ethics statement

The data donation study was conducted with the IRB approval of the Centre for Social Sciences Ethical Board (1-FOIG/130-37/2022) and with the written informed consent of the participants.

Author contributions

ZK: Supervision, Formal analysis, Funding acquisition, Data curation, Writing – original draft, Conceptualization, Methodology, Visualization, Writing – review & editing. ÁS: Conceptualization, Writing – original draft. EB: Writing – original draft, Data curation, Conceptualization. BV: Methodology, Writing – original draft, Data curation. PP: Data curation, Conceptualization, Writing – original draft.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that Generative AI was used in the creation of this manuscript. The author(s) acknowledge the use of Claude (Sonnet 4.6 and Opus 4.7, Anthropic) for assistance with analysis code and figure production, Claude Opus 4.8 (Anthropic) for assistance with the revision process, and Gemini Flash 3.0 (Google) for assistance with language editing and structural revision of the manuscript. The author(s) reviewed and verified all AI-assisted outputs and take full responsibility for the final content.

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Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fpos.2026.1891045/full#supplementary-material>

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