The consequences of online partisan media

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What role do ideologically extreme media play in the polarization of society? Here, we report results from a pre-registered, randomized field experiment embedded in a nationally representative online panel survey (N = 1,037) in which participants were incentivized to change their browser default settings and social media following patterns, boosting the likelihood of encountering news with either a left-leaning (HuffPost) or right-leaning (Fox News) slant during the 2018 U.S. midterm election campaign. Data on $\approx 19m$ web visits by respondents indicate that resulting changes in news consumption habits persisted for at least eight weeks. While we find little evidence of a direct polarizing effect on opinions or affect, a large, durable decrease in overall media trust emerges among those exposed to Fox News within the first few weeks of the intervention (CACE: -0.55 SD; $p < 0.05$). These consequences appear to

broaden over the longer term: Nearly five months later, participants assigned to either partisan news source continue to have lower trust in the media writ large. We additionally find that HuffPost liberalized respondents' views on immigration policy during the campaign (CACE: 0.50 SD; $p < 0.05$), consistent with topic models demonstrating the outlet's emphasis on the humanitarian dimension of the issue during this period. The combination of experimentation and computational social science techniques helps shed light on the long-term corrosive consequences of exposure to partisan news as well as its ability to influence views on highly salient topics.

Introduction The internet is transforming society. One of the fundamental ways in which this is occurring is by dramatically increasing the availability of information. In removing barriers to access, some have debated whether the internet is a democratizing force that helps to level the playing field for underrepresented perspectives and social movements (*1, 2*). These dynamics have eroded the power of traditional gatekeepers to set the boundaries of debate, allowing a wider range of perspectives — but also rumors, misinformation, and biased accounts of reality — to flourish (*3–5*). These structural changes to the information environment have profound implications for understanding the ways people seek political information and their political behaviors. Scholars have debated the extent to which online news consumers exhibit a preference for politically congenial sources (*6–8*). This evidence on people's information consumption raises questions about its causal impact, especially among those frequently exposed to partisan sources of news.

Assessing the consequences of slanted news requires overcoming well-known challenges in the study of media effects. Previous studies have sought to address bias due to self-selection of news sources (*9*); the artificiality of forced-stimuli designs (*10–12*); and the unreliability of

traditional measures of media exposure (*13, 14*). Experimental research designs have focused on the relatively short-term impact of curated treatments such as individual news articles or TV clips in artificially controlled settings. For these reasons, consensus on the impact of media in a fragmented, polarized social media age remains elusive (*15*). We propose a perspective that views people's information environments through the lens of choice architecture (*16*): frictions, subtle design features, and default settings that structure people's online experience. In this view, small changes (or "nudges") could disproportionately affect information consumption habits that inform attitudes and opinions.

To that end, we designed a large, longitudinal online field experiment that subtly but naturalistically increased people's exposure to partisan news websites. Our choice of treatment is ecologically valid: Despite the importance of social media for agenda-setting (*17*) and public expression (*18*), more Americans continue to say that they get news from news websites or apps than social media sites (*19*). The intervention thus served as a nudge, boosting the likelihood that subjects encountered news framed with a partisan slant during their day-to-day web browsing experience, even if inadvertently. The powerful, sustained nature of the intervention and our ability to track participants with survey and behavioral data for up to several months provided the opportunity to test a wide range of hypotheses about the long-term impact of online partisan media.

Our first set of pre-registered hypotheses relates to the effects of partisan media exposure on people's attitudes and opinions. Research on persuasion and opinion change suggests that individuals take cues from the media — especially those that highlight co-partisan elite figures — when evaluating candidates and policy options (*20, 21*). Evidence is also accumulating that people are generally receptive to new information (*22, 23*), although the extent to which these shifts can be attributed to durable changes or top-of-the-head availability due to framing remains an open question (*24, 25*). We follow recent research in looking for shifts in policy opinions

across a range of issues (*26*). In addition, we test for effects on a range of outcomes based on findings in prior research, including recall of current news events (*27*), agenda-setting (*9*), affective polarization (*28*), and perceived polarization (*29*). For these and other outcomes, a minimal-effects interpretation of the evidence to date would lead to an expectation of negligible impact. At the same time, recent formulations of this tradition argue that salient issues may be an exception (*15, p. 725*). For this reason, we additionally pre-registered a hypothesis about attitudes toward immigration, which was the topic of contentious debate during the 2018 U.S. midterm election campaign, during which this study was fielded.

Second, we test hypotheses related to online and offline political behavior. A potential immediate consequence of increased exposure to partisan political coverage is changes to one's information diet, including possible lasting effects on media consumption habits. This expectation is consistent with viewing our intervention as a subtle "nudge" altering informational default options (*16*). Expanding beyond online media, it is possible that exposure to information could motivate people to behave differently on social media, either directly — by sharing links to viewed articles and posts — or indirectly, by altering the amount of posting activity (*3*). Ultimately, we are interested in the effect of partisan media on voting behavior, which has previously been tested in the realm of cable news (*30, 31*).

Third, we study the effect of partisan media on trust in the media generally. The long-term decline in trust and confidence in the mainstream press has been linked to numerous potential causes, most plausibly an increase in attacks from political elites and elected officials (*32*). Since this behavior is not symmetric across political parties in the United States, patterns of media trust have become polarized (*33*). The rise of blogs and social media have further enabled critiques of mainstream coverage; consistent with this, tendencies toward partisan selective exposure are related to a belief that the media is biased (*34*). There is now reason to believe that the conservative media ecosystem itself has become an independent source of criticism of

the mainstream media (*35, 36*). Perceptions of bias have a rich history in studies of exposure to media content (*37–39*). The well-known hostile media phenomenon was demonstrated in scenarios modeled on the broadcast era, with ostensibly neutral or balanced stimuli. Related dynamics have also been shown in response to partisan news shows (*40*). In both sets of studies, however, outcomes focus on subjects' attitudes toward the specific clips, shows, or hosts shown as treatments rather than the media writ large. Building on evidence of partisan criticism of the media overall and the effects of partisan media on trust toward specific sources or figures, it is reasonable to ask whether partisan media can reduce the general public's *overall* level of trust in the mainstream press. To our knowledge, this has not been the focus of prior experimental research.

Design To test these hypotheses, we worked with an online polling firm to field a nationally representative panel survey of Americans, which interviewed the same respondents seven times from July 2018 to April 2019 (see Fig. 1). These respondents were recruited from YouGov's Pulse panel, which unobtrusively collects anonymous web visit and mobile app use data from those who consent to install passive metering software. To maintain realism within the high-choice online environment of our subjects, we opted for an encouragement design (*41*). In the third wave of the survey, we randomly incentivized subsets of our sample to change the default homepage on their primary web browsers for one month. One-third of the sample was asked to set their homepage to Fox News (`foxnews.com`) and one-third to HuffPost (`huffingtonpost.com`), while the last third was assigned to a pure control group. The treatment encouragement was aimed at browsers on desktop computers or laptops. We additionally asked subjects in each treatment group to follow the source's associated Facebook page and subscribe to affiliated newsletters in order to maximize the strength of the intervention. We collected pre-treatment survey measures in the first three waves of the panel and post-treatment

outcomes beginning in Wave 4. The size of our final experimental sample (N = 1,037), a rich set of pre-treatment covariates, and repeated measures of our dependent variables allow for reasonably well-powered estimates: As we detail in the Supplementary Materials, the minimum detectable effect for most survey outcomes is small ($d < 0.10$). The web data collected from our panelists, comprising more than 19 million visits over a two-month period, allows us to create both pre- and post-treatment measures of news consumption as well as to measure treatment compliance more precisely than previous research. In addition to web visits, our digital trace data includes Twitter posts from respondents who agreed to share their usernames for research purposes.

Results We characterize the first stage of our treatments to verify that they increased real-world exposure to online partisan media as intended (Fig. 2). In the first 7 days post-encouragement, our web tracking data reveal that subjects assigned to the HuffPost treatment visited approximately one additional page on the site per day ($M = 1.04$; $p < 0.001$) and those assigned to the Fox News treatment visited between 3 to 4 additional pages on that site per day on average ($M = 3.58$; $p < 0.001$). Neither treatment detectably increased visits to the other site. Focusing on time spent on pages from each site reveals that the intensity of the corresponding treatments in the first week was significant: a mean increase of nearly 50 seconds per day on the HuffPost site ($M = 47.90$; $p < 0.001$) and more than two minutes per day on the Fox News site ($M = 126.15$; $p < 0.001$). The impact of treatment is still measurable in the eighth week, with an estimated average of 0.4 additional visits to HuffPost and 2.7 additional visits to Fox News per day due to the intervention. These results suggest that the Fox News treatment was inherently more powerful, although reassuringly the estimated share of compliers for each treatment is similar according to a pre-registered measure — approximately 29% among those

for whom we have digital trace data.[1] The "compliers" of our study — those who consumed Fox News or HuffPost if and only if encouraged to do so — tend to score higher on political interest than the rest of the sample. Reassuringly, there are no strong differences in ideology between compliers and the rest of the sample or between compliers of the two treatments. We explore the characteristics of compliers in more detail in the Supplementary Materials (Section 3.2).

The exogenous increase in partisan news exposure induced by the randomized encouragement led to additional changes in subjects' news diets in the weeks after the intervention. Both treatments led to an increase in overall news consumption in the first week, and while we could not detect an increase in visits to conservative news sites other than Fox News as a result of that treatment, HuffPost had a lasting effect on visits to other liberal news sites (Fig. 3, left panel). Second, both treatments immediately increased subjects' ability to recognize recent events in the news (Fig. 3, right panel).

Turning to less proximate outcomes, we uncover results that in some ways provide support for a minimalist view of media impact. Despite having enough power to detect small effects (see the Supplementary Materials), we do not find measurable impact on many attitudes and behaviors (Fig. 3, right panel). We are able to rule out modest effects of either treatment on an index of issue positions and self-reported vote turnout intentions. We also cannot reject the null hypothesis that exposure to either treatment shifted people's feelings toward the parties. In the Supplemental Materials, we report additional results indicating few meaningful shifts in survey-based outcomes such as agenda-setting and perceptions of polarization as well as behavioral outcomes such as social media activity (following news sources and sharing links on Twitter).

[1] We also recorded clicks on the email newsletter subscription links shown to respondents assigned to either treatment group. Compliance by this measure was high (76% in the Fox News group and 78% in the HuffPost group), although we could not verify the extent to which clicks led to actual sign-ups.

But on two key outcomes, we uncover intriguing findings that suggest underappreciated pathways of influence. First, we produce compelling evidence that Fox News online meaningfully caused among our subjects a decrease in overall trust and confidence in the mainstream media within the first several weeks of boosted exposure (CACE: -0.55 SD; $p < 0.05$). Over the longer term, we find a lasting effect not only for Fox News (CACE: -0.519 SD; $p < 0.05$) but for HuffPost as well (CACE: -0.628 SD; $p < 0.05$): Remarkably, decreased media trust as a result of increased consumption of both partisan news sources persists at least *five months* after the intervention (in Wave 7), with little decay. Though we did not specifically pre-register analyses beyond Wave 5, this strongly suggests that our results are not likely due to demand effects or other survey artifacts. To our knowledge, we have provided the first real-world causal evidence of a potentially corrosive mechanism underlying the secular decline in media trust in the United States.

Additionally, we detect a liberalizing effect on attitudes toward immigration policy caused by HuffPost — but not by Fox News (CACE: 0.50 SD; $p < 0.05$). We find evidence that this effect persists for approximately two months after the intervention (in Wave 5) in our unadjusted estimates, but the results are not robust (see the Supplemental Materials, Section 5.1). Due to the issue's prominence in news coverage during the 2018 U.S. midterm election campaign, we chose ex ante to investigate effects of partisan media exposure on immigration attitudes specifically (in addition to a summary index of positions on a variety of issues). Our finding that HuffPost had an effect in the expected direction but Fox News did not was counter to expectations given the prominence of coverage on conservative outlets about the migrant caravan in the run-up to the election. To explore possible mechanisms underlying the effect, we ran structural topic models on the text of articles linked on each site's homepage in 2018. Immigration was indeed an intense focus of coverage at both outlets, but as Fig. 4 illustrates, the topic was framed in drastically different ways: At Fox News, stories centered around migrants and the

border, while HuffPost emphasized the humanitarian angle of the story, which may have been more persuasive.

Discussion In this article, we demonstrate a methodological framework for studying the effect of social media and the internet on individuals. By embedding a naturalistic encouragement in an online panel survey with linked digital trace data, our design achieves ecological validity without sacrificing internal validity (*42*). This approach does not come without costs: Our intervention was necessarily a bundle, although multiple survey waves allowed us to pre-register and test for different pathways of influence. We are further able to address the multidimensional nature of the treatments by scraping the content of webpages so that we can characterize the first stage of the treatment. And while our sample enables fairly precise estimates of main effects, we are generally not well-powered to test for subgroup effects (see Supplementary Materials for analyses of heterogeneous effects by party, ideology, and pre-treatment media consumption).

The longitudinal nature of our data enables us to study the cumulative effects of a relatively strong intervention: increased real-world exposure to either a left-leaning or right-leaning partisan news source. Encouraging people to alter their online information environments in this way seems to "work" on a basic level: it can move opinions on highly salient issues, at least temporarily, and increase awareness of recent political events. However, for most of the kinds of outcomes frequently studied by social scientists — such as voting behavior, agenda-setting, and affective polarization — we do not find strong evidence of influence. Despite the seismic technological, societal and political shifts of the past 75 years, this evidence is most consistent with a tradition of research on media's "minimal effects" arising out of the Second World War (*43*).

Our results on the long-term consequences of increased exposure to online partisan news for overall trust in the media point to a possible resolution of a major puzzle in research on

consumption of online news and its effects: Experiments have often found that exposure to partisan media content causes polarization, although whether this is driven by the inadvertent audience (*11*) or already polarized partisans (*26, 44*) remains the subject of debate. At the same time, fine-grained evidence on people's online news diets reveals that the actual consumption of partisan content is limited and that exposure to cross-cutting information is relatively common on the web and on social media (*3, 8, 45, 46*). If "echo chambers" are not as common as popular discourse suggests, then can online partisan media be to blame for polarization (*47*)? Our findings on lowered overall trust in mainstream media suggest an answer: Even if people are regularly exposed to content (partisan or not) that challenges them, they may more heavily discount it as their trust and confidence in news decreases. In this way, partisan media *can* help drive polarization — although not necessarily by influencing opinions directly, as the null effects on our index of issue positions indicates. This conclusion has mixed normative implications: It may be more difficult than ever for people to be swayed by potentially inflammatory partisan content encountered on the internet, but this may come at the cost of reduced trust in crucial informational intermediaries that work to sustain agreement on a shared set of facts and norms.

In a direct test of the power of defaults to structure the information environment, our primary "nudge" urged participants to set their browser homepages — an option they may not have been aware existed (*48*). As illustrated by our tracking data, this simple change had lasting impact on downstream web consumption, suggesting that a behavioral science perspective can usefully be applied to people's interactions with internet media. The intervention can be interpreted as boosting incidental exposure to partisan content in a way that might be comparable to seeing posts from weak ties on social media (e.g., retweets or reshares) that are more likely to be political and counter-attitudinal in nature. Taken together, our findings point to the conclusion that despite today's extremely high-choice media environment (*49*), frictions and "architectures of serendipity" (*47*) can still, at least in principle, allow for engagement with different perspectives

in the news.

Materials and Methods

Sampling and participants In partnership with the online survey firm YouGov, we initially recruited a total of 1,551 respondents from the Pulse panel, a subset of YouGov's traditional survey panels in which members opt in to install passive metering software on their desktop and mobile devices.

Respondents agreed to join a "Politics and Media" study with multiple survey waves. Their participation was rewarded using YouGov's proprietary points system and included a bonus for completing all waves in order to disincentivize attrition. Participation was voluntary and respondents were able to opt out from the passive metering part of the study at any time. Respondents were sampled according to YouGov's demographic/political targets then reweighted in order to obtain a sample that is representative of the U.S. population (*50*).

Specifically, respondents were weighted to a sampling frame constructed from the full 2016 American Community Survey (ACS) 1-year sample. The sample cases were weighted to the sampling frame using propensity scores. The weights were then post-stratified on 2016 presidential vote choice and a four-way stratification of gender, age (4 categories), race (4 categories), and education (4 categories) to produce the final weights.

Digital trace data The Pulse panel uses passive metering technology developed by Reality Mine which relies on a combination of proxy connections and browser plug-ins to collect real-time data on web visits and mobile app use. After pre-processing, we are left with 19,105,773 URL visits (laptop/desktop and mobile/tablet combined) covering the period September 1–October 28, 2018. Respondents provided informed consent and were given the ability to pause or halt data sharing at any time; see below for details on consent and privacy protec-

tions and (*5, 8*) for extensive validation. We also scraped homepages and article text from Fox News and HuffPost stories published in 2018 for the topic model presented in Fig. 4; see Supplementary Materials for details.

In addition to web data, we collected public Twitter data linked to respondents who agreed to share their profile information with the researchers via an approved authentication app. In addition to survey respondents' posted tweets, we periodically collected the friends (followees) and followers of participants' Twitter accounts during the study period.

Survey waves and treatment Figure 1 provides an overview of the data collection process. We conducted multiple survey waves: a baseline survey (Wave 1, July 3–22, 2018; $N = 1,551$), a survey with additional pre-treatment covariates (Wave 2, August 28–September 10, 2018; $N = 1,339$), another survey with pre-treatment covariates in which the treatments were administered (Wave 3, October 5–29, 2018; $N = 1,098$), and a post-treatment survey that contained our outcome measures and was fielded immediately prior to the midterm elections (Wave 4, October 30–November 5, 2018; $N = 1,197$). An additional wave was designed to test for persistence of effects (Wave 5, December 20, 2018–January 7, 2019; $N = 1,195$), and three more waves (not part of our pre-analysis plan) were fielded through October 2019.

In the first two waves of the survey, we asked a battery of questions about news media consumption, attitudes about domestic and foreign policy issues, turnout and vote choice, and presidential approval (Wave 1) as well as affective polarization, social distance, news reception, policy attitudes, and projected U.S. midterm election outcomes (Wave 2). Question wordings and response options for all survey items in all waves used in the study are available in the Supplemental Materials.

The treatment was deployed in Wave 3 starting on October 5, 2018. For the experiment, we administered a randomized encouragement: one third of the sample was asked to change

their browser homepage to a left-leaning news outlet (huffingtonpost.com); another third was asked to change it to a right-leaning news outlet (foxnews.com); and another third received no encouragement (control group).[2] The encouragement also asked respondents to follow the sites' corresponding Facebook page and sign up for related email newsletters. Selection of these news sites was not only based on the significance of Fox News and HuffPost in the current political environment but also based on empirical web-tracking data during the pre-treatment period.

Randomization was blocked by detected pre-treatment browser type (Chrome, Firefox, Safari, Internet Explorer, Edge, and a sixth category for others). Respondents received clear, tailored instructions for how to follow the encouragement and were compensated for doing so with a YouGov points reward equivalent of $8 (in addition to standard incentives for completing the surveys). Wave 3 also included a few questions related to other pre-treatment covariates: attitudes about domestic and foreign issues, most important problem, presidential feeling thermometer, Congress control preference after the midterms, and turnout intention.

Wave 4 was in the field from October 30 to November 5 (the day before the election). This wave was longer than Wave 3 and included a battery of outcome variables, such as attitudes about domestic and foreign issues, most important problem, political knowledge, political perceptions, affective polarization, presidential approval and vote intention/choice, racial resentment, threat perceptions, beliefs about the effects of trade, social media use, and media trust (including trust specifically in HuffPost and Fox News). For our primary analyses, we subset the sample to only those respondents who took part in Waves 3 and 4. This reduces our sample size to $N = 1,037$. Additional details about the surveys, including all question wordings and attrition, are available in the Supplemental Materials.

[2]See the Supplementary Materials for details on how we chose these sites and the full text of the encouragements.

Analysis We estimate average treatment effects using both weighted difference-in-means and saturated regressions (*51*). Both methods enable unbiased estimation of treatment effects given our blocked randomization procedure. For all regressions, we use a lasso procedure to select covariates.

To estimate the treatment effect among compliers, or the Complier Average Causal Effect (CACE), we also use an instrumental-variables framework (*52*). This requires a credible measure of treatment take-up, which we construct using web visit data in the week after subjects receive the encouragement. In the Supplementary Materials we specify our definition and coding rules for this variable, which we pre-registered given the many possible ways in which compliance could potentially be measured.

Consent and ethics Collecting passive behavioral data that can be linked to survey responses poses privacy and ethical challenges beyond those typically associated with traditional social science research methods (*53*). We join other researchers in striving to meet these challenges with robust procedures designed to ensure that informed consent is obtained, privacy is protected, and personally identifiable information is not stored or reported. For the data analyzed in this study, we followed a strict protocol informed by IRB guidance and emerging best practices (*54*). This study was approved by the Institutional Review Boards of Princeton University (protocols 8327, 10014, and 10041) and the University of Southern California (UP-17-00513) and authorized by the University of Illinois via a designated IRB agreement.

First, as with any survey research, respondents are anonymous to the researchers. While we do not ask for identifying information, it is possible that some subjects visited websites or made search queries that contain personal details (for example, by visiting one's own Facebook profile page). While we did not collect the content of these pages, the URLs themselves could

contain such information.[3] We handle this by keeping the raw web visit data stored securely in a strictly separate location from the survey data and by performing the primary analyses for the paper using only individual-level variables that are aggregated to the respondent level (as with counts or shares of visits). Only these aggregates will be released as replication data.

Second, sharing web visits with researchers is done with fully informed consent. People who join the Pulse panel are told about the nature of the data collected, that it is kept anonymous, and that data is not shared with third parties. They are also told that the software can be removed at any time or paused temporarily. When subjects join the Pulse panel, they are given a clear privacy policy that says, in part, that they agree to collection of information about their internet behavior and socio-demographic characteristics. Before joining this specific study, respondents additionally agreed to a separate consent statement informing them, "Your participation is voluntary. Participation involves completion of a short survey and voluntary tracking of online media consumption. You may choose not to answer any or all questions. Furthermore, you are free to opt out of web tracking, which you may have previously agreed to participate in as part of the YouGov Pulse panel, at any time."

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55. This research was generously funded by a grant from the Volkswagen Foundation Computational Social Science Initiative, reference 92 143. The experiment was additionally supported by the Princeton University Committee on Research in the Humanities and Social Sciences. We thank Jona Ronen and Will Schulz for excellent research assistance. Many

thanks to workshop attendees at Rutgers University, the Hertie School, University of Frankfurt, University of Konstanz, UCLA, and Stanford University; participants at the 4th Economics of Media Bias Workshop in Berlin and the Michigan Symposium on Media and Politics; and Brandice Canes-Wrone, Matthew Gentzkow, Nathan Kalmoe, Kevin Munger, Anselm Hager, Mark Kayser, Bernhard Wessels, and Fabrizio Gilardi for helpful feedback. Pre-analysis plan available at `http://egap.org/registration/5311`.

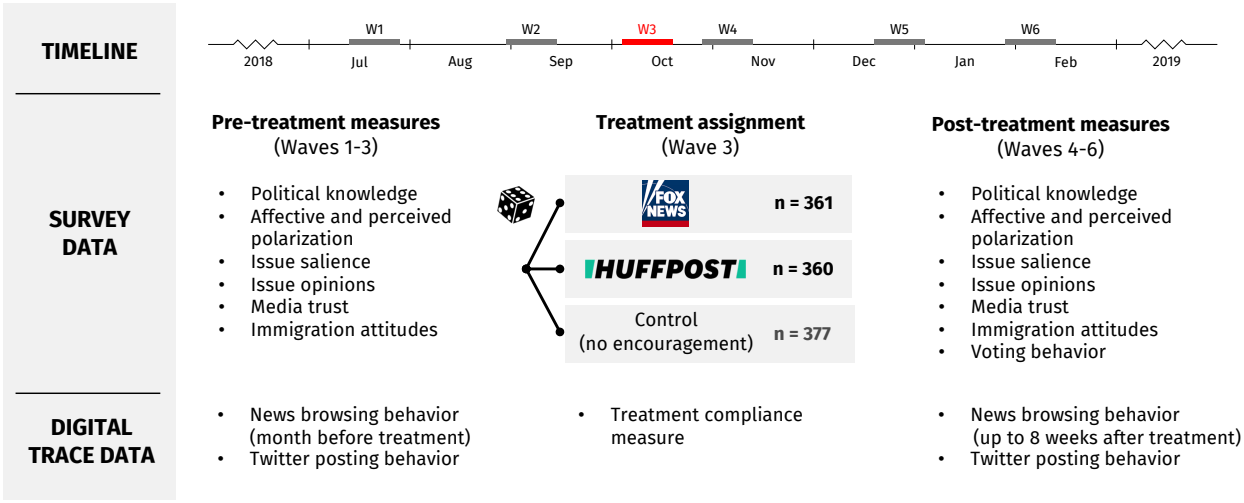

Figure 1: Overview of study design. Subjects in Wave 3 who were randomly assigned to the Fox News or HuffPost encouragement groups were offered $8 in YouGov incentives to participate in the treatment.

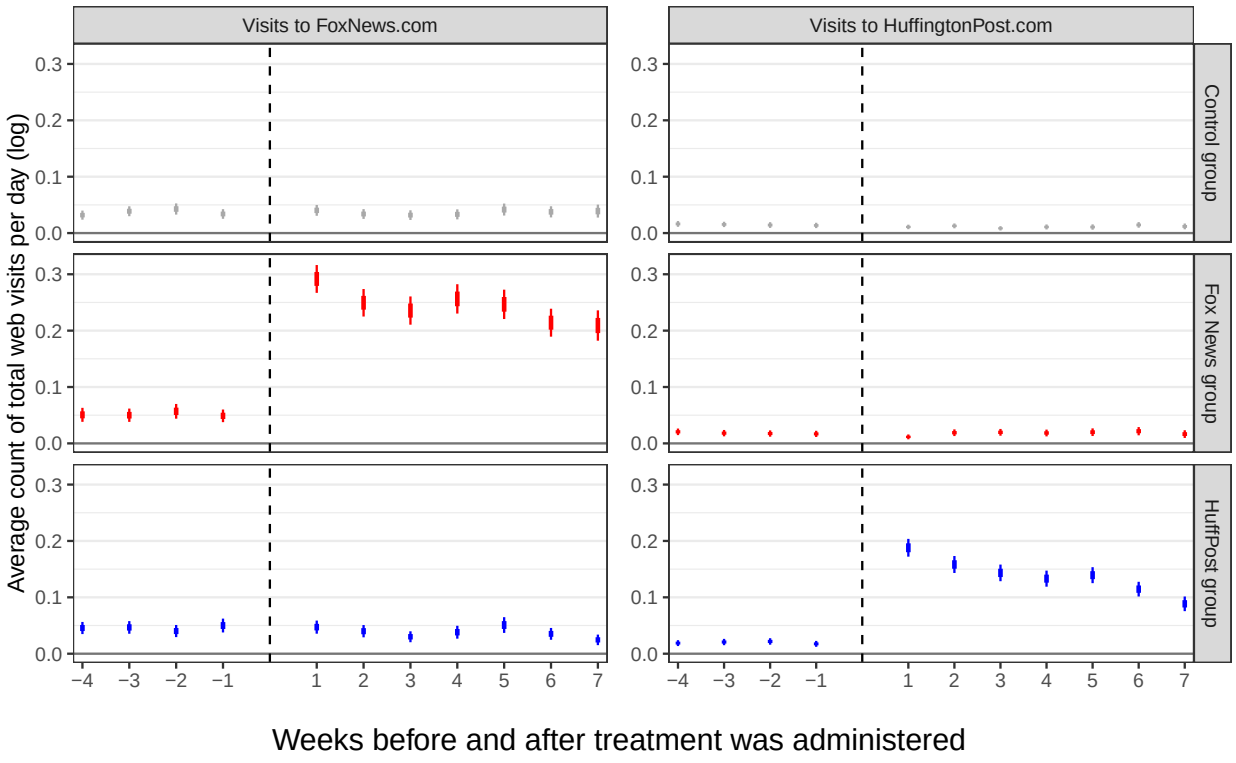

Figure 2: Weekly average logged number of visits to `foxnews.com` (left panel) and `huffingtonpost.com` (right panel) by treatment assignment, with 68% (thick lines) and 95% (thin lines) confidence intervals. Behavioral data from YouGov Pulse panelists.

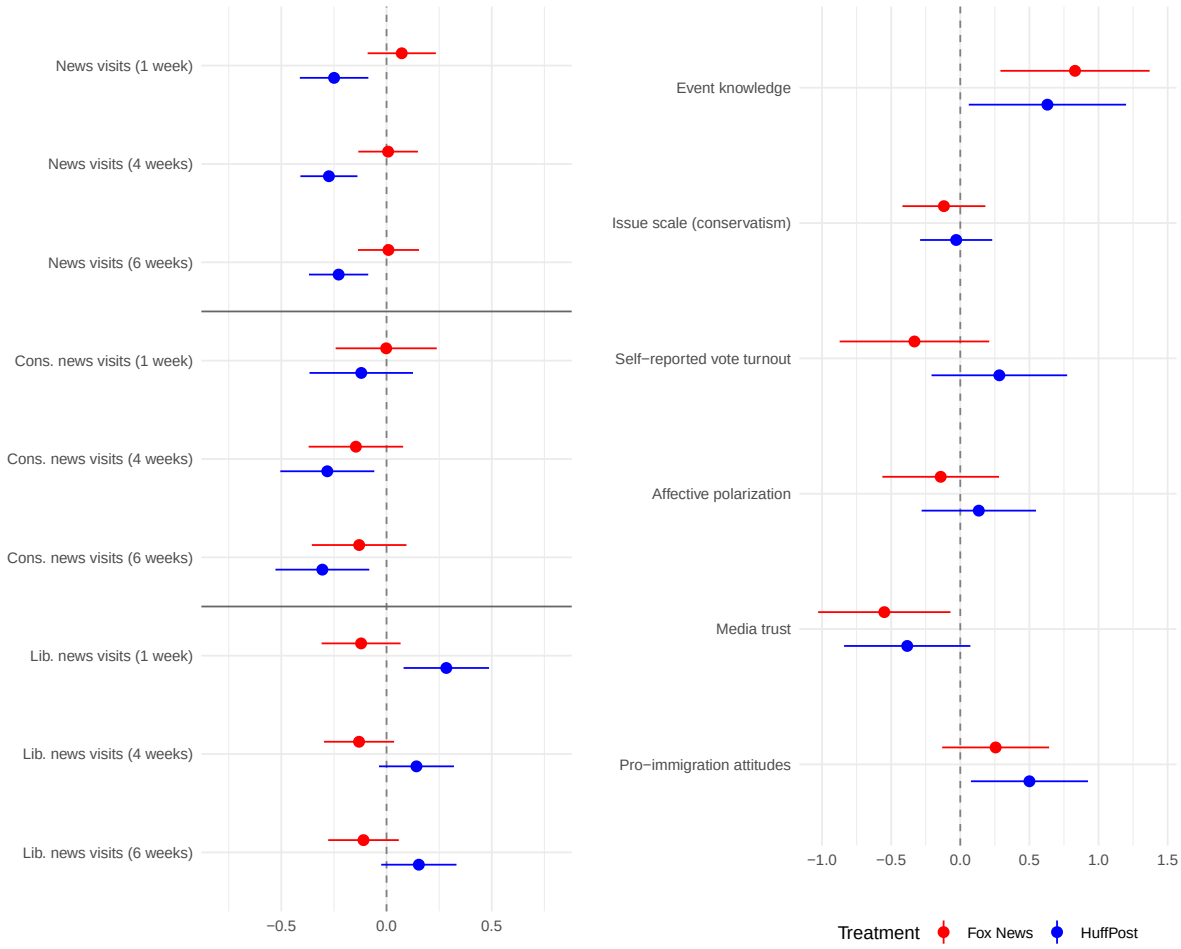

Figure 3: Summary of effects (with 95% confidence intervals) on political knowledge, attitudes, and behaviors. Left panel: Coefficients represent effect of treatment assignment on logged number of news visits over given time period post-intervention. Each visit type (hard news, conservative news, liberal news) excludes visits to both `foxnews.com` and `huffingtonpost.com`. Models are fully saturated OLS regressions with indicator variables for browser using pre-registered LASSO covariate selection procedure. Right panel: Standardized coefficients represent CACE estimates from two-stage least squares models in which treatment receipt, measured using web visit data, is instrumented with treatment assignment.

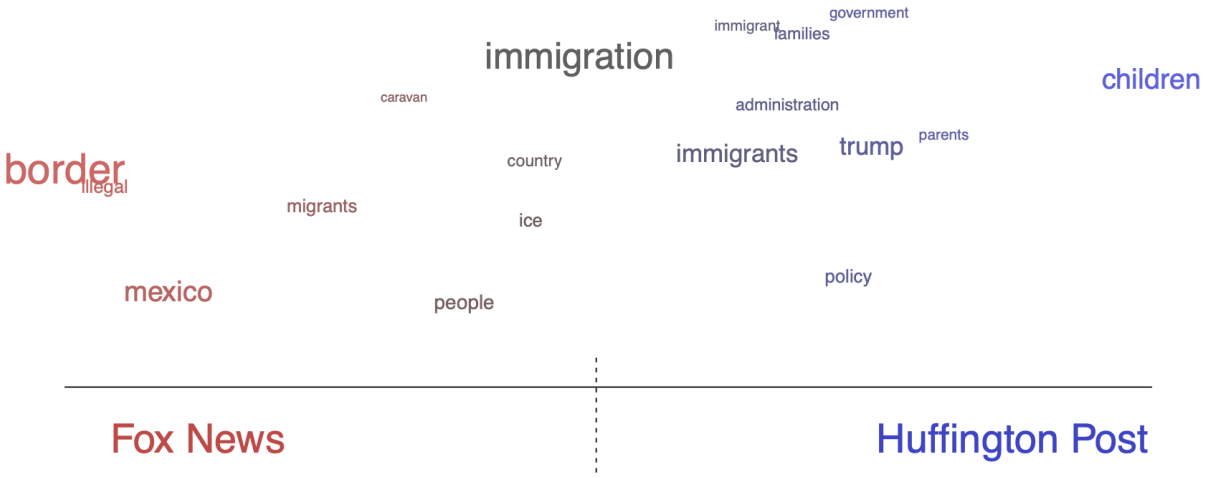

Figure 4: Differences in word use between Fox News and HuffPost within the immigration-related topic identified by a structural topic model (spectral initialization, $K = 56$) on the text of 116,841 articles from 2018. Term size is proportional to overall frequency of use in the immigration topic, and horizontal placement corresponds to terms' association with either source. Vertical placement is random.