Exposure to ideologically diverse news and opinion on Facebook

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Exposure to news, opinion and civic information increasingly occurs through social media. How do these online networks influence exposure to perspectives that cut across ideological lines? Using de-identified data, we examined how 10.1 million U.S. Facebook users interact with socially shared news. We directly measured ideological homophily in friend networks, and examine the extent to which heterogeneous friends could potentially expose individuals to cross-cutting content. We then quantified the extent to which individuals encounter comparatively more or less diverse content while interacting via Facebook's algorithmically ranked News Feed, and further studied users' choices to click through to ideologically discordant content. Compared to algorithmic ranking, individuals' choices about what to consume had a stronger effect limiting exposure to cross-cutting content.

Exposure to news and civic information is increasingly mediated by online social networks and personalization (*1*). Information abundance provides individuals with an unprecedented number of options, shifting the function of curating content from newsroom editorial boards to individuals, their social networks, and manual or algorithmic information sorting (*2–4*). While these technologies have the potential to expose individuals to more diverse viewpoints (*4, 5*), they also have the potential to limit exposure to attitude-challenging information (*2, 3, 6*), which is associated with adopting more extreme attitudes over time (*7*) and misperceiving facts about current events (*8*). This changing environment has led to speculation around the creation of "echo chambers" (in which individuals are exposed only to information from like-minded individuals) and "filter bubbles"(in which content is selected by algorithms based on a viewer's previous behaviors), which are devoid of attitude-challenging content (*3, 9*). Empirical attempts to examine these questions have been limited by difficulties in measuring news stories' ideological leanings (*10*) and measuring exposure—relying on either error-laden, retrospective self-reports or behavioral data with limited generalizability—and have yielded mixed results (*4, 9, 11–15*).

We utilize a large, comprehensive dataset from Facebook that allows us to (i) compare the ideological diversity of the broad set of news and opinion shared on Facebook with that shared by individuals' friend networks, (ii) compare this to the subset of stories that appear in individuals' algorithmically-ranked News Feeds, and (iii) observe what information individuals choose to consume, given exposure on News Feed. To examine how each of the three mechanisms affect exposure (i.e., homophily, algorithmic ranking, selective avoidance of attitude-challenging items), we constructed a de-identified dataset that includes 10.1 million active U.S. users who self-report their ideological affiliation and 7 million distinct Web links (URLs) shared by U.S. users over a 6-month period between July 7, 2014 and January 7, 2015. We classified stories as either "hard" (e.g., national news, politics, world affairs), or "soft" content (e.g., sports, entertainment, travel) by training a support vector machine on unigram, bigram, and trigram text features (see Sec S1.4.1 for details). Approximately 13% of these URLs were classified as hard content. We further limit the set of hard news URLs to the 226 thousand distinct hard content URLs shared by at least 20 users who volunteer their ideological affiliation in their profile, so that we can accurately measure alignment, as detailed below. This dataset included approximately 3.8 billion unique potential exposures (i.e., cases in which an individual's friend shared hard content, regardless of whether it appeared in her News Feed), 903 million unique exposures (i.e., cases in which a link to the content appears on screen in an individual's News Feed), and 59 million unique clicks, among users in our study.

We then obtain a measure of *content alignment (A)* for each hard story by averaging the ideological affiliation of each user who shared the article. Alignment is not a measure of media slant, rather it captures differences in the kind of content shared among a set of partisans, which can include topic matter, framing, and slant. These scores, averaged over websites, capture key differences in well-known ideologically-aligned media sources: *FoxNews.com* is aligned with conservatives (A_s = +.80), while the *HuffingtonPost.com* is aligned with liberals (A_s = -.65, for additional detail and validation, see Sec S1.4.2). We observed substantial polarization among hard content shared by users, with the most frequently shared links clearly aligned with largely liberal or conservative populations (Fig. 1).

The flow of information on Facebook is structured by how individuals are connected in the network. The interpersonal networks on Facebook are different from the segregated structure of political blogs (*16*): while there is clustering according to political affiliation on Facebook,

there are also many friendships that cut across ideological affiliations. Among friendships with individuals who report their ideological affiliation in their profile, the median proportion of friendships liberals maintain with conservatives is 0.20, interquartile range (IQR) [0.09, 0.36]. Similarly, the median proportion of friendships that conservatives maintain with liberals is 0.18, IQR [0.09, 0.30] (Fig. 2).

How much cross-cutting content individuals encounter depends on who their friends are and what information those friends share. If individuals acquired information from random others, approximately 45% of the hard content liberals would be exposed to would be cross cutting, compared to 40% for conservatives (Fig. 3B). Of course, individuals do not encounter information at random in offline environments (14) nor on the Internet (9). Despite the slightly higher volume of conservatively aligned articles shared (Fig. 1), liberals tend to be connected to fewer friends who share information from the other side, compared to their conservative counterparts: 24% of the hard content shared by liberals' friends are cross-cutting, compared to 35% for conservatives (Fig. 3B).

The media that individuals consume on Facebook depends not only on what their friends share, but also on how the News Feed ranking algorithm sorts these articles, and what individuals choose to read (Fig. 3A). The order in which users see stories in the News Feed depends on many factors, including how often the viewer visits Facebook, how much they interact with certain friends, and how often users have clicked on links to certain websites in News Feed in the past. We find that after ranking, there is on average slightly less cross-cutting content: conservatives see approximately 5% less cross-cutting content compared to what friends share, while liberals see about 8% less ideologically diverse content.

Individual choice has a larger role in limiting exposure to ideologically cross cutting content: after adjusting for the effect of position (the click rate on a link is negatively correlated with its position in the News Feed; see fig. S5), we estimate the factor decrease in the likelihood that an individual clicks on a cross-cutting article relative to the proportion available in News Feed to be 17% for conservatives and 6% for liberals, a pattern consistent with prior research (4, 17). Despite these tendencies, there is substantial room for individuals to consume more media from the other side: on average, viewers clicked on 7% of hard content available in their feeds.

Our analysis has limitations. Though the vast majority of U.S. social media users are on Facebook (18), our study is limited to this social media platform. Facebook's users tend to be younger, more educated, and female, compared to the U.S. population as a whole (18). Other forms of social media, such as blogs or Twitter, have been shown to exhibit different patterns of homophily among politically interested users, largely because ties tend to form based primarily upon common topical interests and/or specific content (16, 19),

whereas Facebook ties primarily reflect many different offline social contexts: school, family, social activities, and work, which have been found to be fertile ground for fostering cross-cutting social ties (20). In addition, our distinction between exposure and consumption is imperfect: individuals may read the summaries of articles that appear in the News Feed, and therefore be exposed to some of the articles' content without clicking through.

This work informs longstanding questions about how media exposure is shaped by our social networks. While partisans tend to maintain relationships with like-minded contacts (consistent with (21)), on average more than 20 percent of an individual's Facebook friends who report an ideological affiliation are from the opposing party, leaving substantial room for exposure to opposing viewpoints (22, 23). Furthermore, in contrast to concerns that people might "listen and speak only to the like-minded" while online (6), we find exposure to cross-cutting content (Fig. 3B) along a hypothesized route—traditional media shared in social media (4). Perhaps unsurprisingly, we show that the composition of our social networks is the most important factor limiting the mix of content encountered in social media. The way that sharing occurs within these networks is not symmetric—liberals tend to be connected to fewer friends who share conservative content than conservatives (who tend to be linked to more friends who share liberal content).

Finally, we conclusively establish that on average in the context of Facebook, individual choices (2, 13, 15, 17) more than algorithms (3, 9) limit exposure to attitude-challenging content. Despite the differences in what individuals consume across ideological lines, our work suggests that individuals are exposed to more cross-cutting discourse in social media they would be under the digital reality envisioned by some (2, 6). Rather than people browsing only ideologically aligned news sources or opting out of hard news altogether, our work shows that social media exposes individuals to at least some ideologically cross-cutting viewpoints (4). Of course, we do not pass judgment on the normative value of cross-cutting exposure—though normative scholars often argue that exposure to a diverse "marketplace of ideas" is key to a healthy democracy (25), a number of studies find that exposure to cross-cutting viewpoints is associated with lower levels of political participation (22, 26, 27). Regardless, our work suggests that the power to expose oneself to perspectives from the other side in social media lies first and foremost with individuals.

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SUPPLEMENTARY MATERIALS

www.sciencemag.org/cgi/content/full/science.aaa1160/DC1
Materials and Methods
Supplementary Text
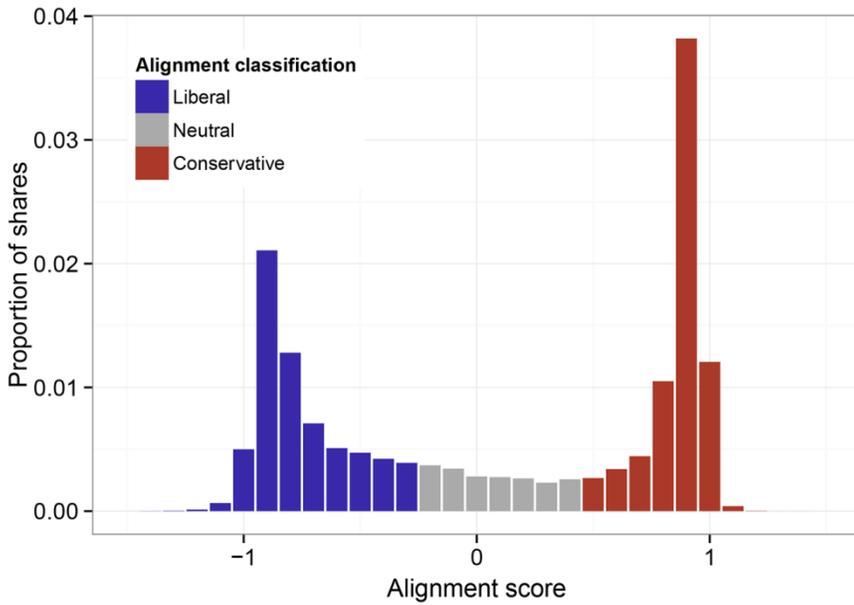Figs. S1 to S10
Tables S1 to S6
References (*28–35*)

Fig. 1. Distribution of ideological alignment of content shared on Facebook as measured by the average affiliation of sharers, weighted by the total number of shares. Content was delineated as liberal, conservative, or neutral based on the distribution of alignment scores (see SOM for details).
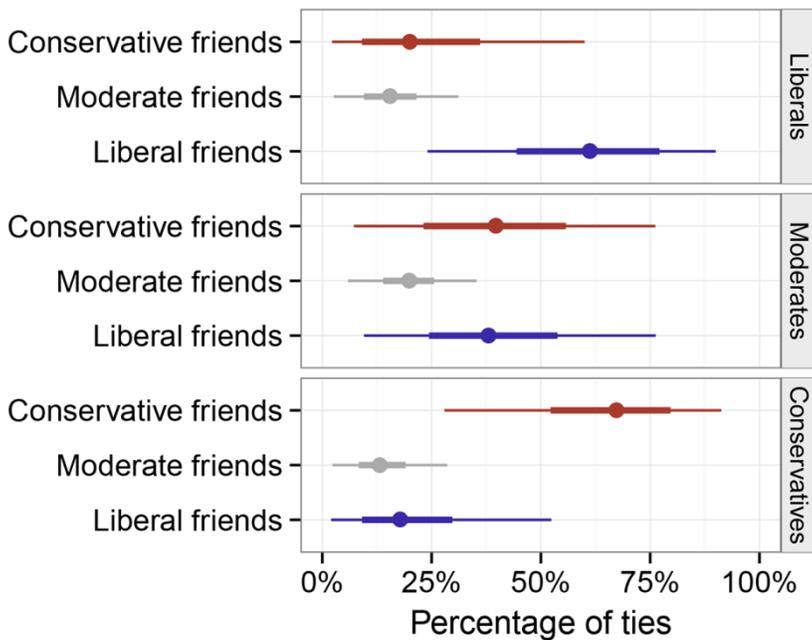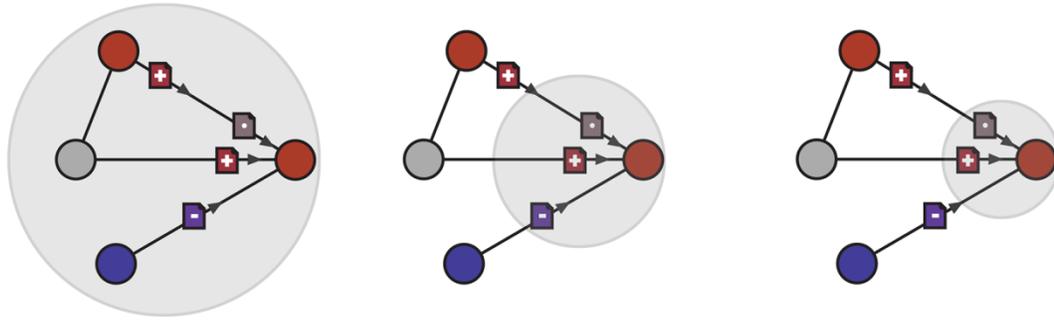

Fig. 2. Homophily in self-reported ideological affiliation. Proportion of links to friends of different ideological affiliations for liberal, moderate, and conservative users. Points indicate medians, thick lines indicate interquartile ranges, and thin lines represent 90% interval.
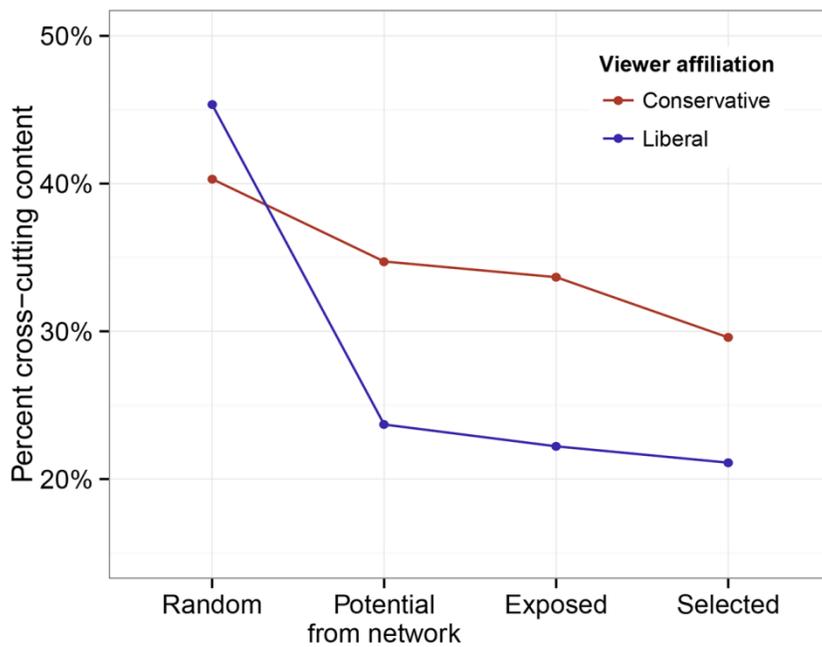
Fig. 3. (Top) Illustration of how algorithmic ranking and individual choice affects the proportion of ideologically cross-cutting content that individuals encounter. Gray circles illustrate the content present at each stage in the media exposure process. (Bottom) Average ideological diversity of content (i) shared by random others (random), (ii) shared by friends (potential from network), (iii) actually appeared in users' News Feeds (exposed), (iv) users clicked on (selected).