Underneath the Filter Bubble:
The Role of Weak Ties and Network Cultural Diversity in Cross-Cutting Exposure to Disagreements on Social Media

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While the idea of the filter bubble, in which people are sheltered from challenging and disagreeable information online, is a valid concern for democracy, it requires much theoretical sophistication and empirical support. This paper explores the extent and scope of the filter bubble, employing the concept of "cross-cutting exposure," or exposure to disagreeable viewpoints, on social media. A survey analysis of 271 Facebook users shows that they do get exposed to cross-cutting information frequently, and that cross-cutting information was more likely to come from weak ties, or acquaintances and strangers in their network, as opposed to strong ties of friends and families. Furthermore, those who have ethnically and religiously more diverse networks were more likely to be exposed to cross-cutting information. Taken together, it is argued that individuals' network characteristics, such as network compositions and cultural diversity, can influence the degree of the filter bubble.

Keywords: filter bubble, cross-cutting exposure, weak ties, diversity, network

M ost news consumption these days migrated to the online sphere, especially social media. Research indicates that 81% of Americans get at least some of their news through websites, apps, or social media (Mitchell et al., 2016), and the majority of American users of Facebook, Twitter, and Reddit say they get news from those platforms (Gottfried & Shearer, 2016). Amid such transitions in the media environment, news is becoming increasingly "algorithmically driven" such that computerized algorithms determine what news contents users are exposed to. This results in a grave societal concern, because the

public may become trapped in the so-called "filter bubble," in which they are protected from new, challenging, and stimulating viewpoints. The filter bubble or echo chamber effects (Sunstein, 2003; 2017) threaten a healthy functioning of democracy, because, the argument goes, the personalized Internet and social media make it difficult for users to see the other side of arguments: When people are stuck in an ideological silo of like-minded people, it provides a fertile ground where disinformation and extreme political polarization can easily occur.

While it is a valid threat to democracy and the public sphere, the concept of the filter bubble or echo chambers requires more theoretical sophistication and empirical support. In particular, popular claims publicizing the negative effects mostly remain at anecdotal case studies (e.g., Pariser, 2011). This means that there is a need to investigate those phenomena more systemically. This study probes the degree to which social media users are exposed to disagreeable viewpoints by employing the idea of cross-cutting exposure (Mutz, 2006). The overall argument and findings of the study are that while we need to acknowledge some of the potential problems of filter bubbles, we need to critically evaluate their extent and effects, because the digital public today, with their multiple and overlapping identities and diverse networks, are keenly aware of different viewpoints surrounding them, and that their media diet tend to include at least some disagreements and challenging perspectives.

Following the crystallization framework (Wohn & Bowe, 2014), which states that people's online social network will act as agenda setters, this study conceptualizes social media as not just a platform of news delivery but socially embedded experience that has influence on individuals' understanding of the world. While the idea of the filter bubble focuses on the power of computer algorithms, this study emphasizes the importance of people in their social media networks. That is, the degree to which people are confined to like-minded opinions is dependent on many factors including the makeup of one's social media network. For example, those who have many weak ties in their network – strangers and acquaintances – are less likely to be trapped in the silo of like-minded viewpoints. Thus, while the filter bubble may still exist, the power of the computer algorithms is countered by the networks that individuals choose to connect with online.

LITERATURE REVIEW

Exposure to Disagreement in the Algorithmic Age

It has been well known in social science research that people tend to selectively expose themselves to the information and viewpoints they agree with. While selective exposure or homophily has been around as long as humans have existed, it is the supposedly unprecedented degree in the age of the Internet and social media that worries many. Pariser (2011), who coined the term filter bubble, argues that today's massive filtering algorithms present threat to our information diet. He shows an example in which the same search term "BP" prioritizes investment information of the firm to a certain user and the oil spill disaster information to another. Pariser argues that this filtering closes users off to new ideas and counter viewpoints. The filter bubble may eventually undermine civic discourse and make people vulnerable to propaganda and manipulation by advertisers and politicians, according to Pariser. In a similar vein, Sunstein's (2003; 2017) echo chamber thesis suggests users in today's Internet are trapped in a chamber in which they listen to only similar voices and this is driving political fragmentation, polarization, and extremism. In his latest book, Sunstein (2017) especially focuses on the negative role of social media in people's news diet, saying its extreme customization creates "cybercascades," and "polarization entrepreneurism," which endangers the shared conversations, understandings, and experiences. It is in this context that some media outlets suggested the proliferation of the filter bubble and fake news even swayed the 2016 U.S. presidential election in favor of Donald Trump (Parkinson, 2016; Read, 2016).

While it is no doubt that the filter bubble or echo chambers are a valid concern that may threaten healthy civic discourse, the ideas are conceptually not clear and their empirical support is rather limited. In fact, latest academic research documents the opposite, showing that people are more likely to be outside the bubble or echo chambers using the Internet or social media than offline, because of the diverse online social structure and personal relationships (See for examples, Bakshy et al., 2015; Barnidge, 2017; Gentzkow & Shapiro, 2011). Theoretically, it would also stand to reason to think that the digital media universe today is actually helpful in breaking the bubble, when compared to the offline world: We are less likely to encounter discussion partners who have different viewpoints from ours in offline, because such face-to-face encounter is very

uncomfortable. But in online, especially in social media, there exists norms of self-expression, and with the help of more anonymity and less social presence, differing viewpoints can be further facilitated (Barnidge, 2017). There is evidence that the existence of social endorsement on social media, such as peer recommendations, mitigates partisan selective exposure, because social endorsements shift attention away from partisan source cues (Messing & Westwood, 2014). Furthermore, many people online select information not necessarily on purpose perusing partisan cues, but on whims while browsing. Doing so, they get exposed to disagreeing viewpoints while they seek news that is interesting, fun, and socially relevant. In other words, there is a higher chance of "incidental exposure" to disagreeable viewpoints on social media than offline (Kim, Chen, & de Zuniga, 2013; Tewksbury et al., 2001).

That's why a well-known large-scale study of Facebook found that exposure to disagreement is not uncommon: Bakshy and colleagues (2015) showed that for every four Facebook friends that share same political ideology, users have at least one friend with contrasting views. Other recent studies that looked at news personalization found no discernable effects of the filter bubble or echo chambers (Flaxman et al., 2016; Haim et al., 2018). Some studies further suggest that social media use is actually helpful in breaking the filter bubble: A study by Beam and colleagues (Beam, Child, Hutchens, & Hmielowski, 2018) found that on the social media, "context collapse" occurs as users have to imagine and negotiate interacting with a large and diverse audience, and that this context collapse leads to more sharing and discussing news with people of diverse backgrounds in the users' lives. Another study by the authors (Beam, Hutchens, & Hmielowski, 2018) found that Facebook news use in the long run leads to depolarization of partisan attitudes among the users.

At the very minimum, it can be argued that online media users, while seeking information that conforms to their pre-existing perspectives, do not necessarily actively avoid counter-attitudinal information, as suggested by Garrett's (2009) research. That is, people use the control afforded by online information sources to increase their exposure to like-minded opinions, without sacrificing contact with other opinions.

The ideas of the filter bubble and echo chambers posited by the popular narratives of Pariser and Sunstein are rather simplistic in that they assume a passive media user

trapped by a loop of similar informational flow: The audience here are considered to be incapable of navigating the diverse world, because they are trapped in their own ideological silo. But in today's digital world, a person usually has multiple and overlapping identities and belongs to fragmented, yet multiple publics. You are a veteran, gay, father, and consumer activist at the same time, for example. This idea is also supported by empirical research. Graellis-Garrido and colleagues (2014) suggest that among people of opposing views, there exists common interests, which may work as an intermediary topic that connect them, thereby increasing diversity in exposure.

The Power of Network Compositions and Diversity

As suggested so far, the concern about the filter bubble or echo chambers is rather overblown. But this does not mean that they do not exist, nor are they a healthy phenomenon. Exposure to diverse viewpoints and civil discussions around them are certainly an important democratic value, and, we should strive to remove any potential roadblocks against such a noble cause. However, much like the fuss surrounding the filter bubble, many attempts to break it seem to be problematic as well. Pariser (2011), for example, suggests Google or Facebook place a slider bar running from "only stuff I like" to "stuff other people like that I will probably hate" at the top of search results and the newsfeed to fight the filter bubble. Others developed the so-called "serendipity" web browsers that encourage users to see disagreeable news and counter viewpoints. Such efforts are noble. However, they are artificial and forced efforts and their effectiveness is questionable. Many of those initiatives are thus short-lived.

This paper argues what matters more in breaking the filter bubble is a diverse network of people in the digital universe that is naturally occurring. Many classical studies in communication and psychology (e.g., Katz & Lazarsfeld, 1955) suggest that it is personal influence rather than media that is far more influential. More recent research documents the positive impact of heterogeneous social networks that include increased news use, political discussion, and democratic citizenship (Kim, Hsu, & de Zuniga, 2013; Scheufele et al., 2006). In particular, weak ties, or a loose coalition of acquaintances, strangers, and distant friends may play a crucial role in encouraging exposure to diverse viewpoints. In the so-called "strength of weak ties," Granovetter (1973) showed that weak ties are critical for the exposure to novel information and political mobilization. While

communication occurring among strong ties usually employ "restricted codes," or an implicit mode of talk that shares a same culture or background, communication among weak ties often requires much more explicit elaboration to achieve more meaningful exchange. That elaboration and openness are often beneficial to new ideas and innovations. This theory of weak ties fits the bill very well in today's connected digital media world where people get informed and mobilized based on specific issues to form an "issue public" or become a "monitorial citizen" (Schudson, 1998; Shirky, 2008). The social media platforms allow individuals to maintain a vast array of online relationship composed of both strong and weak ties (Hampton et al., 2009), which includes workplace relationships, a fertile ground for cross-cutting exposure (Mutz & Mondak, 2006). An enlarged network of people, after all, increases the possibility of exposure to diverse viewpoints in a natural manner. If we want to address the filter bubble and political polarization, we should care about connecting people, not forcefully providing more counter information.

This network effect, rather than a medium effect, is the essence of the crystallization framework (Wohn & Bowe, 2014; 2016). In this framework, the term crystallization is used to describe how people's perception of reality is formed in the age of social media. It is most likely the people in the network, rather than mass media, will act as both first and second-level agenda setters, determining what information users are exposed to and even influence how people will interpret this information. Since most social media contents are created, curated, and engaged by users, the contents that individuals see in their feeds come from the contents that their networks post. The contents they see are not "news on social media," but "news from one's social network via social media" (Wohn et al., 2017). This way, the crystallization framework emphasizes the importance of people's networks, which is absent in the current discussion of filter bubble or echo chamber effects.

Since people have different network compositions, the uniform sense of reality that may have existed in past mass media times may not be present in an era where most news comes through social media. The empirical research from the crystallization framework found the importance of network compositions in social media. For example, having a diverse cultural network in terms of ethnicity and religion influences the users' exposure

and attitudes toward such key social issues as #BlackLivesMatter (Wohn et al., 2017); In another study, it was found that those who had primarily U.S. networks or U.S. military networks, as opposed to non-US networks, were exposed to much cheering and triumph over the news of the death of Osama bin Laden on their social media (Wohn & Bowe, 2014).

Research Questions and Hypotheses

The above section highlights how important network diversity can be, but the concept of network diversity itself is multifaceted and complex. The concept of the filter bubble or echo chambers is also rather vague and difficult to operationalize. The filter bubble and echo chambers, at their root, share the basic idea of selective exposure. But Pariser's filter bubble mostly focuses on algorithmic and technological filters that limit perspectives to like-minded information, whereas Sunstein's echo chambers focus more on the ideological segregation resulting from being surrounded by like-minded contacts and ideas. In terms of operationalizing the ideas of filter bubbles or echo chambers, we employ the "cross-cutting exposure," the degree to which individuals are exposed to socially and politically disagreeable information. This construct is one the most well-known and robust measures to gauge the degree of one's exposure to counter-attitudinal information. Cross-cutting exposure has been widely used and studied in the social sciences (e.g., Min & Wohn, 2018; Mutz 2006; Mutz & Mondak, 2006).

In this study, we first attempt to see to what degree social media users are exposed to cross-cutting information. Therefore,

RQ1. What is the overall extent of cross-cutting exposure to politically and socially disagreeable news on social media?

In particular, we hypothesize that cross-cutting exposure will more likely come from weak ties on social media. Weak ties are a loose connection of acquaintances and strangers, and they can be a better facilitator of new information than strong ties such as family members and close friends, as previous research suggested (Granovetter, 1973; Shirky, 2008). Therefore,

H1. Cross-cutting exposure to politically and socially disagreeable news will more likely come from weak ties than from strong ties.

The more weak ties an individual has, the more diverse his or her network will be. Diversity is critical in facilitating cross-cutting exposure to disagreement. Homogeneous networks of similar cultural backgrounds usually result in the sharing of similar thoughts and discussions, whereas heterogenous networks will likely increase the possibility of encountering differing viewpoints. Based on this rationale, the following hypotheses are presented:

H2. Network cultural diversity will be positively associated with cross-cutting exposure to politically and socially disagreeable information.

METHODS

Procedure and Sample

This study employed a nationwide survey of U.S. Facebook users to understand their exposure to disagreeable information. Between October 6 and 10, 2016, a Qualtrics web panel of 585 individuals took part in the survey and 271 finished it, yielding the completion rate of 46.3%. Although it was a quota sample, not a random sample, it was close to the general U.S. population in terms of various demographic measurements. While there are concerns for using online opt-in panels, it is increasingly an accepted practice in an era where random digit dialing to collect probability samples has become very difficult and expensive. Indeed, evidence suggests that use of online opt-in panels makes little difference in quality (Ansolabehere & Schaffner, 2014).

We limited the sample to Facebook users, because of the social media giant's dominance in news distribution. We also created quotas for political orientation to resemble the U.S. population demographics—thus Republicans and Democrats were even, each making 40% of the sample, while 20% identified as Independents. The sample's average age was 40 years old and it was about 58% female. The racial makeup was about 76% White Caucasian, 11% Asian, 9% Black, and 7% Latino/a. The average network size, or the number of friends, was 423, ranging from 0 to 5,000 ($SD = 799$).

Variables and Analysis

Cross-cutting exposure measured the degree to which respondents encountered politically and socially disagreeable news on Facebook. It employed a two-step measurement such that cross-cutting exposure was differentiated based on the sources of

exposure. The overall cross-cutting exposure from all different sources (M = 17.02, SD = 4.34) were then divided into two groups: Strong and weak ties. Strong ties included romantic partners, friends, families, and relatives, whereas weak ties included strangers, classmates and co-workers, and public figures. This distinction of strong vs. weak ties was supported by factor analysis: A principal component analysis with varimax rotation yielded two factors eigenvalues over 1. Romantic partners, family, and friends all produced loadings of at least .64 onto the first factor (and no significant loadings onto the second factor) and were subsequently labeled "strong ties." Together, they explained 41.5% of the variance. The second factor derived was labeled "weak ties," onto which public figures and strangers produced loadings of over .80, and together they explained 22.2% of the variance. Initially, coworkers/classmates presented an issue because it loaded onto both the strong ties (.55) and weak ties (.54) to substantial degrees. Theoretically, it makes also sense that coworkers and classmates can belong to both strong and weak ties simultaneously because these relationships usually can be intersectional, encompassing one's public and private lives. For a clear empirical and theoretical distinction, we decided to drop the coworkers/classmates from analysis. Dropping classmates/coworkers also improved the amount of variance explained in each of the two factors (See Table 1).

Table 1

Factor Loadings on Strong and Weak Ties

	Spouse/ Partners	Family/ Relatives	Friends	Classmates/ Coworkers*	Strangers	Public Figures	Eigenvalue
Strong	.64	.79	.79	.55	-.01	.16	2.49
Weak	.17	.14	-.07	.54	.85	.84	1.30

* dropped from analysis.

The key independent variable was network cultural diversity, which is a composite index of ethnic and religious diversities. Ethnic diversity and religious diversities were measured by the popular Herfindahl-Hirschman Index, a widely accepted measure of diversity used by ecologists, linguists, economists, sociologists, and demographers (Pew Research Center, 2014). Also known as the Simpson's D, the Herfindahl-Hirschman index

has been utilized in communication research as well (e.g., Eveland & Hively, 2009; McDonald & Dimmick, 2003; Vitak, 2012). To generate the index, each survey respondent was asked to estimate the proportions of their friends' ethnicities and religions in his or her Facebook network. The proportions were then squared and summed, which made the index range from zero to one. One meant complete homogeneity, meaning, for example, someone's Facebook friends consisting of completely one ethnicity only. In this research, the inverse of the index was used to make a number close to one denote higher diversity and a number close to zero denote homogeneity. In mathematical terms, the diversity index (*D*) was calculated as the following:

$$D = 1 - \sum_{i=1}^{n} pi^2$$

where *pi* is the proportion of friends within each ethnic/religious category. The ethnic diversity and religious diversity indexes were calculated separately. However, they were highly correlated (*r* = .64) and these two were summed up and their average was taken to create the network cultural diversity variable (*M* = .45, *SD* = .22).

Other variables included in the regression analysis as controls were political ideology (*M* = 3.87, *SD* = 1.72) on a 7-point scale, with 1 being extremely liberal and 7 being extremely conservative, political interest (*M* = 3.07, *SD* = .83 on a 4-point scale), network size, which is the number of Facebook friends (*M* = 423, *SD* = 799). News media use measured the frequency of radio, television, newspaper, website, and social media news use (*M* = 17.20, *SD* = 3.61). Political knowledge was constructed based on 4-items probing the respondents' knowledge of current and political affairs (*M* = 1.99, *SD* = .82). Finally, for demographics, White Caucasians and males were coded as 1, respectively, and all others as 0. Educational level (*Median* = some college) and income level (*Median* = $50,000 to $59,999) were used as ordinal variables.

RESULTS

First of all, it was found that the vast majority (87.1%) of the respondents answered they get exposed to disagreement to a good degree (RQ1). In descriptive statistics, more than half (53.5%) said they get politically or socially disagreeable information "sometimes," and 33.6% said they get exposed "often" to such information. Only 12.9% said

they "never" (1.8%) or "rarely" (11.1%) get exposed to disagreement on social media. At least in the respondents' subjective perceptions, cross-cutting exposure was prevalent.

Hypothesis 1 predicted that cross cutting exposure to disagreeable information will more likely come from weak ties. A paired sample t-test showed that the cross-cutting exposure score ($M = 2.67$) from weak ties was statistically significantly higher than the one coming from strong ties ($M = 2.38$) ($t = 4.61$, $df = 270$, $p < .001$). Hypothesis 1 was supported. Hypothesis 2 predicted that higher network diversity will be associated with higher cross-cutting exposure. This hypothesis was supported. As seen in Table 2, when the dependent variable of cross-cutting exposure was regressed upon the independent variables, the coefficient for network cultural diversity ($b = 4.80$, $p < .001$), along with those for network size and news media use, statistically significantly predicted higher cross-cutting exposure, meaning that the more diverse and the larger one's network is, and the more people use news media, the more likely they are exposed to disagreement.

Table 2

Cross-cutting Exposure on Social Media Regressed upon Independent Variables

	Cross-cutting Exposure	
	β	S.E.
Political Interest	.43	.33
Political Ideology	.02	.14
Political Knowledge	-.49[+]	.29
News Media Use	.32***	.07
Age	.00	.01
Gender (Female)	.27	.50
Race (Non-White)	-.58	.59
Education	.05	.27
Income	.12	.08
Network Size	.01**	.00
Network Cultural Diversity	4.80***	1.13
Model Fit (R^2)		.29

Note. $N = 271$; + $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$

DISCUSSION

When the idea of the filter bubble was first introduced, there was a heightened sense of concern that the personalized Internet and social media harm democratic discourse and governance. This rather dystopian view that the new media trap us in the silo of selective exposure is being increasingly disputed by latest research (for examples, see, Bakshy et al., 2015; Flaxman et al., 2016; Haim et al., 2018; Newman et al., 2017). The present study adds to this growing body of evidence that the extent of the filter bubble is not as great as imagined in the popular narrative.

This study also contributes to a more nuanced understanding of the filter bubble, probing what exist beneath it: It was found that one's network characteristics may influence the degree of cross-cutting exposure to disagreement. Individuals still have agency in terms of deciding whom to be connected with on social media, which directly relates to the type of content they will see and ultimately engage with. Algorithms do not choose whom one connects to online—this is a human choice. Thus, blaming technology may be an oversight of the underlying problem. The findings do not dismiss, however, the power of algorithms. Algorithms certainly play a part in the news one sees on social media, because many social media systems use algorithms to curate the content users are exposed to. Thus, there is of course the chance that even if one chooses to connect online with a very diverse group of people, the algorithm could potentially filter out all the information coming from those diverse networks.

Consistent with previous research (Granovetter, 1973; Shirky, 2008), weak ties are found to play an important role in facilitating exposure to diverse information. With weak ties that come without strong personal or emotional attachments, social media users may experience more emotionally detached, casual, and incidental social interactions, which creates opportunities for them to gather information, taste, and try out disagreement (Min & Wohn, 2018). The importance of weak ties found in this research needs a cautious interpretation, however. It should be noted that our study is among the few that probed the role of weak ties in acquiring "political information." Much of the original work on information and weak ties was related to information about new jobs—the rationale was that people who are similar have access to similar information, and thus weak ties were more likely to be ones with information about jobs that close ties do not. However, when it

comes to news and politics, the information is much more complex. For example, a strong tie is equally likely as a weak tie to have thoughts that are both agreeable and disagreeable to an individual. Say, among close friends Steve and Alex, it could be the case that Alex posts news about political views that Steve disagrees with, but they are still close friends because of their shared interest in science fiction. This means that there is a need to further investigate complex personal relationships present in social media interactions. Future research should tease out these intricacies.

Another issue with this study is that the factor analysis found coworkers/classmates, often regarded as an example of weak ties where frequent cross-cutting exposure takes place (Mutz & Mondak 2006), belonged to both strong and weak ties. Why this happened is unclear. But we speculate that while Mutz and Mondak imagined the workplace as an archetypical place of a weak tie and cross-cutting exposure in the offline world only, the colleagues and classmates in our study represented relationships taking place both in the offline and social media world. As suggested earlier, the private/public relationship can be easily blurred on social media and that is perhaps why coworkers/classmates loaded onto both the strong ties and weak ties factors. Future research should focus on the changing nature of coworker/classmate relationships in the age of social media.

As typical in survey research, the cross-cutting exposure and the cultural network diversity indexes used in this study were self-perception measures, which suggest they may not accurately reflect the actual amount of cross-cutting exposure or actual diversity in individuals' social networks. However, many studies probing network characteristics routinely use self-report measures (e.g., Choi & Lee, 2015; Lee et al., 2014; Scheufele et al. 2004; 2006). Furthermore, it can be argued that self-perception of disagreement is deemed a better measurement of cross-cutting exposure than a third-party's judgment of incongruence, because, after all, if individuals do not perceive that disagreement has occurred, it will have less of an effect on their attitudes and behavior (Barnidge, 2017). For diversity, it was shown that a subjective measure of diversity is correlated with an objective diversity measure, rendering some support to the use of a self-report measure (Mislevy, 2009).

Cross-cutting exposure to disagreement is normatively a very important concept. Being exposed to diverse viewpoints and experiencing challenging opinions is a bedrock of modern democracy. That's why scholars are concerned about the filter bubble or echo chambers: The more filter bubble or echo chambers we have, the less healthy our democratic discourse will be. That basic premise is a valid idea. But we need more thorough investigation of their concepts and operation. We need better understanding of what exist underneath the filter bubble and what the specific dimensions of echo chambers are, before jumping to the conclusion that they are hurting the public sphere and democracy. We don't know the true extent of the filter bubble, and, even if we acknowledge its existence, we know very little about how people behave within that bubble. There are many different ways people read, process, and engage with information, and thus it's difficult to conclude that the existence of the bubble will automatically leads to negative outcomes.

As an effort to have a more contexualized understanding of the phenomenon, our research found that there exist important roles of network characteristics – composition of people in the social media network – that facilitates the exposure to disagreement, which may mitigate the concerns of filter bubble effects. Therefore, in light of current research, we argue that the best way to fight the filter bubble – if it exists – is naturally occurring networks of diverse connections, especially weak ties. As argued before, users have the agency to decide whom they connect with, and their conscious awareness to broaden their network is an important asset required in the social media age.

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