Technological Forecasting & Social Change 170 (2021) 120924

Contents lists available at ScienceDirect

Technological Forecasting & Social Change

journal homepage: www.elsevier.com/locate/techfore

The impact of group polarization on the quality of online debate in social media: A systematic literature review

Luca Iandoli [a,b], Simonetta Primario [b,*], Giuseppe Zollo [b]

[a] St. John's University, Collins College of Professional Studies, 8000 Utopia Parkway, New York, USA
[b] University of Naples Federico II, Dept. of Industrial Engineering, Piazzale Tecchio 80, 80125, Naples, Italy

ARTICLE INFO

Keywords:
Group polarization
Echo-chambers
Social media
Social networks
Online discussions
Online argumentation

ABSTRACT

Social media are often accused of worsening the quality of online debate. In this paper, we focus on group polarization in the context of social media-enabled interaction, a dysfunctional group dynamic by which participants become more extreme in their initial position on an issue. Through a systematic literature review, we identified a corpus of 121 research papers investigating polarization in social media and other online conversational platforms and reviewed the main empirical findings, as well as theoretical and methodological approaches. We use this knowledge base to assess some recurrent accusations against social media in terms of their supposed tendency to worsen online debate. Our analysis shows that, while some concerns have been exaggerated, social media do contribute to increase polarization either by amplifying and escalating social processes that also occur offline or in specific ways enabled by their design affordances, which also make these platforms prone to manipulation. We argue against suggestions aimed at reducing freedom of speech in cyberspace and identify in inadequate regulation and lack of ethical design as the leading causes of social media-enabled group dysfunctions, highlighting research areas that can support the creation of higher quality online discursive spaces.

1. Introduction and theory background

Group Polarization (GP) occurs when group members end up being more extreme in their position on a given issue after participating or being exposed to a discussion (Isenberg, 1986).

While GP has been studied extensively in face-to-face interaction starting from the 60s (Moscovici et al., 1972; Myers and Lamm, 1976; Stoner, 1961), research on GP has received renewed impulse following the increasing relevance of the Internet in human communication and information consumption. Cass Sunstein's influential work (Sunstein, 2001, 2002a, 2002b) identified in online information cocoons created by like-minded individuals a key mechanism behind GP and hypothesized that GP would impoverish public discourse (Balcells and Padró-Solanet, 2016) and favor extremism.

The large-scale global adoption of Social Media (SM) provided additional fuel to this debate. Notwithstanding their positive role in promoting democratic movements such as the Arab Spring, SM have been later accused of determining the emergence of a public sphere that is increasingly fragmented, misinformed, and prone to social negativity and manipulation. Following Sunstein's work, some scholars accused SM of favoring these trends through a mix of design affordances and algorithmic solutions leading to GP via the formation of ideologically homogeneous information bubbles (Garrett, 2009; Pariser, 2011; Stroud, 2010). Later works, however, rebutted these concerns by offering evidence that information sharing overall favors increased exposure to diverse information (Barberá, 2014) and even promotes wisdom in partisan crowds (Becker et al., 2019). More recent studies claim that concerns over the polarizing power of SM and the risks of manipulation of individual choices and opinion has been exaggerated (Dubois and Blank, 2018) and that there is no conclusive evidence that the Internet and SM make the online debate more polarized than it is in society (Boxell et al., 2017; Gentzkow and Shapiro, 2011; Prior, 2013).

Other works question the diversity perspective by providing evidence that online interaction creates GP precisely because SM heighten involuntary exposure to politicized information generated by "disagreeable others," stimulating social divisiveness via affective polarization (Iyengar et al., 2012; Settle, 2019; Yardi and Boyd, 2010)

Despite the diversity of these findings, the literature on GP shares the following conceptual pillars. GP is typically intended as the result of a group dynamic that favors the emergence of more extreme opinions in group discussion and deliberation. It can result from two mechanisms that can operate independently or in combination: homophily and

* Corresponding author.
E-mail addresses: iandolil@stjohns.edu (L. Iandoli), simonetta.primario@unina.it (S. Primario), giuseppe.zollo@unina.it (G. Zollo).

https://doi.org/10.1016/j.techfore.2021.120924
Received 31 October 2020; Received in revised form 24 May 2021; Accepted 25 May 2021
Available online 10 June 2021

discursive argumentation. Homophily is the tendency to socially engage with similar others, which can lead to the creation of information bubbles in which certain beliefs become dominant thanks to mutual positive reinforcement among like-minded peers. Discursive argumentation (Mercier and Sperber, 2011) is the use of reasoning by individuals and groups as an instrument to advance their preferred agenda by rhetorically defeating their opponents. In this case, GP is produced by the exposure to diversity instead than by its absence. Online interaction can enable both tendencies by making easily available tools and virtual spaces to aggregate users with similar others *and* to expose them to ideologically hostile information. Thus, more than diverging on what GP is and on the explanatory mechanisms, the debate revolves around the trade-off between diversity and homophily and the design of regulatory and technological devices that can counteract GP.

Regardless of the difference in theories and findings, many authors and technologists share the concerns that online GP has a severe impact on the quality of online discourse and the well-being of democracy. These negative impacts seem to be greatly enhanced by the amount and quality of online interaction enabled by SM. Such platforms are increasingly used as a primary news source, especially among younger generations (Sherrer, 2018), and not only enable easy and fast access to content but promote its active diffusion and manipulation across conversational networks that have no equivalent in traditional news media in terms of reach, size, and speed, as well as in their ability to manipulate content. Finally, the business model behind SM is strongly driven by this conversational diffusion regardless of the quality of the content and the impact of this diffusion.

Despite the pervasiveness of this conversationally-enabled content sharing, the impacts of the exposure and active participation in online discussions on the emergence of GP have been relatively under-investigated Settle (2019). For these reasons, our review focuses on GP potentially originating by interaction enabled by online conversational platforms such as SM.

We primarily review research findings obtained in the last decade following large-scale adoption of SM and interpret the empirical discrepancies in the light of theoretical approaches and adopted investigation methods available in the literature. Our findings show that some pessimistic concerns have been exaggerated, but also that SM do contribute to increase GP either by amplifying and escalating social processes that also occur offline or in specific ways enabled by their design affordances, which also make these platforms prone to manipulation.

The paper is structured as follows. The following session describes the methodology adopted for the selection and analysis of the sources. In the results section, we present the bibliometrics extracted from a sample of the 121 publications and present findings regarding factors enabling online GP (antecedents), theoretical explanations (mechanisms), enabling design affordances, and effects of GP. Finally, in the discussion session, we use this knowledge base to verify accusations against SM's impact on online GP and provide suggestions for future research.

2. Review methodology

Following well-established guidelines for systematic literature review (Easterby-Smith et al., 2015), we performed a keyword search of publications indexed in scientific databases (WoS, Scopus). Our key search terms included online polarization, group polarization, opinion polarization, echo-chamber, social media, social network, online platform, Web 2.0, blog, forum, and the Internet. We limited our search to works focusing on Polarization in online group behavior, written in English, and included only articles published in peer-reviewed sources with a minimum of 5 non-self-citations, if published before 2015, or at least one for later works.

Titles and abstracts were screened to eliminate duplicates and papers that did not focus on online GP. This step was performed independently by the first two authors, and differences were resolved involving the third. At this stage, it was decided to exclude from the review works based on simulation and computational models as opposed to works reporting findings based on data collected from human users.

A snowball search based on the references provided by works in this initial corpus allowed us to identify additional papers that had not been retrieved through the initial search. Articles were cataloged in a database that was interrogated through VosViewer to obtain bibliometrics and visualizations. NVivo was used to support content analysis, search for specific concepts, and identify topics mapping by analyzing keyword clusters. The results of the systematic literature review are presented and organized into the following sections:

a) Corpus overview and bibliometrics
b) A review of the main theories of online GP analyzed in terms of social antecedents, cognitive and social mechanisms, enabling design affordances, and social effects (see fig. 4)
c) Methodological issues

3. Corpus overview and bibliometrics

The initial keywords search on Scopus and Web of Science (WoS) databases produced 1346 results (758 Scopus and 588 WoS). After filtering by language, peer-reviewed sources, and duplicates, we brought down the corpus to 537 works. Among these, 215 papers published before 2015 had received more than five citations, while 139 works have been quoted at least once after 2015. After reading the abstracts, 167 relevant works were selected for full-text reading. Fifty-eight titles were excluded from this group because the full text was not available (36) or online GP was not the focus (22). Finally, using Google Scholar, we identified 12 additional papers through the analysis of the references of the remaining 109 papers.

Our final corpus includes 121 articles for which a bibliometric overview is reported in the Table 1. The debate on Online GP started in the early 2000s and built on previous works that studied GP in face to face interaction among like-minded peers (Burtt, 1920; Isenberg, 1986; Lamm, 1988; Moscovici et al., 1972; Myers and Lamm, 1976; Stoner, 1961). Initial works by Sunstein (2002a, 2002b) followed this theoretical perspective and focused on the adverse effects on information diversity due to online information cocoons and echo chambers.

Works on online GP increased significantly after 2016 (Table 1.a), following a trend in research on the dark side of SM (Hemsley et al., 2018). Research on online GP appears to be highly multidisciplinary and published in a variety of journals and conferences (Table 1.b and 1.c) in diverse disciplines and primarily in computer science, political science, communication, and social psychology (Table 1.d).

The 121 selected works are the result of the research effort of 311 unique authors, often collaborating in influential small research teams (Table 1.e and 1.f). A co-authorship network is shown in Fig. 1, where nodes are the authors, and links are weighted based on the number of co-authored documents (311 authors, 660 links). A visual inspection of this network helps to identify the most influential teams and trace the debate's evolution. Some prominent clusters include (by lead author): Sunstein's and Adamic's works on online echo chambers in the early 2000s; Iyengar and Wojcieszak's work on political disagreement in online media (end of 2000s); Garrett, Garimella, and Guerra analyzing the impact of offline controversy on the structure of online communities (mid-2010s); Barbera's group works on the diversity of information in SM and weak ties (Barberá, 2014; Tucker et al., 2018); more recent works by Bail (2018 and onward) showing the concerns about exposure to diversity; and Quattrociocchi's research on the role of GP in the propagation of misinformation and conspiracy theories.

Fig. 2 reports a bibliographic coupling network where nodes are publication sources such as journals or conference proceedings, and links are weighted based on the number of papers from one source citing the other. The analysis of Fig. 3 shows the multidisciplinary character of the debate and the most prominent publication venues. Finally, the heat

Table 1
Bibliometric overview of Selected Works

a. Publication by year

Year	#Paper
2002	2
2005	1
2008	3
2009	4
2010	6
2011	2
2012	2
2013	9
2014	12
2015	8
2016	16
2017	20
2018	16
2019	15
2020	5

b. Publication Source

Source	#Paper	CiteScore[2018]
Proceedings of the National Academy of Sciences	7	8.58
Journal of Communication	5	4.49
Computers in Human Behavior	4	6.14
Journal of Computer-Mediated Communication	4	7.41
Proceedings of the Int. Conf. on Weblogs and Social Media	4	3.28
Nature Scientific Reports	4	-
Communication Research	3	3.3
New Media and Society	3	5.49
Plos one	3	4.29
Government Information Quarterly	2	7.1

c. Document Type

Type	#Paper
Journal Article	86
Conference Paper	31
Note	4

d. Discipline

Area	#Paper
Computer Science	57
Social Science	21
Political Science	19
Management	9
Communication	9
Multidisciplinary	6

e. Top 10 Authors

Author	#Paper	Total Cit.	H-Index
Quattrociocchi W.	10	628	20
Scala A.	9	622	12
Zollo F.	9	551	34
Del vicario M.	8	546	12
Bessi A.	7	511	14
Caldarelli G.	7	613	44
Garimella K.	5	87	8
Sunstein C.R.	4	589	55
Weber I.	4	123	28
Iyengar S.	3	1207	35

f. Top 5 collaborations

Collaboration	#Paper	Total Cit.
Quattrociocchi W., Scala A., Zollo F., Del vicario M., Bessi A., et al.	12	679
Garimella K., Weber I., De francisci morales G., Gionis A., et al.	6	130
Sunstein C.R., Bobadilla-suarez S., Lazzaro S.C., Sharot T., et al.	4	591
Barberà P., Tucker J.A., Jost J.T., et al.	3	595
Shah D.V., Hanna A., Bode L., Wells C., et al.	3	68

Note: Authors H-Index and Number of Citations are updated from Scopus as of June 3rd, 2020. Research Area is the one with the higher quartiles reported under Subject Area and Category available on *https://www.scimagojr.com/*. Top 5 collaborations are based on the co-authorship network developed through VosViewer (fig. 1).

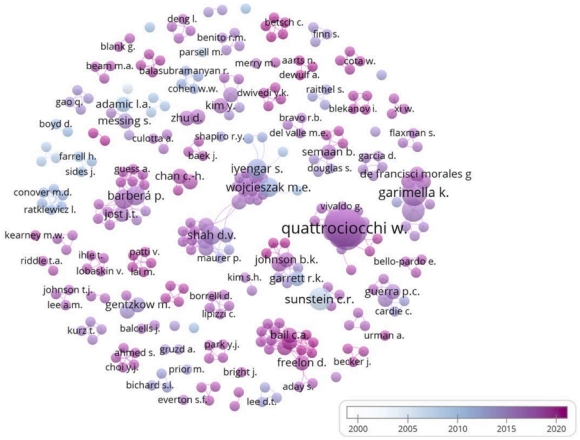

Fig. 1. Co-Authorship Network (Unit of analysis: Authors of the selected works, the size of each node indicates the number of citations, while colors indicate the average publication time of collaborations among authors)

map (Fig. 3) reports the topics that have received greater interest and focus, based on the frequency they are mentioned in titles and abstracts.

In the following, we describe and discuss the output of our review. We organized our findings as conceptually illustrated in Fig. 4, in which the review outputs are classified into 4 main categories: social factors enabling online GP (social antecedents), technical enablers (design affordances), explanatory theories (social and cognitive mechanisms), and social effects. The following sections refer to and describe the concepts visualized in the followig map.

4. Social antecedents of online GP

Through the analysis of the papers contained in our corpus, we identified two categories of antecedents:

a) Information diversity, as determined by intra-group and inter-group dynamics including homophily and selective exposure
b) External triggers such as polarized media & elite, trolls, divisive events, and context.

4.1. Information diversity

Following the echo-chamber paradigm, several studies show how online groups can function as information filters to help their members to deal with information overload. Two key mechanisms favoring online GP are selective exposure/sharing and homophily, and both lead to suppression of diversity in the information available to the group members. These social processes can be further facilitated or magnified by algorithms (Pariser, 2011). and design affordances (Giese et al., 2020).

Under the effect of selective exposure/sharing, online users consume and share contents that reinforce their opinions and contribute to generate information cocoons (Iyengar and Hahn 2009, Stroud 2010). Homophily is people's inclination to gravitate towards participants

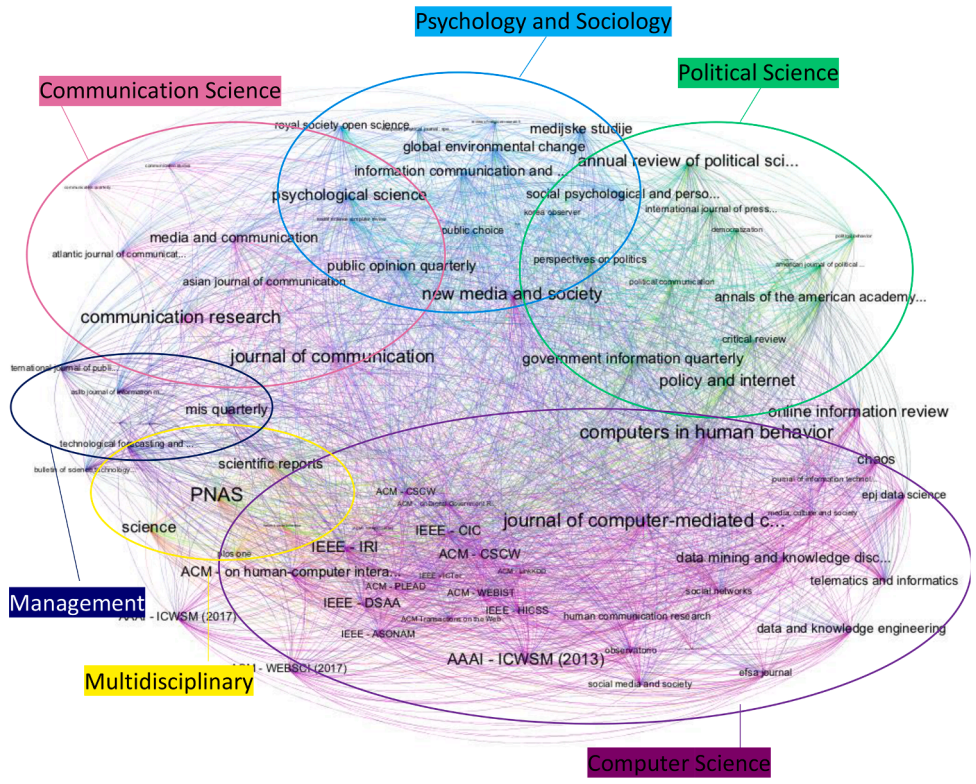

Fig. 2. Bibliographic Coupling Network (Unit of Analysis: publications' sources, colors represent the research area according to the subject and category available on https://www.scimagojr.com)

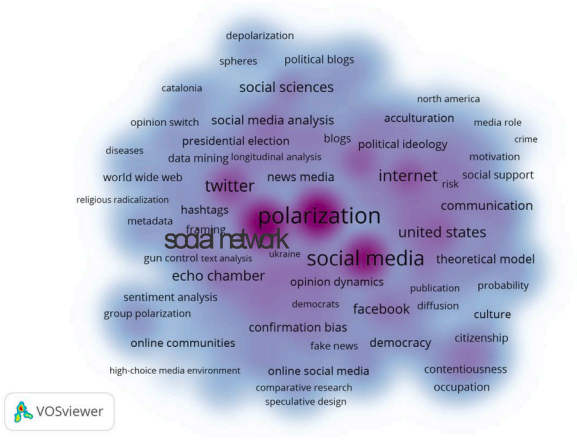

Fig. 3. Topic heat map based on keywords occurrence extracted from titles, authors' keywords and abstracts

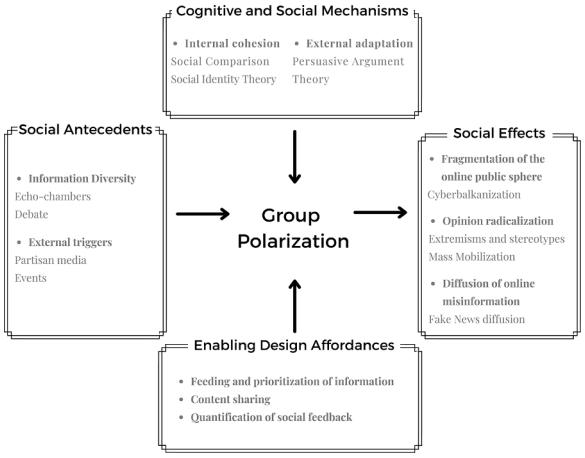

Fig. 4. Concept map of themes emerging from the investigated literature

perceived to be socially similar, a tendency that SM tend to favor (Bessi et al., 2016a; Williams et al., 2015). Some findings link homophily to fragmentation into self-segregated communities (Lawrence et al., 2010; Medaglia and Zhu, 2017). Mutual reinforcement, social support, and peer pressure originated in such communities favor the emergence of stronger convincement (Everton, 2016; Wojcieszak, 2010). Peer pressure can also manifest in oppressive ways as it happens when majoritarian or louder opinions become dominant and reduce to silence any dissenting alternative (Wells et al., 2017).

More recent studies have argued against the echo-chamber and filter bubble paradigm. Internet users are intentionally serendipitous when searching for information (Flaxman et al., 2016; Gentzkow and Shapiro, 2011; Semaan et al., 2014; Shapiro, 2013), consumption of diverse information by users is quite high (Dubois and Blank, 2018), and SM support the formation of weak ties helping to increase information heterogeneity and interaction (Barberá, 2014).

However, this diversity can backfire when opposing factions collide to advance their own agenda through heated debates (Garrett et al., 2014; Kim and Kim, 2019) or through the mere exposure to "disagreeable others" triggering the emergence of affective polarization (Bail et al., 2018; Iyengar et al., 2012; Sunstein et al., 2016; Yardi and Boyd, 2010) favored by the heterogeneous content of SM feeds that users exploit to categorize others into likable or dislikable social groups (Settle, 2019).

4.2. *External triggers*

External triggers include different types of sources that inject

polarizing content into cyberspace. Partisan media and biased elite favor polarization posting divisive stories and arguments (Iyengar and Hahn, 2009). Through the combination of biased narratives and strategic hyperlink connections, these sources can provide versions of facts that feed into the beliefs of the audience they are targeting and even monetize the online traffic generated by the public reaction (Luo et al., 2013; Messing and Westwood, 2014; Shapiro, 2013). Biased contents spread from influential nodes (Guerra et al., 2013; Morales et al., 2015; Primario et al., 2017) via an intermediate layer of not necessarily biased sources that end up magnifying visibility. Sometimes provocative content is injected through fake accounts impersonating real users via spam and trolls (Bail et al., 2020).

Other authors show that online GP is originated by polarizing events taking place offline, such as political elections, referendums, civil unrest, or other occasions that solicit uproar and strong emotional reactions (Del Vicario et al., 2017a; Park et al., 2018; Primario et al., 2017; Yang et al., 2017). In these cases, SM can magnify the discontent generated by emotionally intense events. For instance, the polarization associated with the gun control debate in the US is aggravated whenever a mass shooting occurs (Garimella et al., 2017a). The climate of conflict, distrust, and social malaise generated around these events strengthens beliefs and pushes people to take a side (Borge-Holthoefer et al., 2015; Gruzd and Roy, 2014; Romenskyy et al., 2018).

5. Cognitive and social mechanisms

Several causal theories have been proposed to explain online GP. Following a functional perspective, we define GP as a social dynamic pushing people to align their judgment to support their group's needs. By adopting insights from studies on organizational culture (Schein, 2010), we categorize these needs into two categories: internal cohesion and external adaptation. Theories such as social comparison or social identity fulfill the need to support internal cohesion, while persuasive argumentation theory helps the group to survive and adapt by counteracting external threats.

Social Comparison (Festinger, 1954) and Social Identity theory (Tajfel et al., 1979) explain polarization as the output of the process through which individuals reinforce their sense of membership to a group. Social Comparison favors polarization through judgment aligning with the perceived group norms. Individuals may decide to shift their judgment either to reduce cognitive dissonance when they believe the group is right and they are wrong or to increase social acceptance regardless of whether they deem the group is right. Self-Categorization is a key mechanism through which individuals draw boundaries and trade-in personal identity in favor of group identity based on an "us VS them" rhetoric (Morin and Flynn, 2014; Suhay et al., 2018), stereotypical communication (Turetsky and Riddle, 2018) and proliferation and increased visibility of radical groups (Sunstein, 2002a).

Argumentation Theory posits GP is a mechanism that a group exploits to prevail over other collectives perceived as antagonist or hostile (external adaption). Mercier and Sperber (2011) state that people are more likely to become radical in a position they support under the perceived urge of defending this position from their opponents' attacks. Argumentation Theory predicts that SM users engage with ideologically diverse others to win a rhetorical contest as opposed to the objective of forming an opinion. SM favor this dynamic by providing affordances helping to propagate emotional discourse (Romenskyy et al., 2018; Stevens et al., 2020) and not counteracting biased information diffusion (Nelimarkka et al., 2019).

Another way SM can facilitate polarized argumentation is through exposure to disagreeable others (Settle, 2019) or to disliked evidence (Sunstein et al., 2016). Bail and colleagues (2018) observed that after one month, Republicans who followed a liberal Twitter bots became substantially more conservative while Democrats became more liberal after following conservative Twitter bots. Cross-minded interactions allow Twitter users to reinforce in-group and out-group affiliation (Morin and Flynn, 2014; Yardi and Boyd, 2010). Williams and colleagues (2015) confirm that SM discussions on climate change occurring cross ideologies carry out a stronger negative sentiment. Bode et al. (2015) found empirical evidence that self-affiliated users and organized online communities strategically exploit Twitter conversations to align themselves to identities, contexts, and media of their choice.

6. Enabling design affordances

SM's design affordances — how these conversational platforms are designed and the rules that govern them —play a critical role in shaping users' social behavior and can facilitate the emergence of biases. For instance, the presence or absence of specific features such as a 'like' or 'share' buttons compel and subtly encourage users to engage in certain behaviors rather than in others.

In terms of their influence on GP, we classify SM affordances according to three fundamental tasks that most users perform online: how users are passively exposed to information (feeding and prioritizing), how they actively express and share contents, and how they value and assess feedback and reactions from other.

In terms of information exposure, unlike website, blogs, and forums, where information exposure seems more intentional (Flaxman et al., 2016; Gentzkow and Shapiro, 2011; Semaan et al., 2014; Shapiro, 2013), SM is particularly effective at reaching large numbers of people and passively exposing them to desired and undesired content (Dubois and Blank, 2018; Settle, 2019). In this respect, newsfeed algorithms, such as the ones used by Facebook, can serve a dual purpose. On the one hand, they can reinforce worldviews by prioritizing content produced by like-minded people or paid advertisements tailored to what users like (Paravati et al., 2019). Such content promotion strategy can favor suppression of diversity by limiting users' exposure to alternative content (Bessi et al., 2016b).

On the other hand, SM also increasingly expose us to undesired diversity. Studies on Facebook (Settle, 2019) show that the visibility of "disagreeable others" via Facebook newsfeed favors the growth of affective polarization. This finding could be generalized to other platforms that offer affordances supporting the formation of weak ties and exposure to hostile diversity, such as Twitter.

Sharing affordances can nurture GP as well. In Twitter, for instance, users tend to be less private when sharing content thanks to the broadcasting of content to large and unknown followership via the retweet function. These features may equally support vitriolic and ideological reactions, untethered by any moderating forces of social connection (Settle, 2019; Törnberg, 2018). Literature on GP offers evidence that retweets are used both to signal agreement endorsement (Conover et al., 2011; Lai et al., 2019; Weber et al., 2013) and to carry a negative polarity, conveying a sentiment that is opposite to the one manifested in the tweet's text (Guerra et al., 2017). A less polarized and more civil discourse was instead highlighted when participants use the 'mention' feature (Conover et al., 2011).

Other SM, that are instead primarily designed to maintain stronger ties and more private/familiar networks such as Facebook, offer affordances instead that better support diffusion of information among like-minded peers (i.e. via the friendship) which appear to be very effective at spreading misinformation that is consistent with their preferences and ideological orientation (Bessi et al., 2016a; Del Vicario et al., 2016). Additionally, the possibility of creating very detailed and elaborate individual profiles reinforces the construction of strong digital identities both at the individual and group level (Settle, 2019).

Finally, in terms of access to feedback, a clear culprit favoring online GP seems to emerge in the quantification of social appreciation. It is perhaps not coincidental that a major boost to Facebook's popularity (and revenues) came after the introduction of the "like" button (Kuang and Robert Fabricant, 2019). The number of followers and number of times a message has been read/visualized/retweeted are additional examples of affordances for quantifying social feedback that directly

translate into metrics of impact and visibility of our digital presence. These affordances provide powerful incentives to get attention from other users.

Again, the amount and type of feedback users receive online can act in different ways on GP. In platforms that support sharing short messages, such as Twitter or Instagram, polarization may be favored by the need to attract large followership via provocative and compact, if not simplistic, slogans (Luo et al., 2013; Yang et al., 2017). Instead, Facebook users share more elaborate content about their identity and tastes search for positive feedback primarily in their closer social networks, but they also expose themselves to hostile reactions of people who dislike those identities and tastes (Settle, 2019).

There is certainly limited research investigating the impact of specific SM affordances on online GP. Some areas for future investigation include the following. First, existing studies are unbalanced towards the negative effects of present affordances, while there is a shortage of studies and design effort experimenting affordances that could counteract GP. Second, while studies on Twitter are relatively abundant, other more popular platforms such as Reddit, Instagram, or YouTube have not received the same level of attention. Third, it seems reasonable to expect that polarization dynamics and effects might differ in the amount and type of information shared and the solicited and expected feedback.

7. Social effects of online GP

While some scholars reported some positive effects of online GP such as the increase of trust in institutions and their representatives (Johnson et al., 2017), the positive impact of brand polarization on customers enthusiasm and revenues (Luo et al., 2013), or increase in belief accuracy (Becker et al., 2019), our analysis reveals dominance of negative social consequences that we group in three main categories:

a) Fragmentation of the online public sphere
b) Opinion radicalization
c) Diffusion of online misinformation

The fragmentation of the online public sphere into ideologically adverse sub-groups whose members predominantly interact with each other seems to be a recurring feature of the online social landscape; a tendency also labeled as cyberbalkanization (Bright, 2018; Chan et al., 2019; Chan and Fu, 2017; Merry, 2016; Zhu et al., 2017). While data show that polarization in society has constantly been growing in the last decades (Iyengar et al., 2012) and there is no firm evidence that SM is the culprit (Boxell et al., 2017). Some scholars argue that SM do contribute to such increase by nurturing affective polarization by exposure to disagreeable others, involuntary consumption of biased political news, and active engagement in controversial Discussion (END framework, Settle, 2019).

Other research focuses on whether individuals tend to shift towards radical positions after interacting with members of ideologically homogenous groups (Dandekar et al., 2013; Levendusky, 2013; Warner, 2010; Wojcieszak, 2010). GP has been accused to push individuals' to support extreme political beliefs, feelings, and attitudes (Brady et al., 2017; Romenskyy et al., 2018; Weber et al., 2013), often through verbally violent online expression and incivility (Chan et al., 2019; Kim and Kim, 2019). There is no strong evidence instead that online GP enabled by SM is a causal antecedent of for offline mobilization, as anecdotally reported for big public protest from the web to the square (such as for the Arab Spring, #Metoo, Friday for the future, and the Occupy Wall Street movements), but research show that at the very least online GP reflects the escalation of offline social tensions towards turmoil and violent clashes (Borge-Holthoefer et al., 2015; Lynch et al., 2017; Weber et al., 2013; Zhu et al., 2017).

Several studies report empirical evidence that GP favors the dissemination of fake news and misinformation (Del Vicario et al., 2017a; Törnberg, 2018; Zollo, 2019). Del Vicario et al. (2019) adopted online GP as a metric to identify online groups that were more likely to spread false or misleading rumors. Interestingly, the same dynamic is observed in both pseudo-scientific and online scientific communities (Bessi et al., 2015, 2016a; Del Vicario et al., 2016; Introne et al., 2018).

8. Comments on methodological issues on research on online GP

Research approaches adopted to study online GP differ widely. We analyzed such differences in terms of data sources, data collection methods, metrics, and investigated topic domains.

Data types include metadata, lab studies, surveys, and SM mining (Table 2.a, 2.b). Surveys can suffer from self-reporting bias and limited reach. SM mining "in the wild" emerged as a response to these limitations by providing massive access to data and objective digital tracing of individual opinions and activities. However, while SM data collection is increasingly performed through code libraries and APIs, SM mining suffers from sampling biases and a lack of transparency about how data are collected and processed.

Twitter is the main source of SM data (54 works), followed by Facebook (27), Website and blogs (15), News Media Website (13), Forum (7), and YouTube (3). Data collection methods also differ in terms of length of analysis, ranging from a few hours to up to multiple years (Table 2.c).

The domain in which online GP has been observed the most is by and large politics or politicized topics. GP is intense on public health issues such as vaccination (Giese et al., 2020; Zollo, 2019), abortion (Cho et al., 2018; Garimella et al., 2017a, 2017b), mental illness (Parsell, 2008), and epidemics (Elmedni, 2016). Even when triggered by specific events, such as the death of Venezuelan president Hugo Chavez (Morales et al., 2015) the shooting of George Tiller (Yardi and Boyd, 2010) or that of Michael Brown in Ferguson (Bodrunova et al., 2019; Park et al., 2018; Turetsky and Riddle, 2018), a polarized debate is always fueled by underlying and pre-existing political tensions. The political connotation of polarized debate is originated by "bad" diversity associated with dichotomic value-based preferences, as theorized by Page (2008) linked to underlying irreconcilable political metaphors (Lakoff, 2004).

Most works investigate GP in conversations on a single topic, but several authors replicated analysis across more topics (Barberá et al., 2015; Brady et al., 2017; Cho et al., 2018; Garimella et al., 2017a, 2017b; Gilbert et al., 2009; Guerra et al., 2013, 2017; Hameleers and van der Meer, 2020; Iyengar and Hahn, 2009; Matakos et al., 2017; Wojcieszak and Mutz, 2009; Zollo, 2019).

A detailed overview of GP metrics is reported in the online appendix. Many works use indirect measures based on self-reported users' perceptions. The alternative and increasingly more common approach is to measure GP directly from SM data through hard metrics.

Social network metrics typically assess social fragmentation among users (Bozdag et al., 2014; Garcia et al., 2015) to detect biased interactions by tracking "friendship" relations (Del Vicario et al., 2017b; Garcia et al., 2015; Medaglia and Zhu, 2016, 2017) or conversational exchanges such as retweets and mentions (Adamic and Glance, 2005; Bravo et al., 2015; Conover et al., 2011; Garcia et al., 2015; Lorentzen, 2014; Williams et al., 2015). These metrics have been criticized because they are content-neutral and because fragmentation is not necessarily the effect of polarized debate (Guerra et al., 2013).

Content-based metrics based on a semi or fully automated text analyses have then been proposed to address some of these limitations and been used to identify ideologically separate communities (Gruzd and Roy, 2014; Hemphill et al., 2016), antagonist narratives (Bode et al., 2015; Marozzo and Bessi, 2018; Turetsky and Riddle, 2018), and the emergence of extreme beliefs (Garimella et al., 2016; Romenskyy et al., 2018; Weber et al., 2013), or polarized online sentiment (Alamsyah and Adityawarman, 2017; Borge-Holthoefer et al., 2015; Finn et al., 2014; Gruzd and Roy, 2014; Merry, 2016; Primario et al., 2017).

Table 2
Overview of Social Media, Data Sources, Temporal spaces, and Topics of Analyses

a. Social Media

SM source	*#Papers*
Twitter	54
Facebook	27
WebSite	15
Blogs	15
News	13
Forums	7
YouTube	3
Weibo	2
Google+	2
Wikipedia	1
Politnetz.ch	1
KakaoTalk	1
Other	7

b. Data Sources

Souces	*#Papers*
SM Mining	76
Survey	38
Metadata	7

d. Observation Duration

Duration	*#Papers*
Less than 2 weeks	12
Less than 1 month	11
Less than 1 year	50
More than 1 year	21
Not Specified	27

c. Investigated Topic

Topic	*#Papers*
Politics	86
SM enabled Information consumption	18
Healthcare	7
Gun Control	6
Sport	6
Shooting & Crime	5
Climate Change	4
Business	4
Same-sex Marriage	3
Fracking	2
Race	2
Religion	2
Movie	2
Others	6

9. Discussion

To discuss the main findings and research gaps that emerged from the review, we identified 4 claims on the alleged role of SM in favoring a polarized online debate. These claims were constructed through the following steps. First, we performed a hierarchical clustering analysis of selected papers via NVivo, which generated a dendrogram of the most discriminating keywords. Then, we analyzed the dendrogram to identify clusters of related keywords[1]. Finally, the authors of this paper discussed this output and achieved consensus in terms of associating a topical claim to the top largest clusters. The clustering analysis and the subsequent discussion led to the identification of the 4 claims reported in Table 3. We also report the list of NVivo clustering keywords associated with each claim and an overview of whether the claim is actually supported by evidence and suggestions for future research. Each claim is discussed in detail in the following.

1. SM favor the emergence of polarizing echo-chambers that reduce users' exposure to diverse information

This claim originated from early works on online echo-cambers and filter bubbles. While there is evidence that members of homogeneously ideological group prefer intra-group interaction (Iyengar and Hahn, 2009; Lawrence et al., 2010; Medaglia and Zhu, 2017, 2016; Stroud, 2010; Warner, 2010; Wojcieszak, 2010), subsequent research showed that SM make these bubbles porous and easy to escape (Bakshy et al., 2015; Barberá, 2014; Beam et al., 2018; Dubois and Blank, 2018; Flaxman et al., 2016; Lee et al., 2014; Messing and Westwood, 2014; Semaan et al., 2014), and do not increase people tendency to consume selectively political information (Shapiro, 2013). Furthermore, the effectiveness of exposure to diverse information seems to be strongly dependent on the strength of people's pre-existing beliefs, and ideological affiliation (Bail et al., 2020; Johnson et al., 2017; Levendusky, 2013).

Combining these findings, it seems safe to conclude that, while SM exhibit affordances that favor homophilous social aggregation and propagation of unverified content, these tools not only do not limit individual freedom to access diverse information but actually provide their users with increased opportunities to do so. However, how SM filter information that end up in individual newsfeeds are far from being transparent because algorithms are intrinsically complex and SM companies have neither interest nor obligations to disclose this information. Research on incentives and effective regulations to increase SM platforms' transparency is clearly needed. The design of "persuasive" technologies (Fogg, 2002) pursuing user addiction must better regulated and vetted by companies, not just by way of legal constriction, but also through self-adopted and shared ethical design codes.

Table 3
Claims and empirical evidences

Claim	Keywords	Assessment	More research is welcome on
1. SM favor the emergence of polarizing echo-chambers that reduce users' exposure to diverse information	Echo-chambers, homophily, selective exposure, segregation, homogeneous, like-minded, similarity.	Limited evidence	– Incentives and regulations for SM transparency in information filtering – Sustainable revenues model for SM companies – Ethical Design of persuasive technologies
2. SM enabled online debate is highly fragmented and polarized	Heterogenity, conflict, diversity, discussion,cross-minded, others, disagreement, argumentation.	Ample evidence	– Interplay between endogenous and exogeneous GP – Design and test of de-polarizing affordances and policies to improve the quality/ participation tradeoff – Comparative studies (online VS offline and between different SM platforms)
3. SM communication is increasingly polarized and prone to manipulation	Opinion change, leaders, influence, voters, presidential election, campaign, deliberation.	Increasing evidence	– Types,detection of, and countermeasures to manipulative persuasion – Impact on intention and behavior of the exposure /participation to SM-enabled conversations – Polarization for social good
4. GP eases the diffusion of fake news and misinformation through SM	Misinformation, fake news, trolls, bots, fact-checking, rumor, conspiracy.	Some evidence	– GP and diffusion of information – GP and intention formation – Polarizing narratives

[1] The picture is not included for it would be difficult to visualize but it is available on request to the authors.

Since some of these negative effects are the product of the way SM companies monetize online traffic, users' data, and user-generated generated content, equally urgent is work on revenue models for SM companies that are more respectful of individual freedom and privacy, as well as of the quality of content and interaction they host. In this respect, it would be interesting to assess the effectiveness of self-regulation attempts of both algorithmic and non-algorithmic nature, adopted by some SM platforms as ways to improve the quality of the content they host. Notable examples include the Facebook Oversight board, a panel of experts that work as the ultimate judges deciding when an account should be suppressed, Google initiative to curate search results that are most trustworthy and accurate for users looking for information on COVID 19 news and remedies, or Twitter #ThinkBeforeSharing prompt which notifies users when they are about to share an article.

2. SM-enabled debate is highly fragmented and polarized

Most works identify ideological fragmentation as a stable trait of the online public sphere (Garcia et al., 2015; Garimella and Weber, 2017; Hanna et al., 2013; Yang et al., 2017). Opposite, although minoritarian evidence of absence of ideologically fragmented social networks has also been found (Barberá et al., 2015; Costa e Silva, 2014; Dubois and Blank, 2018; Flaxman et al., 2016).

Available theories explain the relationship between online GP and fragmentation in two fundamental ways.

Approaches such as the ones based on Social Comparison and Social Identity see GP as a *confirmative, endogenous* process aimed at suppressing internal diversity to increase group cohesion and internal integration. Endogenous GP manifests through judgment shifts towards the group norm and is nurtured by mutual reinforcement and support towards like-minded peers. Argumentation theory sees polarization as an *affirmative, exogenous* process through which the group members fight rhetorical battles to prevail against their opponents. Exogenous GP manifests through a judgment shift increasing the distance from the supporters of the rival position. These two dynamics are both responsible for fragmentation, either by isolation or by confrontation, and can reinforce each other. Endogenous and exogenous GP dynamics have been mostly studied in isolation, but in fact, they interact. Thus, more research aimed at creating more comprehensive models for online social interaction is needed to increase our understanding of this interplay.

More research is also needed to better understand the unique ways in which SM contribute to GP and the characteristics of online GP vis a vis polarization in the offline world. For instance, recent studies on Facebook data have found evidence that SM affect both the scale and the nature of polarization favoring affective polarization (Settle, 2019) and the diffused perception that society is more ideologically divided than it actually is.

Interestingly, some scholars found that SM-enabled cross-ideological debate can be beneficial. Balcells and Padró-Solanet (2016) show that cross-minded conversations can lead to more genuine and articulated deliberation and valuable democratic spaces that can favor de-polarization (Beam et al., 2018), or that anyway do not lead to an increase in polarization beyond pre-existing levels (Merry, 2016). Shi et al. (2019) found that ideologically heterogeneous Wikipedia groups working on politically sensitive topics engaged in longer, more constructive, and focused debates and created better quality articles than teams of ideological moderates.

Overall, while there is no strong evidence that SM are a cause of increased polarization in society, these tools definitely favor polarized debate in ways that are specific to the online environment. On the one hand, SM companies do not seem particularly vested in the development of interactional affordances or policies that could temper this problem, especially when these innovations could have a negative impact on traffic monetization (Settle, 2019). On the other hand, with all their limitations, SM provide opportunities for pluralism and increased access to information. Research can help to identify suitable changes at the policy and design level to better handle the trade-off between quality and participation. Insights in this respect could come from more systematic comparisons of existing platforms in terms of polarizing power (Min and Yun, 2018).

3. SM communication is increasingly polarized and prone to manipulation

It has become a frequent practice for politicians, leaders, and influencers to adopt communicative styles expressing moral and emotional endorsement to increase their visibility and online exposure (Brady et al., 2017). Research findings show that increasingly SM communication is deliberately aimed at creating polarization. Morales et al. (2015) propose a model in which polarized opinions spread from elite nodes to a larger audience. In a comparative study, Yang et al. (2016) found that for all of 10 investigated counties, people who acquired their news online tended to perceive a more polarized polity, and if they had extreme issue positions, they also perceive more polarization among the parties. Levendusky's (2013) work shows that motivated reasoning and persuasive arguments by partisan media can polarize voters. Turetsky and Riddle (2018) demonstrate that online GP increases when media sources favor emotionally charged and stereotyped news coverage. In the Cambridge Analytica scandal, political marketers deliberately targeted persuadable individuals with polarized content to tip these voters' choices confirming research showing that polarization depends on individuals' personality (Bessi, 2016).

Another target of induced polarization is the ideological consolidation of own supporters' base. In a recent study on the use of trolls in recent elections in the US, Bail et al. (2020) found that Russian trolls mainly targeted users already polarized. This finding can be predicted based on the endogenous/exogenous character of GP. Since exposure to contrarian information can backfire, there is little gain in targeting voters with solid opposite opinions, whereas it can be more beneficial to reinforce internal cohesion in groups that are already supportive and leverage them to convince persuadable users.

Events such as the Cambridge Analytica scandal or the SM-channeled influence of Russian trolls in the recent US general elections show that there is reason for concerns as well as an ineffective and limited intervention to detect, contain, or punish these attempts. These concerns are aggravated by incomplete evidence on how exposure/participation in SM-enabled conversations can affect individuals' choices and by the availability of limited research on the detection of manipulative tactics and on the design of effective countermeasures.

In opposition to deliberate manipulation carried out by specific individuals or agencies, some works have investigated ways in which behavioral changes are triggered by non-manipulative social influence in homogeneous groups. Becker et al. (2019) found that information exchange between members of an ideologically homogeneous crowd increased belief accuracy. Others have demonstrated the power of peer pressure to induce the adoption of virtuous behaviors for a healthier lifestyle (Centola, 2011) or reduce of energy consumption (Pentland and Petkoff, 2014). Research on social intelligence activated by non-manipulative polarization and transparent design is a fascinating topic that deserves more attention.

4. GP eases the diffusion of fake news and misinformation through SM

Online GP facilitates the diffusion of information of questionable quality (Bessi et al., 2016a, 2015; Del Vicario et al., 2019, 2016; Hameleers and van der Meer, 2020; Törnberg, 2018; Zollo, 2019). Easy access to unlimited but biased information creates overconfident people (Parsell, 2008) who are skeptical toward experts and often considered them as an elite group with vested interests (Bessi et al., 2015; Marozzo and Bessi, 2018; Nichols, 2017).

The propagation of misinformation can be considered the effect of a mechanism in which dubious news, when presented in a way that is consistent with existing value-based preferences, not only end up being more easily accepted by the community but also foster additional propagation through selective sharing (Giese et al., 2020; Wang et al., 2018). Polarization acts as a sort of social fuel that makes the creation and diffusion of misleading information more likely by members of

ideologically homogeneous groups. On the other hand, information exchange inside and across partisan crowds can also be beneficial (Becker et al., 2019; Shi et al., 2019), so more research is definitely welcome to understand under which conditions and through which interaction rules and modes of polarization can work as a positive force.

The energizing effect of GP, for good or evil, and its alleged ability to influence not only opinion formation but also intention formation and actual mobilization (Sunstein, 2002a) is another topic that needs more evidence and for which a perspective based on information diffusion could be helpful. In this respect, several authors have investigated the role of shared narratives in GP (Bode et al., 2015; Marozzo and Bessi, 2018; Turetsky and Riddle, 2018). These studies show that the co-creation of persuasive stories is a key process in polarized groups of like-minded individuals. This is a fascinating mechanism that can help to better understanding the inner workings of GP and offers implications in terms of how to counteract online diffusion of misleading information.

9.1. Additional Implications for practitioners

In addition to the suggestions for research outlined above, it is possible to identify additional implications for practitioners. Those include digital designers, influencers and marketing professionals, and other communicators such as politicians and policy-makers.

New approaches to the design of digital interaction are offering promising developments. The positive computing movement advocates for the primacy of individual and societal well-being over other technical and business performance in the design of digital tools (Calvo and Dorian, 2015). Research in this field has identified a rich set of design criteria articulated by the level of impact (intra-personal, inter-personal, extra-personal), and there is much room for research and development in the application of positive computing-inspired interaction frameworks to the redesign of SM platform. Studies on online collaboration and internet-enabled collective deliberation show examples of how the redesign of certain visual affordances can improve individual and group well-being-related factors such as mutual understanding and perceived quality of collaboration (Iandoli et al., 2014). In addition, to work positively on improving users' well-being, designers should provide more effort in rethinking affordances associated with polarization or introducing adequate countermeasures. Some SM platforms as Facebook, are experimenting with AI-driven algorithms that can detect and possibly neutralize offensive content and hate speech. Ironically, such attempts can produce themselves biased results. For instance, a study by Sap et al. (2020) that content posted by black users was more likely to be tagged as racist than posts published by white users. It seems SM platforms are investing definitely more on detection technologies than on developing digital affordances that nudge users to adopt more balanced and civilized online behavior.

Marketers and influencers can leverage polarizing dynamics to enforce affection to a brand (Luo et al., 2013) and even leverage brand negativity to better focus their marketing efforts on its lovers (Osuna Ramírez et al., 2019). Increasingly, companies try to create or nurture their followership by taking sides in polarizing social or political issues (Kiprop and Samii, 2020). An example is Benetton's campaigns promoting racial diversity and against sex and gender discrimination or the recent initiatives by many US companies reacting to the approval of laws that in several States impose restrictions to voting rights, such as Delta Airline and Coca-Cola rebutting the recently approved electoral law in the State they are based (Georgia). Policy-makers could also attempt to do a better job at leveraging polarization in positive ways, for instance, to favor the adoption of virtuous behaviors thanks to the persuading force of polarized narratives, by exploiting the same mechanisms that in polarized crowds support the diffusion of misinformation. While not in the context of SM, academic studies have shown the power of virtual networks to favor the adoption of healthy behaviors such as proper dieting and exercise (Centola, 2011) or in energy savings (Pentland and Petkoff, 2014).

Following the theory of discursive argumentation, it is important to remark that GP is a spontaneous group dynamic that can help a collective achieve cohesion, internal integration, and coordinate to advance a shared agenda. As such, it is hard, if not impossible, to suppress. Instead, the manipulations and the covert tactics that can leverage polarized crowds to pursue opaque agenda and condition individual behavior without making their targets aware of this action should be taken into account. Then, policy-makers' implication is to identify appropriate regulations to preempt and sanction severely individuals or organizations that pursue polarization without the necessary transparency and by deliberately diffusing blatantly fake information.

10. Conclusion

In this paper, we have carried out an extensive review on online GP occurring through SM. We have identified the main GP antecedents, effects, theoretical and technical explanations and used this body of research to assess claims accusing SM to facilitate GP and identified areas for future research. Based on our analysis, we claim that a better understanding of online GP is crucial for scholars, digital designers/entrepreneurs, and regulators alike, given its impact on fundamental aspects of how digital information is consumed and created through SM, such as the quality of user experience, the economic, social and ethical sustainability of SM business, and the repercussions on the quality of online political discourse.

Our analysis clearly recognizes the importance of the research work on the dark side of SM and shows that most of the negative consequences deriving from SM abuse are related to the fact that these platforms second dysfunctional group dynamics such as GP. An increasing number of users expressing their frustration with SM or invitations to abandon these tools can be observed as reaction to such dysfunctions (Lanier, 2018).

On the other hand, there is less abundant but not less valid research showing how users can benefit from SM and even from GP when the interaction is leveraged and managed to channel participation towards mutual support, better deliberation, and increased access to diverse information. Overall our analysis shows that attributing all the blame to SM is simplistic and that instead, GP appears to be the consequence of a mix including a) individual choices in the way contents are consumed and shared on SM; b) the way leaders communicate on SM; c) revenues model that is primarily driven by traffic and addiction; and d) spontaneous social dynamics that are at work both online and offline but that are amplified and distorted by current SM affordances. Last but not least, it clearly emerges that SM-enabled dysfunctional group dynamics are equally the result of the combination of weak regulation and lack of ethical design. For instance, the manipulation tactics at work in the Cambridge Analytica scandal have been compared by a British Court to information cyber-warfare (Cadwadadr, 2018). However, there is still no trace of real countermeasure in current legislation or SM companies' self-conduct to prevent the use of military-grade propaganda tools from being applied online to manipulate opinions in non-military applications.

We are concerned that the current trend toward the growing consensus around proposals aimed at limiting freedom of speech and controlling user-generated content is also driven by an insufficient understanding of the GP phenomenon and the lack of a more rational and evidence-based assessment of its consequences. This review helped us to identify a series of under-investigated topics for future research that are summarized in Table 3, and we hope that these suggestions will be useful to other scholars to increase the knowledge of this phenomenon and to offer more nuanced and smart ideas to policy-makers for the

pursuit of better cyberspace.[2]

CRediT authorship contribution statement

Luca Iandoli: Conceptualization, Investigation, Supervision, Writing – review & editing. **Simonetta Primario:** Conceptualization, Investigation, Visualization, Writing – review & editing. **Giuseppe Zollo:** Conceptualization, Investigation, Supervision, Writing – review & editing.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.techfore.2021.120924.

References

Adamic, L.A., Glance, N., 2005. The political blogosphere and the 2004 U.S. Election: Divided they blog. In: Proceedings of the 3rd International Workshop on Link Discovery - LinkKDD '05, pp. 36–43. https://doi.org/10.1145/1134271.1134277.

Alamsyah, A., Adityawarman, F., 2017. Hybrid sentiment and network analysis of social opinion polarization, 2017. In: 5th International Conference on Information and Communication Technology (ICoIC7). IEEE, pp. 1–6. https://doi.org/10.1109/ICoICT.2017.8074650.

Bail, C.A., Argyle, L.P., Brown, T.W., Bumpus, J.P., Chen, H., Hunzaker, M.B.F., Lee, J., Mann, M., Merhout, F., Volfovsky, A., 2018. Exposure to opposing views on social media can increase political polarization. Proc. Natl. Acad. Sci. 115, 9216–9221. https://doi.org/10.1073/pnas.1804840115.

Bail, C.A., Guay, B., Maloney, E., Combs, A., Hillygus, D.S., Merhout, F., Freelon, D., Volfovsky, A., 2020. Assessing the Russian Internet Research Agency's impact on the political attitudes and behaviors of American Twitter users in late 2017. Proc. Natl. Acad. Sci. 117, 243–250. https://doi.org/10.1073/pnas.1906420116.

Bakshy, E., Messing, S., Adamic, L.A., 2015. Exposure to ideologically diverse news and opinion on Facebook. Science (80-.). 348, 1130–1132. https://doi.org/10.1126/science.aaa1160.

Balcells, J., Padró-Solanet, A., 2016. Tweeting on Catalonia's Independence: The Dynamics of Political Discussion and Group Polarisation. Medijske Stud 7, 124–141. https://doi.org/10.20901/ms.7.14.9.

Barberá, P., 2014. How Social Media Reduces Mass Political Polarization . Evidence from Germany, Spain, and the U.S. Job Mark. Pap 46, 1–46.

Barberá, P., Jost, J.T., Nagler, J., Tucker, J.A., Bonneau, R., 2015. Tweeting From Left to Right. Psychol. Sci. 26, 1531–1542. https://doi.org/10.1177/0956797615594620.

Beam, M.A., Hutchens, M.J., Hmielowski, J.D., 2018. Facebook news and (de) polarization: reinforcing spirals in the 2016 US election. Information. Commun. Soc. 21, 940–958. https://doi.org/10.1080/1369118X.2018.1444783.

Becker, J., Porter, E., Centola, D., 2019. The wisdom of partisan crowds. Proc. Natl. Acad. Sci 116, 10717–10722. https://doi.org/10.1073/pnas.1817195116.

Bessi, A., 2016. Personality traits and echo chambers on facebook. Comput. Human Behav. 65, 319–324. https://doi.org/10.1016/j.chb.2016.08.016.

Bessi, A., Petroni, F., Del Vicario, M., Zollo, F., Anagnostopoulos, A., Scala, A., Caldarelli, G., Quattrociocchi, W., 2016a. Homophily and polarization in the age of misinformation. Eur. Phys. J. Spec. Top. 225, 2047–2059. https://doi.org/10.1140/epjst/e2015-50319-0.

Bessi, A., Petroni, F., Del Vicario, M., Zollo, F., Anagnostopoulos, A., Scala, A., Caldarelli, G., Quattrociocchi, W., 2015. Viral Misinformation: The Role of Homophily and Polarization. In: Proceedings of the 24th International Conference on World Wide Web. ACM, New York, NY, USA, pp. 355–356. https://doi.org/10.1145/2740908.2745939.

Bessi, A., Zollo, F., Del Vicario, M., Puliga, M., Scala, A., Caldarelli, G., Uzzi, B., Quattrociocchi, W., 2016b. Users Polarization on Facebook and Youtube. PLoS One 11, e0159641. https://doi.org/10.1371/journal.pone.0159641.

Bode, L., Hanna, A., Yang, J., Shah, D.V., 2015. Candidate Networks, Citizen Clusters, and Political Expression. Ann. Am. Acad. Pol. Soc. Sci. 659, 149–165. https://doi.org/10.1177/0002716214563923.

Bodrunova, S.S., Blekanov, I., Smoliarova, A., Litvinenko, A., 2019. Beyond Left and Right: Real-World Political Polarization in Twitter Discussions on Inter-Ethnic Conflicts. Media Commun. 7, 119–132. https://doi.org/10.17645/mac.v7i3.1934.

Borge-Holthoefer, J., Magdy, W., Darwish, K., Weber, I., 2015. Content and Network Dynamics Behind Egyptian Political Polarization on Twitter. In: Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing. ACM, New York, NY, USA, pp. 700–711 https://doi.org/10.1145/2675133.2675163.

Boxell, L., Gentzkow, M., Shapiro, J.M., 2017. Greater Internet use is not associated with faster growth in political polarization among US demographic groups. Proc. Natl. Acad. Sci. 114, 10612–10617. https://doi.org/10.1073/pnas.1706588114.

Bozdag, E., Gao, Q., Houben, G.-J., Warnier, M., 2014. Does offline political segregation affect the filter bubble? An empirical analysis of information diversity for Dutch and Turkish Twitter users. Comput. Human Behav. 41, 405–415. https://doi.org/10.1016/j.chb.2014.05.028.

Brady, W.J., Wills, J.A., Jost, J.T., Tucker, J.A., Van Bavel, J.J., 2017. Emotion shapes the diffusion of moralized content in social networks. In: Proceedings of the National Academy of Sciences, pp. 7313–7318. https://doi.org/10.1073/pnas.1618923114.

Bravo, R.B., Del Valle, M.E., Gavidia, A.R., 2015. A multilayered analysis of polarization and leaderships in the Catalan Parliamentarians' Twitter Network, 2015. In: Fifteenth International Conference on Advances in ICT for Emerging Regions (ICTer). IEEE, pp. 200–206. https://doi.org/10.1109/ICTER.2015.7377689.

Bright, J., 2018. Explaining the Emergence of Political Fragmentation on Social Media: The Role of Ideology and Extremism. J. Comput. Commun. 23, 17–33. https://doi.org/10.1093/jcmc/zmx002.

Burtt, H.E., 1920. Sex Differences in the Effect of Discussion. J. Exp. Psychol. 3, 390–395. https://doi.org/10.1037/h0072937.

Cadwadadr, C., 2018. 'I made Steve Bannon's Psychological Warfare Tool': Meet The Data War Whistleblower. Guard 1–14.

Calvo, R.A., Dorian, P., 2015. Positive computing: technology for wellbeing and human potential. MIT Press.

Centola, D., 2011. An Experimental Study of Homophily in the Adoption of Health Behavior. Science (80-.). 334, 1269–1272. https://doi.org/10.1126/science.1207055.

Chan, C., Chow, C.S., Fu, K., 2019. Echoslamming: how incivility interacts with cyberbalkanization on the social media in Hong Kong. Asian J. Commun. 29, 307–327. https://doi.org/10.1080/01292986.2019.1624792.

Chan, C., Fu, K., 2017. The Relationship Between Cyberbalkanization and Opinion Polarization: Time-Series Analysis on Facebook Pages and Opinion Polls During the Hong Kong Occupy Movement and the Associated Debate on Political Reform. J. Comput. Commun. 22, 266–283. https://doi.org/10.1111/jcc4.12192.

Cho, J., Ahmed, S., Keum, H., Choi, Y.J., Lee, J.H., 2018. Influencing Myself: Self-Reinforcement Through Online Political Expression. Communic. Res. 45, 83–111. https://doi.org/10.1177/0093650216644020.

Conover, M.D., Ratkiewicz, J., Francisco, M., Gonçalves, B., Menczer, F., Flammini, A., 2011. Political polarization on twitter. In: Fifth International AAAI Conference on Weblogs and Social Media, pp. 89–96.

Costa e Silva, E., 2014. A deliberative public sphere? Picturing Portuguese political blogs. Observatorio 8, 187–204.

Dandekar, P., Goel, A., Lee, D.T., 2013. Biased assimilation, homophily, and the dynamics of polarization. In: Proceedings of the National Academy of Sciences, pp. 5791–5796. https://doi.org/10.1073/pnas.1217220110.

Del Vicario, M., Bessi, A., Zollo, F., Petroni, F., Scala, A., Caldarelli, G., Stanley, H.E., Quattrociocchi, W., 2016. The spreading of misinformation online. Proc. Natl. Acad. Sci. 113, 554–559. https://doi.org/10.1073/pnas.1517441113.

Del Vicario, M., Gaito, S., Quattrociocchi, W., Zignani, M., Zollo, F., 2017a. News consumption during the Italian referendum: A cross-platform analysis on facebook and twitter. In: Proceedings - 2017 International Conference on Data Science and Advanced Analytics. DSAA 2017. IEEE, pp. 648–657. https://doi.org/10.1109/DSAA.2017.33.

Del Vicario, M., Quattrociocchi, W., Scala, A., Zollo, F., 2019. Polarization and Fake News: Early Warning of Potential Misinformation Targets, in: ACM Transactions on the Web. pp. 1–22. https://doi.org/arXiv:1802.01400.

Del Vicario, M., Zollo, F., Caldarelli, G., Scala, A., Quattrociocchi, W., 2017b. Mapping social dynamics on Facebook: The Brexit debate. Soc. Networks 50, 6–16. https://doi.org/10.1016/j.socnet.2017.02.002.

Dubois, E., Blank, G., 2018. The echo chamber is overstated: the moderating effect of political interest and diverse media. Information. Commun. Soc. 21, 729–745. https://doi.org/10.1080/1369118X.2018.1428656.

Easterby-Smith, M., Thorpe, R., Jackson, P.R., 2015. Management and business research, 5th ed. Ltd SAGE Pubns.

Elmedni, B., 2016. Death of Rationality: The Social Networks' Factor in Policy Response to Ebola. Int. J. Public Adm. 39, 917–926. https://doi.org/10.1080/01900692.2015.1057851.

Everton, S.F., 2016. Social Networks and Religious Violence. Rev. Relig. Res. 58, 191–217. https://doi.org/10.1007/s13644-015-0240-3.

Festinger, L., 1954. A Theory of Social Comparison Processes. Hum. Relations 7, 117–140. https://doi.org/10.1177/001872675400700202.

Finn, S., Mustafaraj, E., Metaxas, P.T., 2014. The Co-retweeted Network and Its Applications for Measuring the Perceived Political Polarization. In: Proceedings of the 10th International Conference on Web Information Systems and Technologies, WEBIST. SCITEPRESS - Science and and Technology Publications, pp. 276–284. https://doi.org/10.5220/0004788702760284.

Flaxman, S., Goel, S., Rao, J.M., 2016. Filter Bubbles, Echo Chambers, and Online News Consumption. Public Opin. Q. 80, 298–320. https://doi.org/10.1093/poq/nfw006.

Fogg, B.J., 2002. Persuasive Technology: Using Computers to Change What We Think and Do. Elsevier. https://doi.org/10.1016/B978-1-55860-643-2.X5000-8.

Garcia, D., Abisheva, A., Schweighofer, S., Serdült, U., Schweitzer, F., 2015. Ideological and Temporal Components of Network Polarization in Online Political Participatory Media. Policy & Internet 7, 46–79. https://doi.org/10.1002/poi3.82.

Garimella, K., De Francisci Morales, G., Gionis, A., Mathioudakis, M., 2017a. The Ebb and flow of controversial debates on social media. In: Proceedings of the 11th International Conference on Web and Social Media, ICWSM 2017, pp. 524–527 https://doi.org/ArxiV:1703.05994.

Garimella, K., Gionis, A., De Francisci Morales, G., Mathioudakis, M., 2017b. The effect of collective atention on controversial debates on social media. In: WebSci 2017 - Proceedings of the 2017 ACM Web Science Conference. ACM Press, New York, New

[2] The reference list includes only works quoted in the paper. The full list of the 121 works analyzed in this review is available online in the supplemental material

York, USA, pp. 43–52. https://doi.org/10.1145/3091478.3091486 https://doi.org/https://doi.org/.
Garimella, K., Weber, I., 2017. A long-term analysis of polarization on Twitter. In: Proceedings of the 11th International Conference on Web and Social Media, ICWSM 2017, pp. 528–531 https://doi.org/ArxiV:1703.02769.
Garimella, K., Weber, I., De Choudhury, M., 2016. Quote RTs on Twitter: Usage of the New Feature for Political Discourse. In: Proceedings of the 8th ACM Conference on Web Science - WebSci '16. ACM Press, New York, New York, USA, pp. 200–204. https://doi.org/10.1145/2908131.2908170.
Garrett, R.K., 2009. Echo chambers online?: Politically motivated selective exposure among Internet news users. J. Comput. Commun. 14, 265–285. https://doi.org/10.1111/j.1083-6101.2009.01440.x.
Garrett, R.K., Gvirsman, S.D., Johnson, B.K., Tsfati, Y., Neo, R.L., Dal, A., 2014. Implications of Pro- and Counterattitudinal Information Exposure for Affective Polarization. Hum. Commun. Res. 40, 309–332. https://doi.org/10.1111/hcre.12028.
Gentzkow, M., Shapiro, J.M., 2011. Ideological Segregation Online and Offline. Q. J. Econ. 126, 1799–1839. https://doi.org/10.1093/qje/qjr044.
Giese, H., Neth, H., Moussaïd, M., Betsch, C., Gaissmaier, W., 2020. The echo in flu-vaccination echo chambers: Selective attention trumps social influence. Vaccine 38, 2070–2076. https://doi.org/10.1016/j.vaccine.2019.11.038.
Gilbert, E., Bergstrom, T., Karahalios, K., 2009. Blogs are Echo Chambers: Blogs are Echo Chambers. In: 42nd Hawaii International Conference on System Sciences. IEEE, pp. 1–10. https://doi.org/10.1109/HICSS.2009.91.
Gruzd, A., Roy, J., 2014. Investigating Political Polarization on Twitter: A Canadian Perspective. Policy & Internet 6, 28–45. https://doi.org/10.1002/1944-2866.POI354.
Guerra, P.C., Meira, W., Cardie, C., Kleinberg, R., 2013. A measure of polarization on social media networks based on community boundaries. In: Proceedings of the 7th International Conference on Weblogs and Social Media, ICWSM 2013, pp. 215–224.
Guerra, P.C., Souza, R.C.S.N.P., Assunção, R.M., Meira, W., 2017. Antagonism also flows through retweets: The impact of out-of-context quotes in opinion polarization analysis. In: Proceedings of the 11th International Conference on Web and Social Media, ICWSM 2017, pp. 536–539 https://doi.org/arXiv:1703.03895.
Hameleers, M., van der Meer, T.G.L.A., 2020. Misinformation and Polarization in a High-Choice Media Environment: How Effective Are Political Fact-Checkers? Communic. Res. 47, 227–250. https://doi.org/10.1177/0093650218819671.
Hanna, A., Wells, C., Maurer, P., Friedland, L., Shah, D., Matthes, J., 2013. Partisan alignments and political polarization online. In: Proceedings of the 2nd Workshop on Politics, Elections and Data - PLEAD '13. ACM Press, New York, New York, USA, pp. 15–22. https://doi.org/10.1145/2508436.2508438.
Hemphill, L., Culotta, A., Heston, M., 2016. #Polar Scores: Measuring partisanship using social media content. J. Inf. Technol. Polit. 13, 365–377. https://doi.org/10.1080/19331681.2016.1214093.
Hemsley, J., Jacobson, J., Gruzd, A., Mai, P., 2018. Social Media for Social Good or Evil. An Introduction. Soc. Media Soc. 4. https://doi.org/10.1177/2056305118786719.
Iandoli, L., Quinto, I., De Liddo, A., Buckingham Shum, S., 2014. Socially augmented argumentation tools: Rationale, design and evaluation of a debate dashboard. Int. J. Hum. Comput. Stud. 72, 298–319. https://doi.org/10.1016/j.ijhcs.2013.08.006.
Introne, J., Gokce Yildirim, I., Iandoli, L., DeCook, J., Elzeini, S., 2018. How People Weave Online Information Into. Pseudoknowledge. Soc. Media + Soc 4. https://doi.org/10.1177/2056305118785639, 205630511878563.
Isenberg, D.J., 1986. Group polarization: A critical review and meta-analysis. J. Pers. Soc. Psychol. 50, 1141–1151. https://doi.org/10.1037/0022-3514.50.6.1141.
Iyengar, S., Hahn, K.S., 2009. Red Media, Blue Media: Evidence of Ideological Selectivity in Media Use. J. Commun. 59, 19–39. https://doi.org/10.1111/j.1460-2466.2008.01402.x.
Iyengar, S., Sood, G., Lelkes, Y., 2012. Affect, Not Ideology. A social identity perspective on polarization. Public Opin. Q. 76, 405–431. https://doi.org/10.1093/poq/nfs038.
Johnson, T.J., Kaye, B.K., Lee, A.M., 2017. Blinded by the Spite? Path Model of Political Attitudes, Selectivity, and Social Media. Atl. J. Commun 25, 181–196. https://doi.org/10.1080/15456870.2017.1324454.
Kim, Yonghwan, Kim, Youngju, 2019. Incivility on Facebook and political polarization: The mediating role of seeking further comments and negative emotion. Comput. Human Behav. 99, 219–227. https://doi.org/10.1016/j.chb.2019.05.022.
Kiprop, B., Samii, L., 2020. Cause-related marketing in a polarised global marketplace. J. Brand Strateg. 9, 271–283.
Kuang, C., Fabricant, Robert, 2019. User friendly: How the hidden rules of design are changing the way we live, work, and play. Random House.
Lai, M., Tambuscio, M., Patti, V., Ruffo, G., Rosso, P., 2019. Stance polarity in political debates: A diachronic perspective of network homophily and conversations on Twitter. Data Knowl. Eng. 124, 101738 https://doi.org/10.1016/j.datak.2019.101738.
Lakoff, G., 2004. Don't think of an elephant!: know your values and frame the debate: the essential guide for progressives, 1st ed. Chelsea Green Publishing Company.
Lamm, H., 1988. A Review of Our Research on Group Polarization: Eleven Experiments on the Effects of Group Discussion on Risk Acceptance, Probability Estimation, and Negotiation Positions. Psychol. Rep. 62, 807–813. https://doi.org/10.2466/pr0.1988.62.3.807.
Lanier, J., 2018. 10 reasons for deleting your social media accounts right now, 1st ed. Bodley Head.
Lawrence, E., Sides, J., Farrell, H., 2010. Self-Segregation or Deliberation? Blog Readership, Participation, and Polarization in American Politics. Perspect. Polit 8, 141–157. https://doi.org/10.1017/S1537592709992714.
Lee, J.K., Choi, J., Kim, C., Kim, Y., 2014. Social Media, Network Heterogeneity, and Opinion Polarization. J. Commun. 64, 702–722. https://doi.org/10.1111/jcom.12077.
Levendusky, M.S., 2013. Why Do Partisan Media Polarize Viewers? Am. J. Pol. Sci. 57, 611–623. https://doi.org/10.1111/ajps.12008.
Lorentzen, D.G., 2014. Polarisation in political twitter conversations. Aslib J. Inf. Manag. 66, 329–341. https://doi.org/10.1108/AJIM-09-2013-0086.
Luo, X., Wiles, M., Raithel, S., 2013. Make the most of a polarizing brand. Harv. Bus. Rev.
Lynch, M., Freelon, D., Aday, S., 2017. Online clustering, fear and uncertainty in Egypt's transition. Democratization 24, 1159–1177. https://doi.org/10.1080/13510347.2017.1289179.
Marozzo, F., Bessi, A., 2018. Analyzing polarization of social media users and news sites during political campaigns. Soc. Netw. Anal. Min. 8, 1–13. https://doi.org/10.1007/s13278-017-0479-5.
Matakos, A., Terzi, E., Tsaparas, P., 2017. Measuring and moderating opinion polarization in social networks. Data Min. Knowl. Discov. 31, 1480–1505. https://doi.org/10.1007/s10618-017-0527-9.
Medaglia, R., Zhu, D., 2017. Public deliberation on government-managed social media: A study on Weibo users in China. Gov. Inf. Q. 34, 533–544. https://doi.org/10.1016/j.giq.2017.05.003.
Medaglia, R., Zhu, D., 2016. Paradoxes of Deliberative Interactions on Government-Managed Social Media. In: Proceedings of the 17th International Digital Government Research Conference on Digital Government Research. ACM Press, New York, New York, USA, pp. 435–444. https://doi.org/10.1145/2912160.2912184.
Mercier, H., Sperber, D., 2011. Why do humans reason? Arguments for an argumentative theory. Behav. Brain Sci. 34, 57–74 https://doi.org/10.1017/S0140525×10000968.
Merry, M., 2016. Making friends and enemies on social media: the case of gun policy organizations. Online Inf. Rev. 40, 624–642. https://doi.org/10.1108/OIR-10-2015-0333.
Messing, S., Westwood, S.J., 2014. Selective Exposure in the Age of Social Media: Endorsements Trump Partisan Source Affiliation When Selecting News Online. Communic. Res. 41, 1042–1063. https://doi.org/10.1177/0093650212466406.
Min, H., Yun, S., 2018. Selective Exposure and Political Polarization of Public Opinion on the Presidential Impeachment in South Korea : Facebook vs. KakaoTalk. Korea Obs. - Inst. Korean Stud. 49, 137–159. https://doi.org/10.29152/KOIKS.2018.49.1.137.
Morales, A.J., Borondo, J., Losada, J.C., Benito, R.M., 2015. Measuring political polarization: Twitter shows the two sides of Venezuela. Chaos An Interdiscip. J. Nonlinear Sci. 25, 033114 https://doi.org/10.1063/1.4913758.
Morin, D.T., Flynn, M.A., 2014. We Are the Tea Party!: The Use of Facebook as an Online Political Forum for the Construction and Maintenance of in-Group Identification during the "GOTV" Weekend. Commun. Q. 62, 115–133. https://doi.org/10.1080/01463373.2013.861500.
Moscovici, S., Doise, W., Dulong, R., 1972. Studies in group decision II: Differences of positions, differences of opinion and group polarization. Eur. J. Soc. Psychol. 2, 385–399. https://doi.org/10.1002/ejsp.2420020404.
Myers, D.G., Lamm, H., 1976. The group polarization phenomenon. Psychol. Bull. 83, 602–627. https://doi.org/10.1037/0033-2909.83.4.602.
Nelimarkka, M., Rancy, J.P., Grygiel, J., Semaan, B., 2019. (Re)Design to Mitigate Political Polarization. Reflecting Habermas' ideal communication space in the United States of America and Finland. In: Proceedings of the ACM on Human-Computer Interaction, pp. 1–25. https://doi.org/10.1145/3359243.
Nichols, T., 2017. The death of expertise: The campaign against established knowledge and why it matters. Oxford University Press, Oxford University Press.
Osuna Ramírez, S.A., Veloutsou, C., Morgan-Thomas, A., 2019. I hate what you love: brand polarization and negativity towards brands as an opportunity for brand management. J. Prod. Brand Manag. 28, 614–632. https://doi.org/10.1108/JPBM-03-2018-1811.
Page, S.E., 2008. The Difference: How the power of diversity creates better groups, firms, schools, and societies. Princeton University Press. https://doi.org/10.5860/choice.45-1534.
Paravati, E., Naidu, E., Gabriel, S., Wiedemann, C., 2019. More than just a tweet: The unconscious impact of forming parasocial relationships through social media. Psychol. Conscious. Theory, Res. Pract 1–16. https://doi.org/10.1037/cns0000214.
Pariser, E., 2011. The Filter Bubble: What the Internet is Hiding from You. Penguin UK.
Park, Y.J., Jang, S.M., Lee, H., Yang, G.S., 2018. Divide in Ferguson: Social Media, Social Context, and Division. Soc. Media Soc 4, 1–13. https://doi.org/10.1177/2056305118789630.
Parsell, M., 2008. Pernicious virtual communities: Identity, polarisation and the Web 2.0. Ethics Inf. Technol. 10, 41–56. https://doi.org/10.1007/s10676-008-9153-y.
Pentland, A., Petkoff, R., 2014. Social Physics: How Good Ideas Spread - The Lessons from a New Science. Penguin.
Primario, S., Borrelli, D., Iandoli, L., Zollo, G., Lipizzi, C., 2017. Measuring Polarization in Twitter Enabled in Online Political Conversation: The Case of 2016 US Presidential Election. In: 2017 IEEE International Conference on Information Reuse and Integration (IRI). IEEE, pp. 607–613. https://doi.org/10.1109/IRI.2017.73.
Prior, M., 2013. Media and Political Polarization. Annu. Rev. Polit. Sci. 16, 101–127. https://doi.org/10.1146/annurev-polisci-100711-135242.
Romenskyy, M., Spaiser, V., Ihle, T., Lobaskin, V., 2018. Polarized Ukraine 2014: opinion and territorial split demonstrated with the bounded confidence XY model, parametrized by Twitter data. R. Soc. Open Sci. 5, 171935 https://doi.org/10.1098/rsos.171935.
Sap, M., Card, D., Gabriel, S., Choi, Y., Smith, N.A., 2020. The risk of racial bias in hate speech detection. In: ACL 2019 - 57th Annual Meeting of the Association for Computational Linguistics, Proceedings of the Conference. Association for Computational Linguistics, pp. 1668–1678. https://doi.org/10.18653/v1/p19-1163.
Schein, E.H., 2010. Organizational Culture and Leadership. John Wiley & Sons.

Semaan, B.C., Robertson, S.P., Douglas, S., Maruyama, M., 2014. Social media supporting political deliberation across multiple public spheres: Towards Depolarization. In: Proceedings of the 17th ACM Conference on Computer Supported Cooperative Work & Social Computing - CSCW. ACM Press, New York, New York, USA, pp. 1409–1421. https://doi.org/10.1145/2531602.2531605.
Settle, J.E., 2019. Frenemies: How Social Media Polarizes America. Cambridge University Press.
Shapiro, R.Y., 2013. Hearing the Opposition: It Starts at the Top. Crit. Rev. A J. Polit. Soc. 25, 226–244. https://doi.org/10.1080/08913811.2013.843876.
Sherrer, E., 2018. Social media outpaces print newspapers in the U.S. as a news source. Pew Res. Cent.
Shi, F., Teplitskiy, M., Duede, E., Evans, J.A., 2019. The wisdom of polarized crowds. Nat. Hum. Behav. 3, 329–336. https://doi.org/10.1038/s41562-019-0541-6.
Stevens, T.M., Aarts, N., Dewulf, A., 2020. Using Emotions to Frame Issues and Identities in Conflict: Farmer Movements on Social Media. Negot. Confl. Manag. Res 1–19. https://doi.org/10.1111/ncmr.12177.
Stoner, J.A.F., 1961. A comparison of individual and group decisions involving risk. Massachusetts Institute of Technology, School of Industrial Management. Master Science Thesis -.
Stroud, N.J., 2010. Polarization and Partisan Selective Exposure. J. Commun. 60, 556–576. https://doi.org/10.1111/j.1460-2466.2010.01497.x.
Suhay, E., Bello-Pardo, E., Maurer, B., 2018. The Polarizing Effects of Online Partisan Criticism: Evidence from Two Experiments. Int. J. Press. 23, 95–115. https://doi.org/10.1177/1940161217740697.
Sunstein, C.R., 2002a. Why they hate us: The role of social dynamics. Harvard J. Law Public Policy 25, 429–440.
Sunstein, C.R., 2002b. The Law of Group Polarization. J. Polit. Philos. 10, 175–195. https://doi.org/10.2139/ssrn.199668.
Sunstein, C.R., 2001. Republic.com. Princeton University Press.
Sunstein, C.R., Lazzaro, S.C., Sharot, T., 2016. How People Update Beliefs about Climate Change: Good News and Bad News. SSRN Electron. J. 102, 1431–1443. https://doi.org/10.2139/ssrn.2821919.
Tajfel, H., Turner, J.C., Austin, W.G., 1979. An integrative theory of intergroup conflict, in: Austin, W., Worchel, S. (Eds.),. The Social Psychology of Intergroup Relations.
Törnberg, P., 2018. Echo chambers and viral misinformation: Modeling fake news as complex contagion. PLoS One 13, e0203958. https://doi.org/10.1371/journal.pone.0203958.
Tucker, J., Guess, A., Barbera, P., Vaccari, C., Siegel, A., Sanovich, S., Stukal, D., Nyhan, B., 2018. Social Media, Political Polarization, and Political Disinformation: A Review of the Scientific Literature. SSRN Electron. J.
Turetsky, K.M., Riddle, T.A., 2018. Porous Chambers, Echoes of Valence and Stereotypes: A Network Analysis of Online News Coverage Interconnectedness Following a Nationally Polarizing Race-Related Event. Soc. Psychol. Personal. Sci. 9, 163–175. https://doi.org/10.1177/1948550617733519.
Wang, Q., Yang, X., Xi, W., 2018. Effects of group arguments on rumor belief and transmission in online communities: An information cascade and group polarization perspective. Inf. Manag. 55, 441–449. https://doi.org/10.1016/j.im.2017.10.004.
Warner, B.R., 2010. Segmenting the Electorate: The Effects of Exposure to Political Extremism Online. Commun. Stud. 61, 430–444. https://doi.org/10.1080/10510974.2010.497069.
Weber, I., Garimella, K., Batayneh, A., 2013. Secular vs. Islamist polarization in Egypt on Twitter. In: Proceedings of the 2013 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining, ASONAM. ACM Press, New York, New York, USA, pp. 290–297. https://doi.org/10.1145/2492517.2492557.
Wells, C., Cramer, K.J., Wagner, M.W., Alvarez, G., Friedland, L.A., Shah, D.V., Bode, L., Edgerly, S., Gabay, I., Franklin, C., 2017. When We Stop Talking Politics: The Maintenance and Closing of Conversation in Contentious Times. J. Commun. 67, 131–157. https://doi.org/10.1111/jcom.12280.
Williams, H.T.P., McMurray, J.R., Kurz, T., Hugo Lambert, F., 2015. Network analysis reveals open forums and echo chambers in social media discussions of climate change. Glob. Environ. Chang. 32, 126–138. https://doi.org/10.1016/j.gloenvcha.2015.03.006.
Wojcieszak, M.E., 2010. 'Don't talk to me': effects of ideologically homogeneous online groups and politically dissimilar offline ties on extremism. New Media Soc 12, 637–655. https://doi.org/10.1177/1461444809342775.
Wojcieszak, M.E., Mutz, D.C., 2009. Online Groups and Political Discourse: Do Online Discussion Spaces Facilitate Exposure to Political Disagreement? J. Commun. 59, 40–56. https://doi.org/10.1111/j.1460-2466.2008.01403.x.
Yang, J.H., Rojas, H., Wojcieszak, M.E., Aalberg, T., Coen, S., Curran, J., Hayashi, K., Iyengar, S., Jones, P.K., Mazzoleni, G., Papathanassopoulos, S., Rhee, J.W., Rowe, D., Soroka, S., Tiffen, R., 2016. Why Are "Others" So Polarized? Perceived Political Polarization and Media Use in 10 Countries. J. Comput. Commun. 21, 349–367. https://doi.org/10.1111/jcc4.12166.
Yang, M., Wen, X., Lin, Y.-R., Deng, L., 2017. Quantifying Content Polarization on Twitter, 2017. In: IEEE 3rd International Conference on Collaboration and Internet Computing (CIC). IEEE, pp. 299–308. https://doi.org/10.1109/CIC.2017.00047.
Yardi, S., Boyd, D., 2010. Dynamic Debates: An Analysis of Group Polarization Over Time on Twitter. Bull. Sci. Technol. Soc. 30, 316–327. https://doi.org/10.1177/0270467610380011.
Zhu, Q., Skoric, M., Shen, F., 2017. I Shield Myself From Thee: Selective Avoidance on Social Media During Political Protests. Polit. Commun. 34, 112–131. https://doi.org/10.1080/10584609.2016.1222471.
Zollo, F., 2019. Dealing with digital misinformation: a polarised context of narratives and tribes. EFSA J 17, e170720. https://doi.org/10.2903/j.efsa.2019.e170720.

Luca Iandoli: Dr. Luca Iandoli is Associate Dean for Global and Online Programs at St. John's University, College of Professional Studies, where he has also an associate professor appointment in the division of Computer Science, Mathematics and Science. Dr. Iandoli has served as an Associate Professor at the Department of Industrial Engineering, University of Naples Fed- erico II, and as Visiting Research Professor at the School of Systems and Enterprises, Stevens Institute of Technology (USA). He is also serving as the President of the International Council for Small Business (ICSB) for 2016–2017. Dr. Iandoli's current research focus is on how online interaction and collaboration might be leveraged to help groups, organizations, communities, and companies aggregate and store dispersed knowledge; increase creativity, innovation, and problem solving; and support large-scale, collective intelligence.

Simonetta Primario: Simonetta Primario is a research fellow at University of Naples Federico II. She received her PhD in Industrial Engineering from the University of Naples Federico II in 2020. She was visiting PhD student at the College of Professional Studies, St. John's University. She is co-director of StartupGrind University Federico II. Her research interests include online conversational dynamics and information diffusion with a focus on the impact on human behaviors and decision making. Currently, her research activities are also focusing on startups, innovative newborn firms, digitalization, and theory of complex adaptive systems as well as soft computing methods.

Giuseppe Zollo:Giuseppe Zollo is Professor of Management Engineering at the University of Naples Federico II. He has been Visiting Research Associate at the Northeastern University of Boston, MA (USA). He published over two hundred articles on small innovative companies, regional innovation, skills management, fuzzy logic, agent simulation, organizational learning, complex adaptive systems, serving as a member of the editorial board of several academic journals. The research activity has received several international awards. The current research focus is related to the analysis of cognitive aspects in management of complex situations. He coordinated several research projects, among which the most significant concerned the development of assessment systems of individual competencies in large organizations.