Article

Political Interaction Beyond Party Lines: Communication Ties and Party Polarization in Parliamentary Twitter Networks

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Abstract

A growing body of research has examined the uptake of social media by politicians, the formation of communication ties in online political networks, and the interplay between social media and political polarization. However, few studies have analyzed how social media are affecting communication in parliamentary networks. This is especially relevant in highly fragmented political systems in which collaboration between political parties is crucial to win support in parliament. Does MPs' use of social media foster communications among parliamentarians who think differently, or does it result in like-minded clusters polarized along party lines, confining MPs to those who think alike? This study analyzes the formation of communication ties and the degree of homophily in the Dutch MPs' @mention Twitter network. We employed exponential random graph models on a 1-year sample of all tweets in which Dutch MPs mentioned each other ($N = 7,356$) to discover the network parameters (reciprocity, popularity, and brokerage) and individual attributes (seniority, participation in the parliamentary commissions, age, gender, and geographical area) that facilitate communication ties among parliamentarians. Also, we measured party polarization by calculating the external–internal index of the mentions. Dutch MPs' communication ties arise from network dynamics (reciprocity, brokerage, and popularity) and from MPs' participation in the parliamentary commissions, age, gender, and geographical area. Furthermore, there is a high degree of cross-party interactions in the Dutch MPs' mentions Twitter network. Our results refute the existence of "echo chambers" in the Dutch MPs' mentions Twitter network and support the hypothesis that social media can open up spaces for discussion among political parties. This is particularly important in fragmented consensus democracies where negotiation and coordination between parties to form coalitions is key.

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Politicians from new and established parties worldwide have embraced social media. They use these platforms to disseminate their political views and connect with voters, but they also support fellow politicians or engage in debate with them (Esteve Del Valle et al., 2020). The uptake of social platforms opens up new democratic publics because this has been paralleled by the exponential growth in the adoption and use of social media by citizens. For instance, in 2008, Facebook had 100 million users and Twitter 2 million users. By 2016, Facebook had 1.67 billion users and Twitter 313 million users (Facebook, 2016; Twitter, 2016).

Many studies have examined issues related to the uptake of social media by politicians, the formation of communication ties in online political networks (Esteve Del Valle & Borge Bravo, 2018b; González-Bailón & Wang, 2016; Gruzd & Tsyganova, 2015), and the interplay between social media and political polarization (Barberá et al., 2015; Colleoni et al., 2014; Esteve Del Valle & Borge Bravo, 2018a; Sunstein, 2017; Takikawa & Nagayoshi, 2017). However, few studies have analyzed how social media are affecting communication in parliamentary networks (Borge Bravo & Esteve Del Valle, 2017; Hong & Sung, 2016). This is especially relevant now that highly fragmented party systems become increasingly dominant in Europe. In such systems, collaboration between political parties is crucial to win (temporary) majorities in parliament. Studying MPs' use of social media shows whether this fosters communications among parliamentarians who think differently or results in like-minded clusters polarized along party lines, confining MPs to those who think alike.

By affording spaces for conversation between people who think differently, social media could enhance the political infrastructure of "consensus democracies" that allow for effective government despite the political system being highly fragmented. Conversely, social platforms might cause radicalization and polarization (Himelboim et al., 2013; Mutz & Martin, 2001) by limiting exposure to the opinions of like-minded people. If that were the case, social media would pose a serious threat to the governance of political regimes, especially to those highly fragmented. Therefore, growing political polarization on social media would endanger an essential precondition for democracy: The presence of public debate where one's ideas and interests are confronted with the ideas and interests of those who think differently.

To understand how social media afford public debate in fragmented party systems, we study Dutch parliamentarians' use of Twitter, asking how they form communication ties in and between political parties and whether this results in party polarization. Here, the term party polarization is used to describe the degree to which interactions (mentions) in the Dutch MPs' mentions Twitter network occur only among the members of a parliamentary group or also across different groups. The degree of party polarization is measured both at the parliamentary group level and at the level of the parliament as a whole. This conceptualization of polarization differs from other political polarization constructs (e.g., party fragmentation) in its consideration of both the number of parties and the relations—in our case study, the mentions—between these parties as being potential explanatory factors of political polarization.

We collected a 1-year sample (2016) of all tweets in which Dutch MPs mentioned each other ($N = 7,356$). While much research studies the use of social media and resulting online networks in election campaigns, we chose a random year sample because we are interested in the working of the political system as such and did not want the results of our study to be affected by electoral contests. During the parliamentary year, MPs are expected to engage more with colleagues to create alliances to support specific views on political issues. Among the different communication layers (relations, retweets, and mentions) on Twitter, we have focused on MPs' mentions because this network better reflects cross-party and cross-ideological connections (Esteve Del Valle & Borge Bravo, 2018a) as well as MPs' personalized communication behavior (Thamm & Bleier, 2013) and is more decentralized than following–follower and retweet networks (Conover et al., 2011; Hsu & Park, 2012; Yoon & Park, 2014). Furthermore, previous research has shown that politicians actively use mentions to converse with each other (Esteve Del Valle & Borge Bravo, 2018a; van Vliet et al., 2020),

mostly to criticize members of other parties, that is, "point out any apparent mistakes, misbehavior or false statement of their rivals" (Laaksonen et al., 2017, p. 117). Last, compared to the broadcasting practices of parliamentarians in other countries (e.g., the United Kingdom or the United States), Dutch MPs are highly conversational on Twitter, notably vis-à-vis other members of the *Tweede Kamer*, the Dutch House of Representatives (see Tromble, 2018).

We employed a social network analysis (SNA) approach (Marin & Wellman, 2011) to study the factors explaining the formation of communication ties among Dutch MPs. Specifically, we used exponential random graph models (ERGMs; Hunter, Handcock, et al., 2008; Li & Carriere 2013; Lusher et al., 2012) to analyze network parameters (reciprocity, popularity, and brokerage) and individual attributes (seniority, participation in the parliamentary commissions, age, gender, and geographical area) that facilitate communication ties among Dutch parliamentarians. Furthermore, we measured party polarization by calculating the external–internal (E-I) index (Krackhardt & Stern, 1988) of the Dutch MPs' mentions.

The Netherlands offers an excellent case to study this because of its proportional electoral law with an electoral threshold of .67% of the votes, which facilitates relatively easy entry of smaller parties to parliament. This resulted in 11 medium-sized and fringe parties filling the 150 seats in parliament after the elections of September 12, 2012. After three split-ups within a year, parliament got even more fragmented into 14 political parties and groups. This political fragmentation allows us to test hypotheses related to political polarization in a different political system than the United States, where most of the research has been devoted to.

Moreover, the Netherlands is a paradigmatic example of the global social media uptake. In 2016, 9.5 of 17 million people used Facebook and 2.6 million were on Twitter (Jacobs & Spierings, 2016). Among the Dutch political parties and their representatives, the adoption of social media is even more extraordinary—almost all Dutch parties had a Facebook and a Twitter account (Jacobs & Spierings, 2016) and 96% of Dutch MPs were active Twitter users (Esteve Del Valle et al., 2020), the highest number among European Union (EU) parliamentarians and certainly one of the highest in the world. The Dutch are also very active on social media. In 2013, for instance, 65% of the Dutch population reported to have used social media in the last 3 months, occupying the top position in the EU (Jacobs & Spierings, 2016, p. 52). Among the young Dutch adults (16–24 years old), this figure was even higher; 97% used social media daily, again more than in any other European country (Woollaston, 2013). Indeed, a report released by Semiocast (2012) revealed that the Dutch had the highest rate of Twitter users posting tweets (33%), followed by Japan, Spain, and the United States.

In the next section, we review scholarship on MPs' use of Twitter in political networks and polarization in Twitter parliamentary networks. We aim to tackle a gap in the literature when it comes to understanding the formation of communication ties and political polarization in online parliamentary networks. Then, we provide details on the Data and Methods section. We continue by introducing the political and network characteristics of the Dutch case to contextualize the research. Last, we outline the results and discuss its implications for the understanding of how MPs' use of social media affects communications in parliaments.

Theoretical Background

Network-Endogenous Mechanisms in Twitter Political Networks

When parliaments are viewed as populations of interacting agents, questions arise about the specific forms of interdependence that affect MPs' behavior. Local patterns of interdependence (network-endogenous mechanisms) induce different network structures (Song, 2015). While the importance of networks for a broad range of political issues is now generally acknowledged, the mechanisms

underlying the formation of communication ties in social media parliamentary networks remain to be understood. This article therefore asks the following research questions:

Research Question 1: What are the network characteristics and the MPs' attributes explaining MPs' likelihood of forming communication ties in Twitter parliamentary networks?

Research Question 2: Are MPs' communications in online parliamentary Twitter networks leading to political polarization?

SNA provides our study with the theoretical lenses and measures for exploring computer-mediated interactions (@mentions) among Dutch parliamentarians. The core concepts of SNA (such as nodes, relations, ties, and networks) can be used to describe and study interactions in Twitter political networks (Dubois & Gafney, 2014; Esteve Del Valle & Borge Bravo, 2018a; Gruzd & Roy, 2014) and in wider networks (see Haythornthwaite, 2015; Rainie & Wellman, 2012). Specifically, SNA can be employed to (a) discover factors explaining the formation of ties in political networks (Esteve Del Valle & Borge Bravo, 2018b; Song, 2015), (b) predict political outcomes (Wojcik, 2019), and (c) understand the nature and meaning of political ties (Gonzalez-Bailón & Wang, 2016; Gruzd & Tsyganova, 2015).

We propose three network-endogenous mechanisms (see Snijders et al., 2006; Robins et al., 2007) that may be driving MPs' communication ties. The first mechanism is defined by the principle of popularity. One of the most stable findings in the literature on political Twitter networks is the skewed distribution of connections within a network, that is, few nodes have most of the followers, retweets, and mentions (Dubois & Gafney, 2014; Esteve Del Valle & Borge Bravo, 2018b; Gruzd & Roy, 2014). According to Barabási and Albert (1999), this network mechanism emerges from the preferential attachment principle; new nodes prefer to make connections with the already well-connected nodes in the network because this increases their potential chances to access to resources (e.g., new information). Therefore, we expect *the in-degree distribution (number of mentions received) in the Dutch MPs' mentions Twitter network to significantly explain the formation of communication ties among the parliamentarians* (Hypothesis 1).

The second mechanism is defined by the principle of reciprocity, a mechanism that is well explained in the literature on Twitter political networks (Esteve Del Valle & Borge Bravo, 2018b; Yoon & Park, 2014). As Graham et al. (2016) and Vergeer (2020) have shown, reciprocity between Dutch politicians in the 2012 election campaign was high. The chance that candidates responded to tweets directed to them was about 50%, albeit with stark differences between parties. It is therefore expected that the probability of emergence of a tie—a @mention—between two MPs will increase if MP_1 and MP_2 have mentioned each other. Therefore, *we expect the reciprocity of MPs' mentions to significantly explain the formation of communication ties among the parliamentarians*.

As a final mechanism, we consider MPs' brokerage position. Brokers are network entrepreneurs who build bridges between people on opposite sides of the structural holes of the network (Burt, 2005, p. 18). In political settings, brokers help to establish communication between the different clusters of a network, which might remain disconnected without their bridging role. This bridging position gives brokers the ability to control the flows of information (Gonzalez-Bailón & Wang, 2016). In Newman's (2010) words (p. 186), "vertices with high betweenness centrality may have considerable influence within a network by virtue of their control over information passing between others." Previous research in Twitter parliamentary networks has demonstrated that holding a brokerage position increases the likelihood of forming communication ties (Esteve Del Valle & Borge Bravo, 2018b; Xu et al., 2014). Therefore, we expect *MPs' brokerage position to significantly explain the formation of communication ties among the parliamentarians* (Hypothesis 3).

Network-Exogenous Mechanisms in Twitter Political Networks

Previous literature has studied Twitter political networks by focusing on the individual factors explaining politicians' use of Twitter. Graham et al. (2016) and Vergeer (2020) found that in the Netherlands, politicians from bigger parties tweeted more while there were no differences in receiving or sending tweets between genders. Related to this, Tromble's (2018) comparison of UK, USA, and Dutch parliamentarians' conversational practices on Twitter revealed that in the Netherlands, Dutch MPs held most of their conversations with other politicians (p. 232). In the United States, Straus et al. (2013) predicted the adoption of Twitter by congressmen using members' demographic characteristics (age, race, and gender), ideological extremeness, seniority, and congressmen districts' wealth and urbanization level. Their results revealed that young congressmen with extreme ideologies (either liberal or conservatives) living in urban districts were more likely to adopt Twitter than the rest of the members. Also in the United States, Xu and colleagues (2014), study of opinion leadership in activism Twitter networks during the Wisconsin recall elections showed that being a broker—that is, a node with high betweenness centrality—and being geographically close to a given event were factors positively associated with influencing the flows of information in the networks.

Jackson and Lilleker (2011) found that British MPs' use of Twitter was motivated by age, gender, and seniority. Front bench female MPs aged 45–54 appeared to be most likely to tweet. In Germany, younger members were most likely to adopt Twitter (Saalfeld & Dohmeier, 2012), while in Norway and Sweden, the most active MPs tended to be younger, nonincumbents, and outside the political hotspots (Larsson & Kalsnes, 2014). Karlsen and Ejolras' (2016) analysis of the candidates to the 2013 Norwegian elections with a Twitter account revealed that the most influential candidates were young, male, and relatively centrally placed in their parties.

More recently, in Catalonia, Esteve Del Valle and Borge Bravo's (2018b) analysis of the factors explaining the formation of following ties among Catalan MPs on Twitter showed that these ties arose from network dynamics—reciprocity and popularity—and from MPs' political position, age, and gender. MPs who were young, male, and held leadership positions (inside and outside the chamber) were more likely to establish communication ties. Other factors were also expected to have an effect in explaining the formation of ties, such as MPs' activity in the chamber (i.e., parliamentarians' interventions in the commissions and in the plenary) or MPs' online behavior (having a blog and having a Facebook account), but they did not exhibit any appreciable impact.

In sum, given the attributes outlined by previous literature in the field of Twitter political networks concerning politicians' use of Twitter, we expect that *Dutch MPs' probability of establishing communication ties in the mention Twitter network will increase if parliamentarians are young, male, and live in the same geographical area* (Hypothesis 4).

Polarization in Twitter Political Networks

In the political Twittersphere, some have argued that Twitter can facilitate ideological self-segregation (Hong & Sung, 2016; Sunstein, 2017), while others have shown that Twitter increases exposure to political disagreement (Barberá et al., 2015; Colleoni et al., 2014; Vaccari et al., 2016). Among the first, Vergeer (2020) showed that during the 2012 Dutch elections, candidates mostly communicated with other candidates from their own party. When there was cross-party communication, it was mostly with parties that were ideologically close. Moreover, ideologically centrist parties also were at the center of the network, suggesting that this has a moderating effect. Feller et al.'s (2011) study of the 2009 German federal elections found that tweeters tended to follow like-minded peers, that is, users with similar political affiliation, while Korean politicians preferred posting hyperlinks to websites related to politicians from their own party (Choi, 2015) and also communicated mostly with like-minded MPs (Hsu & Park, 2012). Similarly, retweet networks

during the 2010 UK general election showed a very segregated partisan structure in which party members were more likely to retweet content from their own party than from other parties (Boutet et al., 2012). Studying interactions on Twitter about the 10 main controversial topics of the 2010 midterm elections, Himelboim and colleagues (2013) found that users preferred to follow, retweet, and reply other users with similar political views and that the political content of these interactions was "confined to like-minded clusters of users" (p. 171).

In addition to MPs' Twitter networks consisting of like-minded politicians, research has shown that in those networks diverging discourses circulate. Examining the Twitter activities of U.S. House of Representatives, Hong and Sung (2016) found evidence of strong selective behavior on politician's Twitter readership. Takikawa and Nagayoshi's (2017) study of the Japanese Twitter political field revealed an association between political polarization and the topics of conversation; while right-wing users wrote about Korea, Korean Japanese, and dual nationality issues, left-wing users wrote about conspiracy law and the corruption of government. Boutyline and Willer (2017) achieved similar results when analyzing the U.S. political Twittersphere. They discovered that both more extreme and more conservative individuals were more likely than liberal and more moderate individuals to form homophilic ties. Given that the literature suggests that individuals are likely to see agreement on Twitter, we expect *communications in the Dutch MPs' mentions Twitter network to be polarized along party lines* (Hypothesis 5).

However, not all studies find increased political polarization in Twitter political networks. Several studies in different countries show that the existence of cross-ideological interactions may depend on its layer of interaction (following–follower, retweet, and mention; Conover et al., 2011; Esteve Del Valle & Borge Bravo, 2018a; Esteve Del Valle et al., 2020; Yoon & Park, 2014). While retweets and following–follower networks point at homophily, mention networks show interaction among users with opposed political ideologies. A study of political hashtags before U.S. congressional midterm elections showed that users tend to retweet users with the same political affiliation, but they also revealed that users mention others with opposed ideologies (Conover et al., 2011). Ogawa and colleagues (2013) also found evidence of strong selective exposure in retweet networks, while this exposure tended to be weaker for mention networks. Yoon and Park's (2014) study of Korean politicians' use of Twitter revealed high degrees of homophily in the following–follower network, while the mention network facilitated cross-ideological interactions between politicians. And in Catalan MPs' communications on Twitter, the relations network was the most polarized, while cross-party and cross-ideological interactions were greater in the retweet network and most present in the mention network (Esteve Del Valle & Borge Bravo, 2018a). In sum, given that previous research has shown that political interactions on Twitter are party and ideologically polarized but that the degree of that polarization depends on the layer of interaction (relations, retweets, and mentions) in which the communication flows take place, we expect *the Dutch parliamentary Twitter mention network to reveal cross-party connections* (Hypothesis 6).

Data and Methods

We used Coosto (2020), a social media management software package that has previously been used for similar research purposes (van de Belt et al., 2015; van Gelder et al., 2019) to collect a 1-year sample (November 3, 2015, until November 3, 2016) of all tweets posted by 144 Dutch MPs. In total, we collected 131,963 tweets. Then, a Python script (version 3.7) was developed to filter out those tweets in which MPs mentioned other MPs and to create the adjacency matrix of MPs' mentions. This gave us a final network of 7,356 mentions among Dutch MPs.[1]

The descriptive statistics of the network were obtained by using UCINET (version 6), a software package for the analysis of social network data (Borgatti et al., 2002). The visualization of the network was created with Gephi (version 0.92), an open-source network exploration and

manipulation software (Bastian et al., 2009). In the networks, each node represents a parliamentarian with a Twitter account. An MP_1 has a directed link with MP_2 if MP_1 mentions MP_2. The links have weights equivalent to the number of mentions that MP_1 sends to MP_2.

To discover the network characteristics and the Dutch MPs' attributes facilitating communication ties among the parliamentarians, we employed ERGMs (*p**models). ERGMs are "tie-based models for understanding how and why social network ties arise" (Lusher et al., 2012: p. 9). These models are designed to test various network-based hypotheses by generating a large set of random networks based on a chosen set of network properties and node attributes and comparing these networks to an observed network (Gruzd & Tsyganova, 2015). The use of ERGMs allows us to test whether the presence of ties in the Dutch MPs' mentions Twitter network is not based on chance but on network properties and the nodes' attributes and which of these network properties and nodes' attributes influence the formation of these ties.

ERGMs estimate an empirical likelihood by making many draws from a set of random networks based on principles of Markov Chain Monte Carlo (MCMC). The parameter estimates are derived by finding the maximum likelihood from the MCMC-generated distribution. Given any set of coefficients, ERGMs render it possible to "create marginal distributions of the coefficients from which it is possible to make inferences about causal effects and variances of covariates of interest" (Wojcik, 2017: p. 514). The ERGM equation is

$$p(X = x) = \frac{\exp\theta' z(\mathrm{x})}{k(\theta)},$$

where X is a random network of n nodes, x is the observed network, θ is a vector of parameters, $z(x)$ is a vector of network statistics, is a normalizing constant, and $k(\theta)$ is a normalizing constant that defines all possible networks. The log-odds of a tie is given as

$$\mathrm{logit} = (Yij = 1) = \theta^T \delta[g(y, X)_{ij}],$$

where $\delta[g(y, X)_{ij}]$ is the change in network statistics $g(y, X)$ produced when Yij goes from 0 to 1. This change allows to calculate the conditional log-odds of the network, given any value of $g(y, X)_{ij}$ (Goodreau et al., 2008; Hunter et al., 2008).

To run the ERGMs, we used the "statnet" (version 2019.6) package in *R* (Goodreau et al., 2008; Hunter, Handcock, et al., 2008). We started by building a null model without any predictors (*net ∼ edges*), followed by Model 1 with the three network parameters most examined in previous literature as indicators of influence (*popularity*, by number of mentions received and *brokerage position* by the betweenness centrality of the MPs), combined with two parameters (*reciprocity*, by mutual ties among the MPs, and *edges*) that are basic estimators (Shumate & Palazzolo, 2010) of the formation of communication ties in online networks (*net ∼ edges + popularity + brokerage position + reciprocity*). We then added different attributes of the Dutch MPs to Model 1 (see the Appendix Table A1 for a definition of the network parameters and a codification of the node's attributes). These attributes were selected in line with the results of previous research, as outlined in the previous section. First, we added two characteristics related to the MPs work in the chamber (Model 2), their seniority ($M = 2{,}231.06$; $SD = 1{,}336.51$), that is, the number of days MPs spent in the chamber, and their participation in parliamentary commissions ($M = 2.27$; $SD = 1.57$), that is, the number of commissions MPs participated in (*net ∼ edges + popularity + brokerage position + reciprocity + nodefactor ["seniority"] + nodefactor ["Interventions in the Commissions"])*. We then added two sociodemographic characteristics (Model 3), MPs' age ($M = 46.76$; $SD = 8.32$) and gender ($M = 0.6$; $SD = 0.49$; *net ∼ edges + popularity + brokerage position + reciprocity + nodefactor ["Interventions in the Commissions"] + nodefactor ["seniority"] + nodefactor ["age"] + nodefactor ["gender"])*. At the final iteration (Model 4), we added MPs' geographical area ($M = 0.29$;

$SD = 0.45$), that is, whether they resided in the Randstad (a megalopolis consisting of the four largest cities, Amsterdam, Rotterdam, the Hague, and Utrecht) or outside it. To determine the quality of the resulting models, randomly generated networks were compared to the observed networks by assessing the goodness of fit of the ERGMs in plots (Hunter, Handcock, et al., 2008; Li & Carriere, 2013). To assess the goodness of fit of the models, we included the in-degree statistic and the geodesic distance statistic because they are the basis for two of the endogenous network mechanisms of our model.

Political and Network Characteristics

Political Characteristics

After the elections of September 12, 2012, the Dutch party system was fragmented into a wide variety of 11 medium-sized and fringe parties who occupied the 150 seats in parliament. The People's Party for Freedom and Democracy (VVD) is a right-wing liberal party emphasizing freedom and self-initiative (Van Herk et al., 2018). It won the 2012 elections and gained 41 seats. The Labour Party (PvdA) -38 seats- is a progressive and social democratic party. The Party for Freedom (PVV) -15 seats- is a nationalistic, populist party with conservative and rightist views. It stands against immigrants, Islam, and the European integration. The Socialist Party (SP) is a left-wing socialist and Eurosceptic party with 15 seats. The Christian Democratic Appeal (CDA) -13 seats- is a centrist, conservative, and religious party that unifies three Christian parties, two protestant and one catholic. Democrats 66 (D66) -12 seats- is a reformist social, liberal party. The Christian Union (CU) -five seats- is a Christian democratic party with stronger Christian values than the CDA but more progressive views on social issues. The Green Party (GL) -5 seats- is a social, democratic left-wing party emphasizing environmental issues. The Reformed Political Party (SGP), that has three seats, is a right-wing conservative protestant Christian party. Both the Party for the Animals (PvdD), a social democratic party that strives for animal rights and animal welfare, and the 50Plus party (50Plus) that promote pensioners' interests have two seats.

In addition to these 11 parties, three other parliamentary groups were formed throughout the legislature; on April 25, 2014, the Group Bontes/Van Klaveren (GrBvK) was formed after Joram van Klaveren left the PVV and joined the Bontes group which was created by the parliamentary Louis Bontes after being expelled from the PVV group in 2013. Further, on November 14, 2014, the group Kuzu/Öztürk (GrKÖ) was formed after Tunahan Kuzu and Selçuk Öztürk were expelled from the PvdA. Finally, Johan Houwers, a former member of the VVD, from November 8, 2012, until July 22, 2013, when he resigned following a mortgage fraud investigation, served as an independent MP between March 25, 2015 and March 23, 2017.

Network Characteristics

In our 1-year sample, 144 Dutch MPs tweeted a total of 7,356 mentions. The network statistics of this Twitter network are summarized in Table 1:

The statistics reveal that, as is usual in most online networks, a minority of MPs attracts and sends most of the mentions, thus the maximum values—Max $(K_{in}) = 204$ and Max $(K_{out}) = 362$—compared to the mean degree ($d = 15.354$) are indicative of the underlying long tail distribution. Further, the density of the network is relatively low (.341), meaning that only 34.1% of the total relations among the MPs occur. Indeed, the average path length of the network is also low, 2.191, indicating that the average distance between the users is 2.191 steps. All in all, although the density in the network is low, the short distances make it possible for MPs to connect easily to others.

The network is classified as a tight crowd network because it has between (two and six clusters with a modularity score value of .286) and few isolates (Hansen et al., 2010, p. 8). It is also a

Table 1. Network Statistics of the Dutch MPs' Mentions Twitter Network.

Statistics	Dutch MPs' Mentions Twitter Network
N (number of vertices)	144
E (number of directed edges)	2,211
(d) mean degree	15.354
Max (K_{in}; maximum in-degree)	204
Max (K_{out}; maximum out-degree)	361
Graph density	.341
Average path length	2.191
Modularity (Newman and Girvan)	.286

Note. MP = member of parliament.

so-called affiliation network (Borgatti et al., 2016), the typical network type to be expected in the online parliamentary networks, given its partisan and ideological structure (Esteve Del Valle & Borge Bravo, 2018b).

Results

> **Research Question 1**: What are the network characteristics and the MPs' attributes influencing MPs' likelihood of forming communication ties in Twitter parliamentary networks?

The selection was driven by significance levels and the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). The first column of Table 2 reports the estimates of the baseline model (Model 1) containing the arc and the full specification of endogenous network effects: reciprocity, popularity, and brokerage. The edge parameter is negative, a common characteristic of sparse networks (see Mai et al., 2015). The estimates suggest that reciprocity, popularity, and brokerage remain positive and significant ($p <$ 1e-04) across all model specifications. This means that, as expected, reciprocity, popularity, and brokerage increase MPs' likelihood of establishing communication ties. Model 2 adds two characteristics related to MPs' work in the chamber, their seniority in the chamber, and their participation in parliamentary commissions. The estimates for seniority are not significant in any model, while the estimates of MPs' participation in the parliamentary commission are positive and significant ($p <$ 1e-04) for all models. In line with these estimates, which can be interpreted as conditional log-odds ratios, participation in the parliamentary commissions positively affects MPs' likelihood of establishing communication ties. For instance, in our final model (Model 4), MPs' participation in the parliamentary commissions increases parliamentarians' odds of being mentioned by 2.57%.

Model 3 adds to the previous models MPs' age and gender as possible explanations of establishing communication ties. Controlling for endogenous network effects, the estimates suggest that parliamentarians' age (estimate [EST] = $-.0015$; SE = .0005) and gender (EST = $-.0271$; SE = .0004) are significant and negative ($p <$ 1e-04) in all the models. This means that young and female MPs are more likely to be mentioned than the rest of parliamentarians. Last, in Model 4, we added MPs' geographical area. The estimates of MPs' geographical area are positive (EST = .0325; SE = .0056) and significant ($p <$ 1e-04), which means that MPs' likelihood of being mentioned increases by a 3.25% when both MPs reside in the Randstad or outside it.

To assess how well the final model (Model 4) captures the structure of the observed data, Figure 1 shows how the observed in-degree and minimum geodesic distance distributions reproduce the network's statistics observed in the original data.

Table 2. Factors Underlying the Formation of Communication Ties in the Dutch MPs' Mentions Twitter Network.

| Endogenous and exogenous factors	Model 1		Model 2		Model 3		Model 4	
	EST	SE	EST	SE	EST	SE	EST	SE
Structural features								
Edges	−4.0090***	.0090	−4.161***	.0132	−4.0170***	.0268	−3.623***	.0228
Reciprocity	0.1382***	.0057	0.1546***	.0079	0.1672***	.0072	−0.1797***	.0001
Popularity	0.3006***	.0006	0.3188***	.0012	0.3168***	.3168	−0.3167***	.0007
Brokerage	0.0025***	.0014	0.0008***	.0001	0.0004***	.0001	0.0005***	.0001
Parliament activity								
Seniority			−0.0002	.0000	0.0000	.0000	0.0000	.0000
Participation in the commissions			0.0189***	.0015	0.0243***	.0014	0.0257***	.0013
Sociodemographic characteristics								
Age					−0.0015**	.0005	−0.0058***	.0003
Gender					−0.0271***	.0041	−0.0236***	.0003
Location								
Geographical area							0.0325***	.0056
Akaike information criterion	13,893		13,892		13,892		13,885	
Bayesian information criterion	13,925		13,940		13,956		13,957	

Note. MP = member of parliament; EST = estimate.
**$p < .01$. ***$p < .001$.
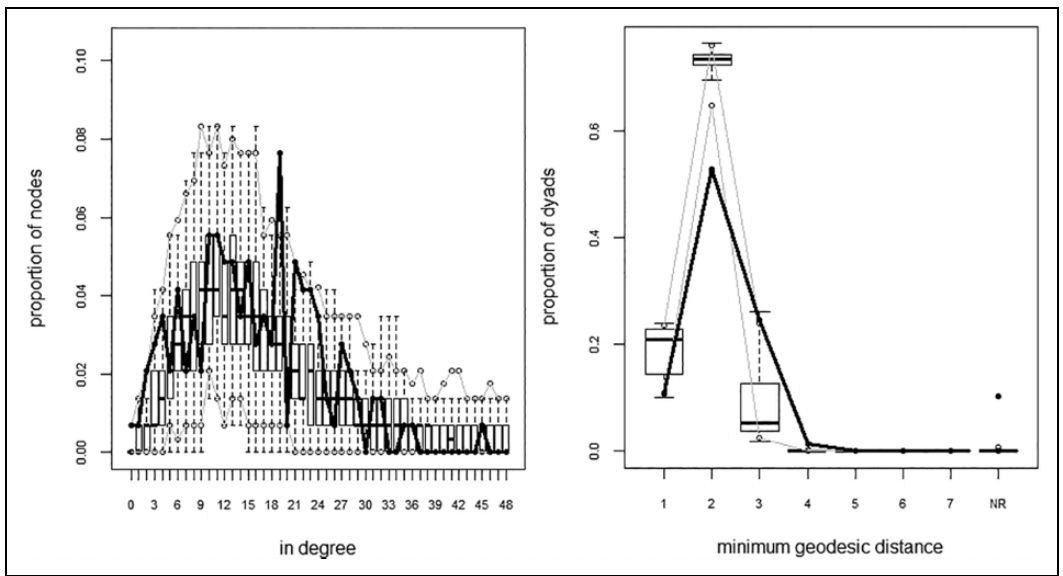
Figure 1. Model 4: Goodness-of-fit diagnostics.

In the plots, the vertical axis is the relative frequency of nodes (in-degree) and dyads (minimum geodesic distance). The observed statistics in the actual network are indicated by the solid lines (thick black lines). The gray dotted lines represent the range of 95% of the simulated statistics. The
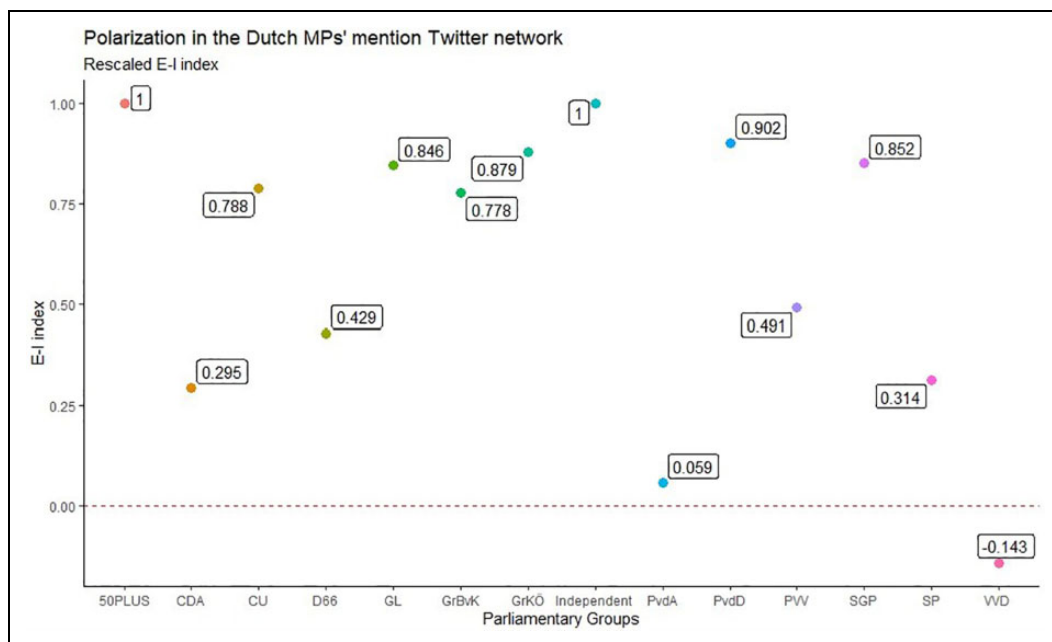
Figure 2. Rescaled external–internal (E-I) index of the Dutch MPs' mentions Twitter network. *Note.* *y*-axis shows the E-I index (from −0.25 to 1); *x*-axis displays the parliamentary groups. The dashed red line shows threshold of the groups' external and internal index (E-I = 0).

models perform relatively well for the in-degree and geodesic distance distributions. The observed distributions generally fall within the quantile curves for most of the range. The model overestimates the average in-degree distribution and geodesic distance, but overall, it captures the shape of the distributions.

> **Research Question 2**: *Are MPs' communications in online parliamentary Twitter networks leading to political polarization?*

To assess the degree of polarization, we computed the E-I index of the Dutch parliamentarians' mention Twitter network. Figure 2 shows the results of our analyses:

The values of the rescaled E-I index (number of iterations = 5,000) which takes into account the group sizes of the parties at a parliamentarian group level—reveal that only the mentions of the VVD parliamentary group are homophilic (−.143). For the rest, eight of the groups (50Plus, CU, GL, GrBK, GrKÖ, Independent, PvdD, and SGP) show high levels of cross-party interactions, that is, above 0.75 points of the E-I index. These are followed by a set of parliamentary groups showing moderate levels of cross-party communications (CDA, D55, PVV, and SP), that is, between .25 points and .5 points of the E-I index. Last, we find the case of the PvdA, which shows a slight cross-party communication behavior (0.059). As for the existence of party polarization at a network level, the rescaled E-I index of the Dutch MPs' mentions Twitter network is .238, refuting the existence of party polarization in the network.

These different levels of cross-party polarization can also be visually observed in the network visualization shown in Figure 3. In the network, the nodes are colored according to party affiliation. The size of the nodes is equivalent to their in-degree (number of mentions received). We used the ForceAtlas2 algorithm layout, which locates connected nodes, that is, those that send more mentions
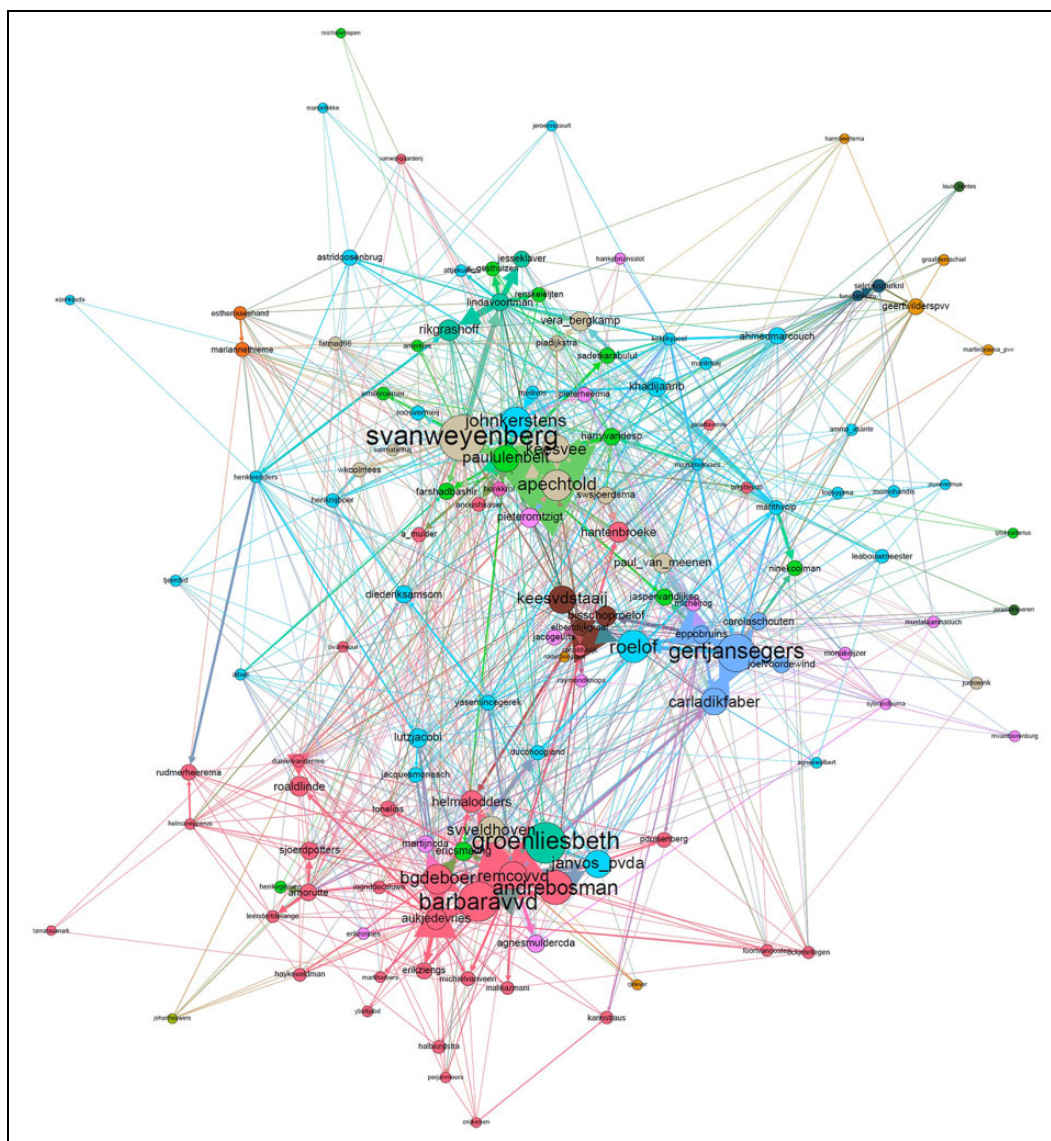
Figure 3. The Dutch MPs' mentions Twitter network. *Note.* For visualization purposes, the nodes of the network are the MPs receiving a minimum of two mentions. The size of the nodes is equivalent to the number of mentions received by the MPs. The color of the nodes represents the political party (orange = VVD, light blue = PvdA, light green = SP, pink = CDA, gray = D66, blue = PVV, red = CU, dark mauve = GL, dark green = SGP, brown = Group Bontes/Van Klaveren, turquoise = Kuzu/Öztürk, green olive = PvdD, and yellow = Independent MP (Howers).

among them, closer to one another. As shown, while the members of the VVD (orange nodes) are closely located in the graph, indicating an intense flow of communication between them, the rest of the MPs are much more dispersed, and they mix up with parliamentarians of other political parties (see, for instance, the location in the network of the PvdA MPs—light blue nodes—and those of the SP parliamentarians—light green nodes).

Discussion

This study asked what network characteristics and MPs' attributes explain the likelihood of forming communication ties in parliamentary online networks. Moreover, we analyzed whether Dutch MPs' communications on Twitter lead to political polarization. Theoretically, this study is rooted in two streams of research, one stream analyzing the formation of communication ties in online political networks (Esteve Del Valle & Borge Bravo, 2018b; Gonzalez-Bailón & Wang, 2016; Gruzd & Tsyganova, 2015) and the other studying the interplay between social media and political polarization (Barberá et al., 2015; Colleoni & Arvidsson, 2014; Esteve Del Valle & Borge Bravo, 2018a; Sunstein, 2017). As for the first, our analysis shows that, in line with findings by Song (2015), Mai et al., (2015), and Esteve Del Valle and Borge Bravo (2018b), communications in the Dutch MPs' mentions Twitter network are affected by both endogenous network parameters (mutuality, reciprocity, and popularity) and exogenous (nodal) factors (participation in the parliamentary commissions, age, gender, and geographical area). Concerning the debate on the interplay between social media and political polarization, our results reveal the existence of cross-party communications in the Dutch MPs' mentions Twitter network (E-I index of the network = .238). These results align with those of Ogawa et al. (2013), Yoon and Park (2014), and Esteve Del Valle and Borge Bravo (2018a) who found cross-party and cross-ideological interactions in Twitter political networks. However, this differs from communication during election campaigns when Dutch politicians mainly communicated with candidates from their own party (Vergeer, 2020).

Methodologically, we adopted a multilevel approach (Choi, 2015) by studying the flow of information in the whole network (macro-level) by analyzing the relationships between the nodes of the network (meso-level) and investigating MPs' characteristics (micro-level). At the network level, our research contributes to the previous congressional network studies, which have mainly focused on the U.S. two-party system, adding understanding of a multiparty system. The analysis sheds light on the factors explaining the formation of communication ties in multiparty systems and it expands the understanding of party polarization in highly fragmented (13 parliamentary groups and one independent MP) parliamentary Twitter networks. The statistics of the Dutch MPs' mentions Twitter network reveal that a minority of MPs attracts and send most of the mentions. This, in line with the results found by Dubois and Gaffney (2014) and Choi (2015) which showed the concentration of information flows around a limited number of nodes playing opinion leader roles, seems to underline the validity of the two-step flow communication model (Choi, 2015; Katz, 1957). And for the rest of the network characteristics, the short distances between the Dutch MPs (average path distance = 2.191) and its clustering structure (modularity score = .341) indicate the existence of an affiliation network (Borgatti et al., 2016), the type of network to be expected in a working milieu such as the *Tweede Kamer* (Dutch parliament) with its particular partisan structure.

At a meso-level, the results of the ERGMs show that parliamentarians' popularity, reciprocity, and brokerage position increase Dutch MPs' likelihood of establishing communication ties. This means that Dutch MPs' communication ties are guided by the preferential attachment principle (Barabási & Albert, 1999), that is, MPs prefer to make connections with the already popular MPs in the network. Further, based on the results of previous studies (see Esteve Del Valle & Borge Bravo, 2018b; Yoon & Park, 2014), we expected reciprocity to explain the probability of establishing communication ties among MPs. Our results corroborate that hypothesis, since engaging in conversations increases MPs' probability of being mentioned. Last, in line with previous research in Twitter parliamentary networks (Esteve Del Valle & Borge Bravo, 2018b; Xu et al., 2014), holding a brokerage position, that is, playing, and intermediary role in the flows of communications across different parliamentary groups increases the likelihood of forming communication ties. This means that in a highly fragmented political system such as the Netherlands, the MPs occupying structural holes (Burt, 2005) in the network are more likely to be mentioned than the rest. This finding

contradicts the results found by Esteve Del Valle and Borge Bravo (2018b) in the Catalan MPs parliamentary Twitter network, where parliamentarians' brokerage position was found to have a negative effect on their propensity to form communication ties. A possible explanation for the positive effect of Dutch MPs' brokerage position in their likelihood of forming communication ties could be rooted in the different nature of parliamentary politics in the Netherlands and in Catalonia. While in the Catalan parliament—recently extremely polarized around the independence cleavage—the bridging role played by some MPs seems to be penalized by their peers, in the *Tweede Kamer* a culture of negotiation, which requires bridging those party groups ideologically different, seems to be promoting the MPs holding brokerage positions.

At a micro-level, we have found evidence of four factors explaining MPs' Twitter communications. First, we discovered that Dutch parliamentarians' engagement with the work in the chamber—their participation in the parliamentary commissions on certain topics in which MPs from all political parties are represented—increases their likelihood of being mentioned. Ceteris paribus, the more commissions an MP participates in, the more likely to be mentioned by other MPs. Second, in line with the results of previous research in parliamentary politics (Borge Bravo & Esteve Del Valle, 2017; Jackson & Lilleker, 2011; Straus et al., 2013), young MPs are more likely to be mentioned than older MPs, but unlike previous studies (Karlsen & Ejolras, 2016; Straus et al., 2013), Dutch female parliamentarians are more likely to establish communication ties than their male peers. A possible explanation of the effects of these two sociodemographic characteristics on the likelihood of forming communication ties can be drawn from the study conducted by Esteve Del Valle and Borge Bravo (2018b), which shows that young and female MPs, in search of novel power spaces, emerged as new political influentials (brokers) within the Catalan parliamentary Twitter network. Future research needs to investigate whether this is also the case for the Dutch MPs' Twitter network. Finally, we discovered the existence of a homophilic geographical tendency among the communication ties of Dutch MPs. Specifically, our results show that Dutch MPs who reside in the Randstad area are more likely to communicate with MPs residing in this same area than with the rest and vice versa. This tendency seems to respond to a well-known sociological phenomenon called propinquity (see Scott, 2017), which states that some nodes are more likely to be connected with one another, other conditions being equal, if they are geographically near.

As for the degree of party polarization, although some differences can be found among parties (see Figure 2), only the mentions sent by the parliamentarians of the VVD are homophilic. In fact, at a network level, we have found clear evidence of cross-party interactions in the Dutch MPs' mentions Twitter network (E-I index = .238). This conflicts with findings from Vergeer (2020) who found that Dutch politicians mainly communicated online with fellow party members. However, this research took place during the 2012 election campaign when differences are highlighted and giving competitors a stage by mentioning them might be counterproductive. However, our result mirror findings in other countries (Conover et al., 2011; Esteve Del Valle & Borge Bravo, 2018a; Garcia et al., 2015), which discovered the degree of cross-party communications in the mention Twitter network to be much higher than in the following–follower and the retweet networks. In the case of the Catalan parliamentary Twitter network, for instance, a relevant number of cross-party and cross-ideological interactions between MPs of opposed ideologies (e.g., ERC—left-independentist party—and those of the PP—right-Spanish nationalist party) occurred in the mentions Twitter network. Therefore, it seems as if in several countries, including the Netherlands, interactions in MPs' mentions Twitter network are reflective of cross-party and cross-ideological connections.

Two reasons might explain this relatively high degree of cross-party and cross-ideological connections in the Dutch MPs' mentions Twitter network. On the one hand, the affordances of Twitter networks are conducive to different types of communication; while the following–follower network and the retweet network are support networks, the mention network is a dialogical network. In their

study of Catalan MPs' use of Twitter, Esteve Del Valle and Borge Bravo (2018a) observed that Catalan MPs used relation and retweet networks mainly to follow and support the MPs of their party and those who think alike, whereas they used the mention network to interact with MPs who think differently. On the other hand, the intensity of cross-party and cross-ideological interactions between Dutch MPs in the mentions Twitter network could be explained by the fact that MPs use the affordances of this network to engage with one another, either assentingly (Esteve Del Valle et al., 2020) or disapprovingly (see Laaksonen et al., 2017). They could either mention MPs from other parties to criticize them or to engage in exchanges aimed toward finding common ground and form alliances on certain political issues.

As previously mentioned, there are interesting differences in parties' polarization degrees. For instance, mentions among the MPs of the two largest parties (VVD and PvdA) who together formed the government seem to be more homophilic than those of smaller parties (e.g., 50 PLUS or PvdD). This aligns well with the closed conversational Twitter practices Tromble (2018) found for MPs belonging to large parties and with Esteve Del Valle and Borge Bravo's (2018b) findings for the Catalan parliamentary groups, which showed that the smallest and least institutionalized parties showed the least homophily. Our research shows that governing parties like to keep their ranks closed, while opposition politicians have more leeway for engaging with other parties. Unlike Tromble (2018) who found a positive association between MPs' ideology and their conversational Twitter practices, our analyses do not seem to show any relation between MPs ideological position and the degree of polarization of their mentions. Future research could further empirically assess the existence of such a relation.

Our analysis refutes the existence of so-called "echo chambers" in the Dutch MPs' Twitter mentions network. On the contrary, it supports the hypothesis that online platforms open up spaces for conversation between political parties. We argue that digital networks enhance the infrastructure of "consensus democracies" in which effective government is possible although the political landscape is highly fragmented (in this case with 14 groups in parliament). The Netherlands has a strong tradition of consociationalism in which parties that represent a substantial part of the voters are to a more or lesser extent involved in decision making, different ideological communities are allowed a certain level of autonomy and there is a strong tradition of mutual consultation (Lijphart, 1999). Negotiations and coordination to form coalitions between different parties about policy issues are crucial here to organize support for policy change (Hendriks & Toonen, 2001). This tradition of consensus-seeking is reinforced by the understanding that parties alternate in government. From 2010 to 2020, five of 14 parties were part of the government, and a sixth one was involved as a parliamentary supporter. At the same time, especially during the year we researched and in which a two-party government was in place, opposition parties need to confer to make sure their points are taken into consideration (Lijphart, 1999). This political culture that is geared toward consensus-seeking is not only reflected in Twitter networks but also supported by social media platforms, we argue. Future research that also analyzes the content of tweets could address of our hypothesis that online parliamentary networks indeed mitigate the negative effects of political fragmentation and support effective government in consensus democracies.

This study has some limitations. First, inherent to any case study, our results are highly affected by the characteristics of the Dutch political system. Therefore, more studies carrying out comparative analyses between parliamentarians of different and similar political systems could provide powerful insights into the way in which MPs deal with Twitter in parliament. Second, we only studied MPs' communications in the mention Twitter network, and in line with previous literature findings, we expect the results of political polarization to vary across the different communication layers of the platform. Thus, future research should expand our analyses to the study of the other two Twitter communication layers (following–follower and retweet). Third, due to the difficulties of collecting data on some MPs' characteristics, our ERGMs could be complemented with more

dimensions, for instance, including MPs' educational degree, to give a better account of the formation of ties in Twitter parliamentary networks. Notwithstanding our research does suggest that in the case of the Dutch MPs' mentions network, Twitter seems to provide a space for debate among MPs who think differently, thus living up to its democratic potential.

Appendix

Table A1. Description of the network parameters.

Network Parameter	Description
Popularity (Idegreepopularity)	This network parameter adds one statistic to the model equaling the sum over the actors of each actors' in-degree taken to the 3/2 power (or equivalent, multiplied by its square).
Brokerage (m2star)	This network parameter adds one statistic to the model equal to the number of mixed two-stars in the network, where a mixed two-star is a pair of distinct edges (*i-j*) and (*j-K*). A mixed two-star is sometimes called a two-path because it is a directed path of length form *i* to *k* via *j*. However, in the case of a two-path, the focus is usually on the endpoints *i* and *k*, whereas for a mixed two–star the focus is usually on the midpoint *j*.
Reciprocity (mutual)	This network parameter adds one statistic to the model equaling the number of adjacent actors that are connected to the actor with edges in both directions divided by the number of adjacent actors.
Nodes attributes	Codification
Seniority	Number of days MPs spent in the chamber. From 9 to 6,743.
Participation in the commissions	Number of commissions MPs participated in. From 0 to 9.
Age	Age of the parliamentarians. From 28 to 66.
Gender	Gender of the parliamentarians (0 = female, 1 = male).
Geographical area	MPs' geographical area of residence (0 = other locations, 1 = Randstad).

Authors' Note

Data Availability

The adjacency matrix of the Dutch MPs' mention Twitter network and the file containing the attributes of the MPs are available through this website: https://osf.io/h63ba/?view_only=8f3ad2138fc6422f9508b797196dc6b5

Declaration of Conflicting Interests

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Software Information

We used Coosto, a social media management software package, to collect a 1-year sample—from November 3, 2015, until November 3, 2016—of all tweets the 144 Dutch MPs posted on Twitter. Then a Python script was developed to filter from all these tweets only those in which MPs mentioned other MPs and to create the adjacency matrix of MPs' mentions. The descriptive statistics of the network were obtained by using UCINET, a software package for the analysis of social network data (Borgatti et al., 2002). The visualization of the network was created with Gephi, an open-source network exploration and manipulation software (Bastian et al., 2009). Finally, to run the ERGMs, we used the "statnet" package in *R* (Goodreau et al., 2008; Hunter, Handcock, et al., 2008).

Note

1. The data of this network are made available: https://osf.io/h63ba/?view_only=8f3ad213 8fc6422f9508b797196dc6b5

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