

# Social Networks

How Twitter divides the Dutch parliament: Segregation along party lines and social dimensions in the following, @-mentions and retweets Twitter Networks of Dutch MPs  
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Abstract:	Communication and engagement on Twitter by MPs with other MPs may facilitate the formation of cross-party solidarity networks as well as provide public micro deliberation, making differences between parties visible. At the same time, divisions of Twitter networks along party lines, or other important social dimensions, may lead to online interaction that strengthens information bubbles and political polarization. Despite its relevance, research into the Twitter networks among MPs is rare. In this contribution we investigate segregation in Twitter networks among Dutch MPs, mapped at three time-points shortly after the 2017 elections. We provide a thorough understanding of MPs digital social networks by scrutinizing the extent to which Twitter networks among MPs, formed by following, @-mentioning and retweeting relations, are segregated along party membership lines and sex, age and ethnicity. We bring together the online network literature with that on the political consequences of the digital architecture of social media platforms and their political use. We employ a robust combination of data visualization, descriptive statistics and Social Network Analysis (i.e., RSiena). We find that Twitter relations with MPs of the same political party are substantially more common than with MPs of other parties. These segregation patterns are strongest within the retweet-layer and weakest in the @-mention layer. We found no consistent indication of the MP Twitter networks to be segregated by age, sex or ethnicity. The opportunities that Twitter offers MPs, such a creating cross-party deliberative spaces, may be underutilized.
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*Manuscript: How Twitter divides the Dutch parliament: Segregation along party lines and social dimensions in the following, @-mentions and retweets Twitter Networks of Dutch MPs*

Dear editor,

Please find enclosed a submission to *Social Networks* titled, 'How Twitter divides the Dutch parliament: Segregation along party lines and social dimensions in the following, @-mentions and retweets Twitter Networks of Dutch MPs'.

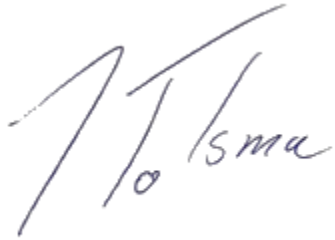
Despite its relevance, research into the Twitter networks of MPs is rare. Our study is a quantitative study on segregation in Twitter networks of MPs. We bring together the online network literature with that on the political consequences of the digital architecture of social media platforms and their political use. To test our hypotheses, we use a combination of descriptive statistics and longitudinal Social Network Analysis with RSiena. We find that Twitter relations with MPs of the same political party are substantially more common than with MPs of other parties. These segregation patterns are strongest within the retweet-layer and weakest in the @-mention layer, in line with the architectural reasoning that retweets are generally political endorsements whereas @-mentions are more a way to hold micro discussions. Segregation patterns within the three network layers are interrelated and reinforce each other. Party-based segregation is not the by-product of social inbreeding homophily.

We have chosen to submit our manuscript to *Social Networks* because we believe the topic of our research, segregation in Twitter networks among MPs along party membership lines and social dimensions, contributes to the understanding of segregation dynamics in (online) social networks more generally, and hence may be of interest to the readers of the journal.

In the manuscript, at different points, we refer readers to our GitHub replication website, accompanying this manuscript (<https://jochemtolsma.github.io/Twitter/>). We have anonymized the link in the manuscript.

I will serve as the corresponding author for this manuscript. I have assumed responsibility for keeping my co-authors informed of our progress through the editorial review process, the content of the review, and any revisions made.

Sincerely,

A handwritten signature in blue ink, reading 'J. Tolsma'.

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Also on behalf of

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## Highlights

- The following, @-mention and retweet twitter networks of Dutch MPs are segregated along party lines.
- Party-based segregation patterns are strongest within the retweet-layer and weakest in the @-mention layer.
- MP Twitter networks are not segregated by age, sex or ethnicity.
- Segregation within the different layers of the Twitter network reinforce each other.
- The offline seating position of MPs in parliament impacts their online Twitter relations.
- Twitter offers democratic potential in terms of forging new connections, also to dissimilar others but does not live up to this potential among Dutch MPs.

**How Twitter divides the Dutch parliament: Segregation along party lines and social dimensions in the following, @-mentions and retweets Twitter Networks of Dutch MPs**

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## **How Twitter divides the Dutch parliament: Segregation along party lines and social dimensions in the following, @-mentions and retweets Twitter Networks of Dutch MPs**

### **Abstract**

Communication and engagement on Twitter by MPs with other MPs may facilitate the formation of cross-party solidarity networks as well as provide public micro deliberation, making differences between parties visible. At the same time, divisions of Twitter networks along party lines, or other important social dimensions, may lead to online interaction that strengthens information bubbles and political polarization. Despite its relevance, research into the Twitter networks among MPs is rare. In this contribution we investigate segregation in Twitter networks among Dutch MPs, mapped at three time-points shortly after the 2017 elections. We provide a thorough understanding of MPs digital social networks by scrutinizing the extent to which Twitter networks among MPs, formed by following, @-mentioning and retweeting relations, are segregated along party membership lines and sex, age and ethnicity. We bring together the online network literature with that on the political consequences of the digital architecture of social media platforms and their political use. We employ a robust combination of data visualization, descriptive statistics and Social Network Analysis (i.e., RSiena). We find that Twitter relations with MPs of the same political party are substantially more common than with MPs of other parties. These segregation patterns are strongest within the retweet-layer and weakest in the @-mention layer. We found no consistent indication of the MP Twitter networks to be segregated by age, sex or ethnicity. The opportunities that Twitter offers MPs, such a creating cross-party deliberative spaces, may be underutilized.

## 1. Introduction

Twitter is a popular communication tool among politicians. Twitter is simple and easy to use and it allows politicians to directly communicate and engage with colleagues, journalists, pundits and voters (e.g. Klinger and Svensson 2015; Spierings and Jacobs 2019; Spierings, Jacobs, and Linders 2019; Tromble 2018). When looking at with whom MPs actively connect and interact on Twitter, particularly other politicians are strongly overrepresented. Although they only make up a small part of the pool of possible Twitter ‘friends’, a study on Dutch MPs estimated that over 40 per cent of the accounts MPs follow are other politicians (Spierings et al. 2019). However, the current research on politicians’ use of social twitter mainly focuses on politicians’ vertical connections: how they create relations and engage with their electorate, or how they use Twitter contact with journalists to reach potential voters (Jungherr 2016; Kruikemeier 2014).

Research into the Twitter networks among MPs is rare despite its relevance. Communication and engagement on Twitter by MPs with other MPs may facilitate the formation of cross-party solidarity network as well as provide public micro deliberation that allow citizens to get a better understanding of policy consideration and differences between parties. At the same time, however, twitter networks among MPs might be strongly divided across party lines or other important social dimensions such as sex, age and ethnicity, leading to online interaction that strengthens information bubbles, political polarization and, in extremis, harm political functioning.

What do we know about MPs intraparlimentary networks? Hsu and Park (2012) showed that members of the 18th Korean National Assembly with a Twitter account were more likely to have links to fellow party members than to non-members, and Del Valle and Bravo (2018) demonstrated that the twitter networks among Catalan parliamentarians are segregated along party and ideological lines. Based on these studies we might conclude that Twitter functions as an ‘ideological echo chamber’ in which MPs are mostly exposed to MPs with consonant views. However, it is unclear to what extent these results are generalizable. The Korean study was performed in a time period when only early adopters in the National Assembly had a Twitter account (only 25% at the time) and even less did

actively use their Twitter account, and the study of Del Valle and Bravo refers to a regional Spanish case, Catalonia. A more recent study on parliamentary Twitter networks in 12 countries observed party based segregation in Twitter in most countries but not in all, notably not in the Netherlands (Praet, Martens, and Aelst 2021). Although results of the latter study are harder to interpret as the investigated twitter networks are not only formed by members of parliament but also include the senate and members of cabinet, that twitter networks among Dutch MPs are segregated is not at all empirically self-evident. Moreover, all above mentioned studies did not move beyond their valuable descriptives, they did neither theorize nor test other division lines and other explanations for the observed patterns of segregation.

In this contribution, we will therefore investigate segregation in Twitter networks in more detail, both theoretically and empirically, and do so among parliamentarians in The Netherlands. Network segregation is loosely defined as relatively frequent in-group relations and scarce out-group relations. Network segregation along party lines is sometimes labeled as elite polarization in the communication literature (e.g., Praet et al. 2021). Theoretically, we bring together the conceptual notion of digital architectures, or affordances, from the political communication literature (Bossetta 2018; Jacobs & Spierings, 2016) and the literature on segregation dynamics in online social networks (Boutyline and Willer 2017; Hofstra et al. 2017; Lin and Lundquist 2013; Wimmer and Lewis 2010), in order to understand how the different twitter network might be segregated. We particularly provide a more thorough understanding of MPs digital social networks with respect to four issues of political segregation: (a) to what extent are the Twitter networks among MPs segregated?; (b) to what extent are the observed segregation patterns along party membership lines on Twitter a by-product of social homophily (i.e., the preferences to form ties with socio-demographic similar others)?; (c) to what extent do the segregation patterns within the three network layers formed by following, @-mentioning and retweeting relations reinforce each other?; and (d) to what extent do segregation patterns change over time?



More specifically, our empirical focus will be on how relations within the three layers of the Twitter network among the 150 Dutch MPs have evolved after the national elections of 2017. Where the Catalan case of Valle and Bravo (2018) is a most-likely case to observe party cleavages in MPs' twitter networks, because of the strong independence movement, the Dutch case could be seen as a least-likely case to observe segregation in twitter networks, because of the multiparty system with a very large number of effective parties. After the 2017 elections, 13 parties were presented in Parliament by 150 MPs and the effective number of parties was above 8 (Casal Bértoa 2021). In parliament, parties need to collaborate, not only to form and support a government, but also to find majorities for specific proposals and to become an effective party in either coalition or opposition. In such a setting, we might expect less clear party and ideological division lines running across MPs' Twitter networks, whereas MPs from different parties might form networks around for instance gender or minority status. In other words, if ideological and party divides are still found in the Netherlands, this is a strong confirmation of the prior findings by del Valle and Bravo (2018). We thus present a replication in a different site, which is relevant in itself, but at the same time, we also expand on previous work in several important ways.

Theoretically, we acknowledge (1) that segregation may manifest itself not only along party membership lines but also along traditional social dimensions; (2) that Twitter consists of different interrelated network layers and segregation may manifest itself differently in each layer; and (3) that the degree of segregation may change over time. We will discuss each step in more detail in the 'Theoretical background section' below. Methodologically, we take advantage of unique longitudinal complete network data on Twitter relations among Dutch MPs collected in April, June and September 2017. We will first visually inspect these networks before giving a description of the observed degree of segregation by different formal network segregation measures. We will complement this descriptive part with a Stochastic Actor-Orientated Modelling approach as implemented in RSiena (Ripley et al. 2021; Snijders, Van de Bunt, and Steglich 2010). RSiena allows us to assess (political) segregation among MPs while controlling for structural network effects and a wide array of MP

characteristics (at the ego, alter and dyad-level) which may influence whether relations between MPs are present. Our data and SNA modelling strategy is discussed in more detail in the ‘Data and Methods’ section.

## **2. Theoretical background**

### ***Multi-dimensionality: Segregation in Twitter along political and social dimensions.***

Whereas previous studies focused on cleavages along political dimensions alone (Del Valle and Bravo 2018; Hsu and Park 2012), we will link this to socio-demographic segregation within MPs’ Twitter networks along major axis of representation: sex, age and ethnicity (Celis and Mügge 2018). This focus aligns with and builds on crucial insights from social network studies. Particularly, we distinguish between structure-based and choice-based mechanisms leading to network segregation below.

It has been a well-established finding that social interactions are more likely between people who are similar (McPherson, Smith-Lovin, and Cook 2001). The observed degree of network homogeneity is to a large extent the result of the opportunity structure, i.e., the availability of contact partners within and outside one’s group. Moreover, initial levels of network segregation may be amplified by common structural network processes such as reciprocity (i.e., “If you scratch my back, I will scratch yours.”) and transitivity (i.e., “Friends of friends become friends.”). Over and above such structurally-induced network homogeneity, people commonly have preferences to interact with similar others. The latter are called inbreeding homophily preferences, which surface in the choices that individuals make regarding whom to form ties with. Inbreeding homophily – also called choice homophily – contributes to segregation as it results in ties being more likely within specific groups and less likely between different groups than could be expected based on opportunity structures and structural network processes alone.

The above refers to general mechanisms and network homogeneity are observed across a wide array of social dimensions and for different type of social relations, but studies on segregation in extended online networks have remained rare. One may intuitively expect that the degree of

segregation would be less pronounced in online than offline networks and in extended versus core networks, because online there are fewer structural constraints and because the (emotional) risk involved in forming 'wrong' relations in extended networks of weak ties is lower than in core networks formed by strong ties. That being said, corroborative empirical evidence for this idea has been meagre at best (Hofstra et al. 2017). Regarding our focus, the online Twitter networks of MPs cannot be considered a core network, but MPs will be exposed to each other in parliament regularly nevertheless. It can thus be expected that real-life social cleavages matter, but it remains an open question whether those cleavages based on sex, age and ethnicity are indeed mitigated by Twitter or whether Twitter reifies these social divides in parliament.

As in other countries, Dutch political parties differ in their socio-demographic composition (see Supplementary Material A.). For instance, after the 2017 elections, women were underrepresented in parliament (54 MPs, 36%) and in most factions, women hold a numerical minority position. The exceptions are found among some within the political left: Green Party ('GroenLinks'; 8 MPs, 57%); Social Democratic Party ('PvdA'; 5 MPs, 56%); and Animal Interest Party ('Partij voor de Dieren'; 3 MPs, 60%). The mean age of MPs in parliament does slightly deviate downwards from the mean age in the general Dutch electorate (45 versus 50), but there are striking differences across parties. The MPs of the Senior Interest Party 50Plus, have a mean age of 65 year. The mean age of MPs of the radical left Socialist Party ('SP') is just over 38. Lastly, in The Netherlands, the share of MPs with a visible ethnic-minority background reflects the group size within the electorate fairly well (Van der Zwan, Lubbers, and Eisinga 2019), but zooming in we see that some specific groups are overrepresented, such as Moroccan-background Dutch citizens, while other are underrepresented, like Surinam-background Dutch citizens. Moreover, we observe marked differences across parties. In the 2017 election, a new Ethnic Minority Interest Party ('DENK') entered the arena, focusing in their campaign on racism and discrimination in Dutch society, and they won three of 150 seats in parliament. All three MPs have an ethnic-minority background. At the other end of the ideological spectrum, the Populist Radical Right

Party ('PVV') of Geert Wilders also has 1 MP (5%) who has a visibly-noticeable ethnic-minority background.

Considering these differences in social composition across parties, political segregation in Twitter networks could be the result of selective interaction along party lines, as well as of social inbreeding homophily, selecting Twitter partners based on attributes other than party membership. In this contribution, we will assess exactly that: the extent of political segregation, the degree of sex, age and ethnicity-based network segregation in Twitter networks, and the extent to which political segregation in Twitter networks along party-membership among Dutch MPs is a by-product of social inbreeding homophily (cf. Kalmijn 1998; Smith, Maas, and Van Tubergen 2014).

### ***Multiplexity: segregation in different layers of the Twitter network***

Up until here we discussed network formation in general terms. However, networks come in many different types and sizes. Even when we focus on a single social media platform, different layers of social networks are created due to different types of interaction being part of the platform's affordances or digital architecture (Bossetta 2018; Jacobs and Spierings 2016; Praet et al. 2021). Three of the most prominent layers of interaction on Twitter include follow relations, retweets and @-mentions. Discussing the nature of these forms of interaction provides our next theoretical building block.

On Twitter, one can follow another account in a non-reciprocal way. Once a connection is made, the tweets of the followee will appear in the timeline of the follower. Following an account could thus indicate that a follower finds the content posted by the followee interesting, regardless of whether one agrees or disagrees with the content of that followee. Forming (reciprocal) following relations can also be used strategically to boost the prominence of an account, because it will increase the likelihood that one's own tweets are shown in the timelines of others with whom no following relation is formed. However, in this respect, it should be noted, that although political parties want

their politicians to have and show large numbers of followers, hardly any party in the Netherlands seems to actively stimulate their MPs to follow each other on Twitter (Jacobs and Spierings 2016).

Next, Twitter allows users to basically copy a post of another user and push it to their own followers via the retweet function. Retweeting a message indicates that the original tweet is deemed an interesting enough intervention in the public debate to pass it on to one's own followers. Although politicians tend to explicitly claim that a retweet is not necessarily an endorsement (Boyd, Golder, and Lotan 2010; Klinger and Svensson 2015; Metaxas et al. 2015), particularly among politicians, retweeting a message of another politician one disagrees with is relatively unlikely, because the retweet function is mainly a passing on of content. The exception here is retweeting a post by 'quoting' it (as Twitter calls this) and adding one's own take on the issue. This function can be used to show what one disagrees with. While this is not uncommon, retweets are of the three relationship types the one most likely to signal positive affect.

In contrast, of the three, the @-mention functionality of Twitter is most likely to be used by politicians for debating with opponents and to signal negative affect. There are two ways in which one could @-mention others. First, a user can write a post and invite others to be aware of, look at, or respond to that post by including the person in the message using the @-mention. If one does so, the @-mentioned account gets a notification, strongly increasing the likelihood that the tweet is noticed by the @-mentioned person. Second, below each tweet, Twitter puts a small speech bubble icon via which users can directly, but publicly, reply to a message. Using this function automatically leads to including the author of the original message to be @-mentioned in the reply. This way, Twitter facilitates interaction among users. Overall, the @-mention is thus used for 'calling upon a person', holding conversations, and debating (Spierings and Jacobs 2019).

Given their different functions, and the presumed different emotional valence attached to the different type of ties, MPs may hold different structural positions in each network-layer and the network structures present in each layer of Twittersphere – most importantly the degree of segregation – do not necessarily need to be similar (Del Valle and Bravo 2018). So far, it has remained

unclear how the different Twitter network types co-evolve. Does debating with opponents makes friendships (i.e., following relations) with opponents more likely, or are MPs more likely to ignore their opponents and prefer to engage in debates with MPs they already follow? In the present contribution we take this so-called multiplexity of twittersphere into account. We will assess the extent to which the degree of segregation differs across layers, and how segregation in one layer of the Twitter network impacts segregation in another layer, i.e., how the different elements of the digital architecture are interrelated and may reinforce each other.

***Multiple time points: development of segregation in Twitter over time.***

Finally, we expand on previous work by investigating the over-time (co-)development of the three Twitter networks. More concretely, we will investigate how the Twitter networks among Dutch MPs have evolved between May 2017 and October 2017. In May 2017 a new, 13-party, parliament was installed following the elections of March 2017. In October 2017, a new government was formed after more than 200 days of fierce negotiations among different potential coalition partners.

Politicians of the same party who have been elected as MP are likely to have worked together before or during the campaigns leading up to the election. Their shared social contexts will undoubtedly have led to (structurally-induced) homogeneity in their offline relations (Feld 1981), and could have translated into their online Twitter relations. Following this line of reasoning and the lead of previous research demonstrating the ubiquitous presence of network segregation (Colleoni, Rozza, and Arvidsson 2014; Del Valle and Bravo 2018; McPherson et al. 2001), we thus expect to see at least some degree of segregation in the Twitter networks based on party-membership shortly after the time when parliament is established.

The degree of segregation is, however, unlikely to be stable. Common structural network dynamics like reciprocity and transitive closure may act as catalyzer and may contribute to the further over-representation of intra-party relations, thereby increasing the degree of segregation. On the other hand, the presumed initial segregation in twittershpere may be overcome merely because offline

contact and exposure to dissimilar MPs in the actual parliament increases. Such a process was argued for among the public's political discussion network by Brundidge (2010), who found evidence that through inadvertent exposure, the Internet increased the heterogeneity of political discussion networks, and thus people's exposure to political difference. Contrasting the often alluded to echo chamber effect, interview-based studies have shown that Twitter is used by politicians as a political instrument to be aware of what opponents think and say (Jacobs and Spierings 2016), which actually facilitates cross-ideological contacts. Our unique time window enables us to assess the development of segregation in Twittersphere over time, showing how it increases or decreases.

### ***Expectations***

Given the rationale outlined above and based on previous research on segregation in Twitter networks (Colleoni et al. 2014; Del Valle and Bravo 2018; Hsu and Park 2012), we expect to observe at least some degree of segregation along the party dimension in all three Twitter networks of Dutch MPs, and thus that MPs are more likely to interact on Twitter with same party MPs relative to MPs from different parties, even after we take into account structurally induced network segregation resulting from differences in opportunity structures and structural network dynamics (Hypothesis 1).

Since political parties have different social compositions (see Supplementary Material A.) and inbreeding homophily has been observed previously across a wide array of social dimensions, among which sex, age and ethnicity, for different type of offline and online networks, we expect to observe social divisions on twitter along these social dimensions as well (Hypothesis 2a), and that political segregation in Twittersphere will in part be a by-product of inbreeding homophily in these social dimensions (Hypothesis 2b).

Moreover, we expect that segregation will be most pronounced in the retweet layer of the twitter network, as this type of relation is of the three most likely to be formed between MPs who evaluate each other positively (Hypothesis 3a). In a similar vein, the @mention relation will, in contrast, be formed relatively more between political foes as they debate each other on twitter. Hence, of the

three layers, we expect to observe the lowest degree of political segregation in the @mention layer (Hypothesis 3b). Regarding the third layer, one may follow MPs on Twitter because of positive reasons, for example MPs may like the follower and/or want to increase the Twitter visibility of the follower, or for negative reasons when MPs want to be informed what political foe tweets. Hence, we expect the degree of political segregation in this layer will fall between the retweet and @mention layer (Hypothesis 3c).

From previous research, we know that (physical) proximity and exposure to others is a very important determinant for tie formation and maintenance (Rivera, Soderstrom, and Uzzi 2010). Once you follow someone on Twitter or are followed by someone, the tweets of this followee/follower become more visible to you. Hence, we expect that the digital proximity that results from a follow relation on Twitter will increase opportunities for both MPs to retweet each other's tweets or to react on tweets via @mentions. Consequently, we expect follow relations to increase retweet and @mention relations and thus that the degree of segregation in the retweet and @mention layer is in part the result of the degree of segregation in the follower layer (Hypothesis 4a and 4b). Similarly, when an MP retweets another MPs tweet or @mentions them, this may be an incentive for the second MP to become closer to the first MP and to start following this MP. Thus, we expect that segregation in the friendship network will also be in part the result of segregation in the retweet and @mention network (Hypothesis 4c and 4d).

Finally, we could expect that initial levels of segregation may deepen, because of inbreeding homophily and structural network dynamics, in line with the idea of the development of political echo chambers. On the other hand, networks may become more integrated over time because of the (offline) meeting opportunities with dissimilar MPs in the House. MPs may also form new (strategic) follower relations with dissimilar MPs, because they want to be informed on the Twitter content of these dissimilar MPs. Similarly, MPs may enter @-mention discussions with political opponents on Twitter, either steered by genuine political motives or to strategically increase Twitter visibility. From a theoretical perspective of network dynamics and digital architectures, both mechanisms are likely to



occur and we cannot deduce an a priori expectation on whether deepening or easing segregation will dominate. Therefore, we only formulate a research question on this to explore the development of segregation in Twitter over time: To what extent do the different forms of segregation in the different layers of Twitter networks among MPs deepen or ease over time? (Research question 1)

### 3. Data and methods

The Netherlands is a Twitter frontrunner, with a high adoption rate among MPs (>85% since 2012). Before the elections of 15 March 2017, we searched for relevant Twitter handles for all persons on election lists. Of the 150 politicians who eventually entered parliament we have 147 twitter handles; the other three did not have a known Twitter account (Tony van Dijck ('PVV'), Sietse Fitsma ('PVV') and Albert van den Bosch ('VVD')). Via the Twitter REST API follower and retweet relations were mapped and via the Twitter SEARCH API @-mention relations were mapped, at three time-points (April 2017, June 2017 and September 2017; two spells of 85 days in between).

The sex of MPs is taken from the election lists, which provides this for all candidates. The *age* (or more precisely birth year) of the MPs was collected via the official website of the House of Parliament ([www.tweedekamer.nl](http://www.tweedekamer.nl)). For our descriptive analyses we constructed a dummy variable indicating whether the age difference between two MPs was less than 6 years. We considered MPs as having a *visible ethnic-minority background* using a common contextual definition and procedure in the literature on representation: name and photo recognition or being well-known as such (Bird 2005; Bloemraad and Schönwälder 2013). This approach avoids issues of how to define 'non-Western migration background', which in the Dutch case for instance excludes MPs with an Indonesian roots even though they are likely to identify and be treated as ethnic minority in terms of segregation. For instance, prominent MP Vera Bergkamp of the Liberal Democratic Party ('VVD') has a Moroccan father but this is not wellknown and she hardly ever brings it up or makes it part of her politics. Given her appearance, it is also highly unlikely that she is treated as such in the streets. In our data she is not considered 'ethnic minority'. In terms of measurement, we used the categorization of MPs as

underlying prior work on the Netherlands (Jacobs and Spierings 2019; Spierings et al. 2019). The MPs who were not listed in previous elections (which were studied by those prior studies), we coded ourselves, using the same criterions. Consequently, we consider 16 MPs (11%) as belonging to a ‘visible ethnic minority’.

In our multivariate explanatory models, we take into account several control variables at the ego, alter and dyad-level: party-leadership, position on the election list, (difference in) incumbency status of MPs, whereby we defined incumbency as having been Member of Parliament before the 2017 election, and physical proximity within parliament is based on the seating positions of MPs in April 2017 as published in the ‘Debat Direct’ app (debate directly) present via the official website of the parliament (<https://www.tweedekamer.nl/debat-direct>). The dataset on all 150 MPs is accessible via our GitHub repository and replication website (\*\*\*)

### ***Analytical strategy***

We will start with a visual inspection of the directed and reciprocated ties present in the three network layers. We then move on to a description of the extent of segregation by formal statistics. There are many ways to measure segregation in social networks (Bojanowski and Corten 2014). Staying close to our definition of segregation, we start with comparing intragroup and intergroup densities. Network density is easy to interpret, but it takes into account neither relative groups sizes, nor that MPs differ in activity (number of outdegrees) and popularity (number of indegrees), while such differences in group sizes and unequal degree distributions alone may already cause structurally induced differences in inter- and intra-group densities. A measure of segregation that ‘controls for’ relative group sizes and degree distributions is the network-level version of Coleman’s Homophily Index. In this measure a value of 0 would indicate that the observed number of within-group ties is the same as would be expected under random choice by MPs. A value of 1 would indicate maximum segregation and a value of -1 indicates the unlikely case that MPs maximally avoid within-group relations. Unfortunately, Coleman’s Homophily Index does not measure the level of homophily or segregation along a social

dimension that is measured at the interval-scale, such as age. The third measure of network segregation we will use is Newman's Assortativity Coefficient. This coefficient takes the maximum value 1 if all connected dyads are within-group dyads. When the probability to observe a within group dyad is solely the result of proportionate mixing (i.e., just depends on the proportions of in- and out-degree for each involved group), it takes the value 0. Coleman's Homophily Index and Newman's Assortativity Coefficient fulfill different ideal properties of segregation measures as proposed by Bojanowski and Corten (2014). Most crucially for the goals of this study, if our descriptive results are stable across our three different measures of segregation, we are able to view results as reliable.

Although the descriptive part will inform us about the actual segregation in the network layers, they do not provide explanations for the found segregation. For that we need take into account how Twitter relations are formed and broken, how forming and breaking connections may depend on structural network effects (i.e., how the network structure at time  $T$  influences the network structure at time  $T + 1$ ) and on ego, alter and dyad covariate effects (i.e., the extent to which ego, alter and dyad characteristics influence the likelihood that a tie is present). Our data refers to three snap-shots of complete networks on a fixed node set (the MPs). For the statistical analysis of these network data we turn to the Stochastic Actor Oriented Model (SAOM) as implemented in SIENA (Simulation Investigation for Empirical Network Analysis), which we will estimate in R (R Core Team 2021) with the package RSiena (Ripley et al. 2021).

With RSiena, tie changes are modelled as resulting from actions by actors (or agents). An important assumption of the implemented SAOM is that of the so-called *ministep*. Only one actor per time is allowed to make a tie change, and this actor can change only one tie at a time. Which actor is allowed to change is determined by the rate-function but this is not our focus of interest. The decision on tie change, including the option of no change, is based on how the actor that is being allowed to change evaluates the current and possible future network structures in its direct vicinity. How these networks are evaluated is determined by the so-called evaluation function:

$$f_i^{net}(x) = \sum_k \beta_k^{net} s_{ik}^{net}(x)$$

Thus,  $f_i^{net}(x)$  is the evaluation function. And it maps a value to the *attractiveness* of the network,  $x$ .  $\beta_k^{net}$  refers to the estimated parameters of the model and these parameters of the evaluation function are what we are interested in. For each network effect  $k$ ,  $s_{ik}^{net}$ , (also called a network statistic) we will obtain a separate parameter estimate indicating the strength of the network effect. Each agent evaluates the attractiveness of its own local network environment. This is why  $s_i$  has a subscript  $i$ . Based on the mathematical definitions of the included network effects  $s_{ik}^{net}$ , agent  $i$  will determine the attractiveness of the possible networks that may result from a ministep. Agent  $i$  is most likely to take the ministep that will result in the network with the highest attractiveness value, thus higher values of the evaluation function indicate the preferred direction of change. Suppose that actor  $i$  who is allowed to make a tie change can choose between three possible future network states:  $x_a$ ,  $x_b$  and  $x_c$ . The probability that the tie change that will result in  $x_a$  is then given by:

$$P(X = x_a) = \frac{\exp(f_i^{net}(x_a))}{\exp(f_i^{net}(x_a)) + \exp(f_i^{net}(x_b)) + \exp(f_i^{net}(x_c))}$$

The interpretation of the parameters of the evaluation function resembles the interpretation of a logistic regression:  $\exp(\beta_k^{net})$  is the ratio of the probabilities to observe network  $x_a$  versus  $x_b$ , under the ceteris paribus condition that the only difference between these networks is that  $s_{ik}^{net}(x_a) - s_{ik}^{net}(x_b) = 1$ .

Following the RSiena manual (Ripley et al. 2021) , we started with a preliminary model, Model 0, for the three dependent network-variables (i.e., followers, retweets, @-mentions) in which we included (uniplex) structural network effects (*out-degree* and *reciprocity* effects, *in-degree popularity* (square root version), *out-degree activity* (square root version), *out-degree popularity* (square root version) and *transitive triplets*), time-period specific rate functions, and the *shared popularity* effect.

The out-degree effect can be seen as a constant, the likelihood to observe a tie. The reciprocity effect assesses the extent to which forming a reciprocated tie is more likely than a non-reciprocated tie. In-degree popularity and out-degree activity take into account the dispersion in degrees, that is, that MPs who receive/send many ties at time T also receive/send many ties at time T + 1. The out-degree popularity effect models the covariance between indegrees and out-degrees. With the transitive triplets effect we test network closure and its interpretation can best be explained by the expression “friends of friends are my friends”. With the shared popularity effect we aim to capture complex contagion processes, whereby MPs are more likely to form a new (follower, @-mention, retweet) relation to a specific MP when they observe that other MPs with similar relations as oneself also have a relation to this specific MP (c.f., Harrigan, Achananuparp, and Lim 2012). For the mathematical definition of each included network statistic we refer to chapter 12 of the RSiena manual (Ripley et al. 2021). With this structural-effects-only model we reached an acceptable fit (with an overall maximum convergence ratio of .16).

In Model 1, we subsequently included controls for MPs activity and MPs popularity: *political party*, *party-leadership*, *position on election ballot*, and *incumbency status*. The dyadic control covariates were: MPs *similarity in incumbency status* and the *seating distance* between MPs. Moreover, this model also includes our main variable of interest, namely the dyadic covariate MPs *similarity in party membership* with which we intend to test Hypotheses 1. Positive values of the corresponding parameter estimate will indicate that MPs are more likely to form ties with co-party members than with MPs from a different political party. Parameters estimates with a *t*-value smaller than one were subsequently dropped to obtain an acceptable fit of the model.

To assess the degree of segregation along sex, age, and ethnic lines and to assess the extent to which segregation along party division lines is a by-product of online social inbreeding homophily (Hypotheses 2a and 2b) we included the relevant dyadic covariates (*same sex*, (absolute) *age difference*, *same visible minority status*) in Model 2. In this model, we also included the corresponding covariates at the ego and alter level (*sex*, *age*, *visible minority*), to make sure our segregation estimates

are not biased by ego and alter effects. We subsequently dropped the respective estimates at the ego/alter-level with a  $t$ -value smaller than one to obtain an adequate model fit. With this model, we will compare the remaining degree of segregation along the party dimension across the three dependent variables to test hypothesis 3.

In our next model, Model 3, we added the following structural multiplex effects between on the one hand the follow layer and on the other hand the retweet and @-mention layer: *crprod* and *crprodRecip*. Cross-network effects between the retweet and @mention layer were thus not included. With the *crprod* effect we assess the likelihood for an MP who has a specific relation with another MP (e.g., follower) to also ‘send’ a different relation to this MP (e.g., retweet or @-mention relation). The *crprodRecip* effect captures the effect that if an MP has a specific relation with another MP (e.g., follower) this MP will ‘receive’ a different relation from this other MP (e.g., retweet or @-mention). Once again, we dropped estimates with a  $t$ -value smaller than one (now also including estimates referring to social inbreeding homophily). With the resulting model we investigate whether segregation in one layer of Twittersphere causes segregation in another layer (hypothesis 4).

Finally, to assess whether party-based segregation increased or decreased in our time window, we included an interaction between period and our dyadic variable same party in Model 4. Please note that our data consists of three timepoints and thus two periods (period 1: T1 to T2; period 2: T2 to T3).

We refer interested readers who would like to replicate all reported findings in our manuscript, or who want to assess how robust our findings are for alternative modelling strategies, to the replication GitHub website, accompanying this paper (\*\*\*)

## 4. Results

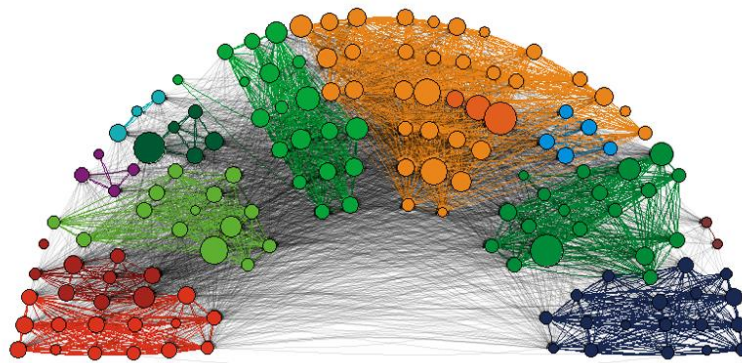
### *Observed segregation*

The networks that existed in April 2017 among the Dutch MPs are summarized in Figure 1. The node positions reflect the actual seating positions within parliament, party colors match those used on the official website of the house of representatives ([www.tweedekamer.nl](http://www.tweedekamer.nl)). It becomes apparent

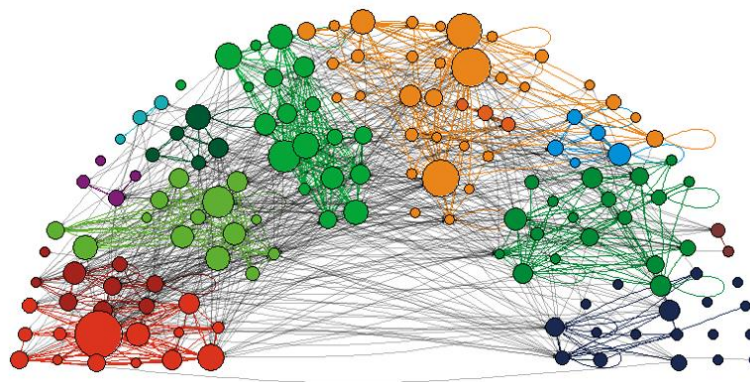
immediately that the density – the number of observed ties divided by all possible ties – is much higher in the follower network than in the @-mention or retweet layer. This means that MPs are more likely to be connected as follower-followee than that they regularly retweet or @-mention each other, which is logical given the architecture of the platform, with the following connections being permanent (unless actively broken).

The nodes in the directed networks of Figure 1 are proportional to their outdegree (the number of other MPs they follow, retweet or @-mention). In each layer of the Twitter network, we observe quite some variation across MPs in outdegree to which we already alluded to in the introduction. However, the figure also shows that it are not necessarily the same MPs who have a relative high outdegree in each network layer. For example, Pieter Heerma (Christian Democrats) follows most other MPs, Peter Kwint, (Socialists) @mentions most other MPs, and Dilan Yesilgöz-Zegerius (Conservative Liberals) retweets other MPs' posts most. That MPs hold different network positions in each layer, is not just based on anecdotal or visual evidence, it is also evidenced by the modest Spearman's rank order correlation between follower outdegree and @-mention outdegree (.39) and between the @-mention outdegree and retweet outdegree (.53). These observations underscore the importance to investigate the degree of segregation and underlying mechanism in the three network layers separately but interdependently.

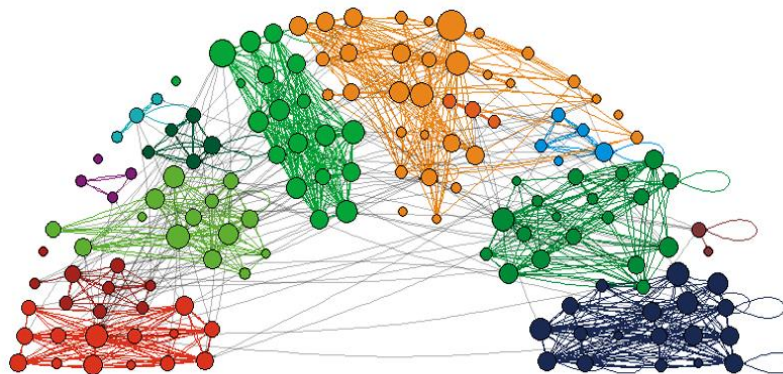
While Figure 1 provides insight in the layers of the Twitter network, they do not (easily) show whether twitter division lines run across the different political parties in the House of Parliament. The graphical summary of reciprocated relations in the Twittersphere of MPs in Figure 2 proves more informative in that respect; the reciprocated intra-party relations become more prominent relative to inter-party relations. It also seems that, as expected, especially (reciprocated) @-mention relations go across party boundaries, while (reciprocated) retweet relations predominantly exist between MPs of the same party.



**Panel a.** Follower relations



**Panel b.** @-mentions



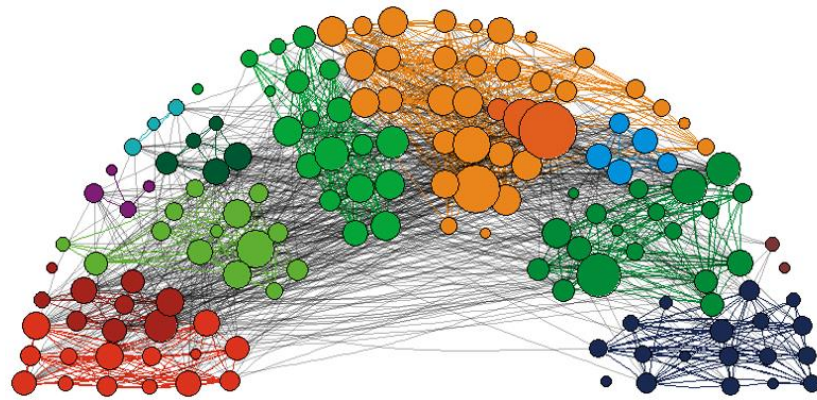
**Panel c.** Retweets



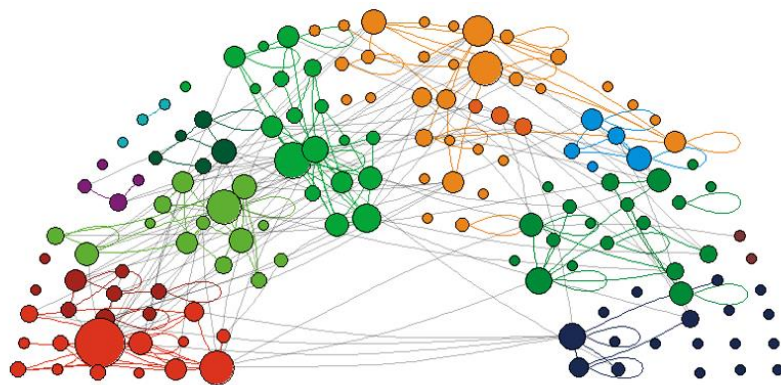
**Figure 1.** Directed twitter relations between Dutch MPs (2017)

*Notes: Node size based on degree. Edge color based on Party affiliation, black if MPs from different party*

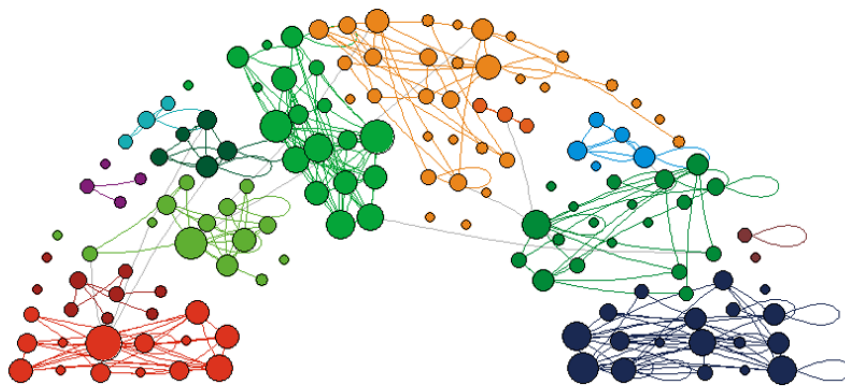




**Panel a.** Follower relations



**Panel b.** @-mentions



**Panel c.** Retweets



**Figure 2.** Reciprocated twitter relations between Dutch MPs (2017)

*Notes: Node size based on degree. Edge color based on Party affiliation, black if MPs from different party*

## ***Segregation indices***

### *Segregation along party lines*

We observe that Twitter relations with MPs of the same political party are substantially more common than with MPs of other parties (e.g., 0.71 over 0.19 for follower networks at T1; Table 1). This holds true for all network layers within Twitter and all three time points. Also based on our other two segregation measures we observe segregation along party lines. All respective values for Coleman's Homophily Index and Newman's Assortativity Coefficient are positive (row party, Table 2 and 3, respectively). This clearly goes against the somewhat surprising findings of Preat et al. (2021) but the apparent inconsistency is likely caused by the fact that Preat and colleagues investigated inter- and intraparty relations on twitter among a larger sample of politicians, namely, next to members of parliament, members of the senate and members of the cabinet.

### *Segregation along social dimensions*

Considering the different socio-demographic axis of segregation, Twitter relations with same-sex MPs are not substantially more common than different-sex relations. MPs who have a similar age (i.e., less than a 6-year difference) are more likely to have twitter ties than MPs with a dissimilar age. Follower relations on Twitter between MPs with the same ethnic background are more common than follower relations between MPs with a different ethnic background. But all in all, for these social dimensions differences in within group and between group densities are relatively small. This is confirmed by the results based on Coleman's Homophily Index and Newman's Assortativity Coefficient; segregation scores are close to zero and not consistently observed across the three twitter layers and time points.

### *Comparison of segregation patterns along the different Twitter layers*

According to both Coleman's Homophily Index and Newman's Assortativity Coefficient, we would conclude that segregation patterns along party division lines are most pronounced within the retweet network. This finding supports our conclusion based on a visual inspection of the Twitter networks

above (Figure 1 and 2) and is in line with the architectural reasoning that retweets are generally endorsements of the original tweet. In contrast to our expectation, both of these segregation measures indicate that party segregation is weakest within the follower layer. One possible reason might be that when intra party relations hit a plateau in this layer, inter party relations caught up.

#### *Development of segregation in Twitter over time*

The density of the follower network has increased over time, which is not a real surprise because ‘unfriending’ someone on Twitter is a rare event and we focus on a relatively small group of politicians with seats in parliament to which several new members are introduced through the elections. On the other hand, the density of the retweet and @-mentioning network has decreased over time. This reflects that our time point moved away from the elections: after the campaigning period of the elections and government formation, politicians feel less of an urge to be visible for their electorate via Twitter and take it a notch back after the intensive and energy-consuming events elections are.

The ratio of same-party and different party ties has decreased in the following layer (T1:  $0.71/0.19=3.74$ ; T3:  $0.74/0.22=3.36$ ; Table 1) and retweet layer (from 34 in T1 to 25 in T3, Table 1). For the following layer – but not for the retweet layer –, we see that Coleman’s Homophily Index and Newman’s Assortativity Coefficient has decreased over time as well. In contrast, the ratio of same-party and different party ties has increased in the @-mention layer and we also observe increasing numbers over time in this layer for the other two segregation measures (e.g., from 0.39 in T1 to 0.48 in T3 for Coleman’s Homophily Index in Table 2). Thus, we conclude that for the 170 days of our time window, segregation has been decreasing in the following layer and has been increasing in the @-mention layer. The results for the retweet layer are mixed.

**Table 1.** Inter- and intra-group densities within the three Twitter layers among Dutch MPs (2017)

	following	following	following	@-mentions	@-mentions	@-mentions	retweets	retweets	retweets
	T1	T2	T3	T1	T2	T3	T1	T2	T3
total	0.25	0.28	0.28	0.05	0.04	0.01	0.05	0.03	0.03
same party	0.71	0.73	0.74	0.20	0.14	0.06	0.34	0.25	0.25
different party	0.19	0.22	0.22	0.03	0.02	0.01	0.01	0.01	0.01
same sex	0.26	0.29	0.29	0.05	0.04	0.01	0.05	0.03	0.03
different sex	0.24	0.27	0.27	0.04	0.03	0.01	0.05	0.03	0.03
same age (<6)	0.29	0.31	0.31	0.06	0.04	0.01	0.05	0.04	0.04
different age (>5)	0.24	0.26	0.26	0.04	0.03	0.01	0.04	0.03	0.03
same ethnicity	0.27	0.29	0.29	0.05	0.04	0.01	0.05	0.03	0.03
different ethnicity	0.21	0.24	0.24	0.05	0.03	0.01	0.04	0.03	0.03

**Table 2.** Coleman's Homophily Index within the three Twitter layers among Dutch MPs (2017)

	following	following	following	@-mentions	@-mentions	@-mentions	retweets	retweets	retweets
	T1	T2	T3	T1	T2	T3	T1	T2	T3
party	0.23	0.21	0.21	0.39	0.40	0.48	0.80	0.80	0.80
sex	0.05	0.04	0.04	0.07	0.03	0.05	-0.01	-0.03	-0.01
ethnicity	0.12	0.10	0.10	-0.03	0.00	-0.02	0.05	-0.01	-0.01

**Table 3.** Newman's Assortativity Coefficient within the three Twitter layers among Dutch MPs (2017)

	following	following	following	@-mentions	@-mentions	@-mentions	retweets	retweets	retweets
	T1	T2	T3	T1	T2	T3	T1	T2	T3
party	0.22	0.20	0.20	0.39	0.39	0.47	0.82	0.83	0.83
sex	0.04	0.03	0.04	0.10	0.04	0.06	0.01	-0.01	0.02
age	0.05	0.04	0.04	0.09	0.02	0.12	0.02	0.01	0.06
ethnicity	0.06	0.05	0.05	0.08	0.02	-0.07	0.09	0.02	0.04

## ***RSiena results***

### *Structural and covariate effects*

Before we delve deeper into our core results derived from the RSiena models, we briefly describe the observed structural effects and the estimated covariate effects as summarised in Supplementary Material B. In all three network layers we observe positive and significant reciprocity effects. Reciprocity effects are strongest in the @mention layer ( $b=1.402$ ,  $se=0.090$ ), likely reflecting that MPs hold small back-and-forth conversations or discussions via Twitter. Our significant indegree popularity and out-degree activity estimates demonstrate the significant dispersion of out-degrees (i.e., activity) and in-degrees (i.e., popularity). Interestingly, more active MPs are significantly less popular, as indicated by the negative outdegree-popularity parameters ( $b=-0.186$ ;  $b=-0.096$ ;  $b=-0.271$ , respectively for following, @-mentions and retweets). This could indicate that less important MPs try to use Twitter to gain prominence and that some more prominent politicians do not need Twitter or have less time to invest in it (see Jacobs and Spierings, 2016; Jungherr, 2014). All networks show transitive closure (e.g., MPs are likely to follow MPs who are followed by MPs already being followed). Additionally, the shared popularity effect was negative in all three layers but only reached significance in the retweet layer ( $b=-0.014$ ,  $se=0.005$ ). In other words, different MPs have their unique ‘fan base’ of MPs which retweets their tweets. This finding is in line with the theory that social contagion is lower within a community because of the inherent redundancy and lack of novelty of messages within a community but contradicts the idea that tweets spread via complex social contagion (Harrigan et al. 2012).

Incumbent MPs are followed by fewer MPs ( $b=-0.507$ ,  $se=0.087$ ), and follow relations are more likely within the subgroups of incumbent and non-incumbent MPs than between these subgroups ( $b=0.165$ ,  $se=0.083$ ). An explanation is the different shared (political) history and meeting opportunities during the previous parliament. Incumbent MPs also retweet less ( $b=-0.114$ ,  $se=0.045$ ) and are retweeted less often ( $b=-0.082$ ,  $se=0.046$ ). MPs with a better ballot position – who score lower on this variable – follow fewer other MPs ( $b=0.542$ ,  $se=0.154$ ) but are @-mentioned ( $b=-0.012$ ,

se=0.003) and retweeted ( $b=-0.012$ ,  $se=0.004$ ) more, possibly indicating that MPs with a less favourable position on the ballot are less likely to hold and communicate important viewpoints on core political issues, according to other MPs. Party leaders initiate significantly less discussions on Twitter than non-party leaders as indicated by the corresponding negative and significant estimated ego covariate effect within the @-mention layer ( $b=-0.300$ ,  $se=0.096$ ) but are @-mentioned and retweeted relatively often ( $b=0.129$ ,  $se=0.092$ ;  $b=0.122$ ,  $se=0.079$ ; respectively). Although there are 13 different parties in parliament, we only find few significant party effects at the ego- or alter-level. MPs of the liberal democrats and green party are @-mentioned less often than others, and MPs of the liberal democrats and the populist radical right significantly less often retweet.

Acknowledging that (real-life) contact opportunities may translate into contact in online twittersphere, we wanted to take the physical structure of parliament into account. Therefore, we included a measure of the distance between the seats of MPs as a dyadic covariate in our models. These 150 seats are allocated to the parties after the elections by the presidium based on party size and mimics to some extent the classical, economic left/right political dimension: the socialist party ('SP') have seats on the left and the populist radical right ('PVV') have seats on the right in parliament (see also Figures 1 and 2). Per party, party leadership determines which MPs sit on which of the allocated seats, with the party leader generally sitting on the first row. Our results indicate that seating position influences Twitter relations among MPs: the further MPs sit from one another (already accounting for list position and party affiliation), the less likely they are to follow ( $b=-0.022$ ,  $se=0.007$ ) and retweet each other ( $b=-0.031$ ,  $se=0.006$ ). This likely reflects the impact of geographical distance, as expected, but we cannot completely rule out the influence of ideological distance.

### *Political segregation*

Turning back to our variable of interest, the 'same party' dyadic covariate, we find positive and significant estimates in all three layers of the Twitter network (see Supplementary Material B and Model 1, Table 4). Thus, even if we take into account structural network effects, factors that impact

MPs' activity and popularity, and the (physical and ideological) proximity between MPs within parliament, we still observe that MPs are more likely to form relations on Twitter with MPs of their own party than with MPs of different political parties. More concretely, the probability to form a relation with an MP of the same party versus a different party is approximately three times larger ( $e^{1.088}$ ), for @-mentions this is approximately two-and-a-half ( $e^{.922}$ ) and for retweets four ( $e^{1.388}$ ) times larger. These findings underscore our previous (descriptive) observations, and we thus clearly find corroborative evidence for Hypothesis 1.

More specifically, we expected to see party-based segregation most clearly in the retweet-layer and that the degree of political segregation would be lowest in the @mention layer, the follower-layer being in-between (Hypothesis 3a, 3b, and 3c respectively). This expected order of political segregation can indeed be observed but segregation in the retweet layer ( $b=1.386$ ,  $se=0.078$ , Table 4) is not *significantly* higher than in the follow layer ( $b=1.083$ ,  $se=0.146$ , Table 4) and segregation in the follow layer is not *significantly* stronger than in the @-mention layer ( $b=0.918$ ,  $se=0.054$ , Table 4). That being said, segregation in the retweet layer is clearly and significantly more pronounced than in the @-mention layer (the difference is .468 with  $se = .096$  and  $t\text{-ratio } t = 4.887$ ,  $p < 0.001$ ). Hence, overall, we find convincing corroborative evidence for the expected ordering of Hypothesis 3.

#### *Socio-demographic segregation and it's political by-product*

In Model 2 we assessed social inbreeding homophily. The main results are summarized in Table 4, the full results of Model 2 can be accessed via our GitHub replication website (\*\*\*). MPs are more likely to retweet tweets of MPs of the same sex ( $b=0.127$ ,  $se=0.049$ ). But this is our only estimate in line with the idea of social inbreeding homophily. Most respective estimates do not reach conventional levels of statistical significance. In contrast to our social inbreeding homophily hypothesis (Hypothesis 2), we even find that the larger the age difference between MPs the more likely they are to follow each other ( $b=0.035$ ,  $se=0.07$ ) and that MPs with the same visible ethnic minority status are less likely to follow each other ( $b=-0.390$ ,  $se=0.152$ ).



To be clear, the sex, age and ethnic background of MPs do impact twitter relations. Female MPs are more likely to be followed than male MPs ( $b=0.241$ ,  $se=0.086$ ), and on average they retweet and are retweeted more often ( $b=0.129$ ,  $se=0.053$ ;  $b=0.105$ ,  $se=0.051$ , respectively). Older MPs follow fewer other MPs ( $b=-0.140$ ,  $se=0.054$ ), are followed less often themselves ( $b=-0.017$ ,  $se=0.005$ ), and tweets of older MPs are retweeted less often ( $b=-0.009$ ,  $se=0.003$ ). MPs with a visible ethnic minority status are more likely to retweet ( $b=0.173$ ,  $se=0.102$ ). But, to hammer the point home, there are no clear and consistent social division lines running through twittersphere in parliament and we reject hypothesis 2a. And with no pronounced social inbreeding homophily present, it is not surprising that our estimates referring to segregation patterns running along the party division line are hardly affected. Party based segregation is not a by-product of social inbreeding homophily and we therefore refute Hypothesis 2b.

#### *Segregation crossing network-layers*

Above, we observed party-based segregation in all three layers of the Twitter network, which makes it relevant to test the idea that segregation in the follower network *causes* segregation in the @mention and retweet network and vice versa. Model 3 (main results summarized in Table 4, full results on GitHub replication website: [\\*\\*\\*](#)) is specified to estimate this and our results reflect the digital architecture of Twitter. Following MPs and being followed also leads to @-mentioning ( $b=0.400$ ,  $se=0.072$ ;  $b=0.158$ ,  $se=0.066$ , respectively) and retweets ( $b=0.647$ ,  $se=0.092$ ;  $b=0.251$ ,  $se=0.076$ , respectively). To @-mention a colleague MP will increase the chance that your tweets will be retweeted by this MP ( $b=0.988$ ,  $se=0.231$ ), possibly indicating that twitter discussions cross network layers. MPs are more likely to start to follow and @-mention MPs who they retweet ( $b=1.718$ ,  $se=0.536$ ;  $b=0.454$ ,  $se=0.212$ , respectively) and to start following MPs by whom they are retweeted ( $b=0.677$ ,  $se=0.483$ ). The direction from retweets to following stronger than from following to retweets and the direction from mentions to retweets is stronger than the reverse causal pathway.

The observed segregation along party membership lines in each respective layer of twittersphere is thus in part the result of the degree of segregation in the other two layers and we

hereby find corroborative evidence for Hypothesis 4. After taking cross-network effects into account the 'net party-based segregation effect' is considerably lower; the respective probability ratio's decreased from Model 2 to Model 3 by approximately 28, 40 and 25 percent, respectively for following ( $e^{(.755 - 1.088)}$ ), @-mentions ( $e^{(.406 - .922)}$ ) and retweets ( $e^{(1.106 - 1.388)}$ ).

#### *Segregation over time*

Finally, we tested for developments in the importance of party-based homophily over time by interacting the 'same party' variable with a period dummy (period 1 is reference category). In Table 4 we summarized the results of Model 4, which is Model 1 with the additional interaction terms. Results based on Model 2 and 3 with additional interaction terms led to similar results. We observe that the tendency of MPs to follow and retweet colleagues from the same party is more important for the explanation how the network developed in period 2 than in period 1, within the @-mention layer party-based segregation has less impact on network development in period 2 than in period 1.

At first sight, these results seem to point in the opposite direction as our descriptive results discussed above. We have to keep in mind, however, that in Table 1, 2 and 3 we described the *current* degree of segregation at three *timepoints*. In our RSiena models, summarized in Table 4, we looked at the *development* of party-based segregation in two *periods*. To illustrate the difference, if party-based segregation decreased faster between T1 to T2 (period 1) than between T2 and T3 (period 2), party-based segregation may be more important to explain how the network developed from T2 to T3 (period 2) than from T1 to T2 (period 1). Unfortunately, we only have data at three time points and cannot delve deeper into the question how party-based segregation changes in Twitter among MPs after elections.

**Table 4.** Multiplex RSiena model to predict twitter relations among (147) Dutch MPs in 2017: summary of main results from Model 1, 2, 3 and 4

	b	se	b	se	b	se
	<i>following</i>		<i>@-mentions</i>		<i>retweets</i>	
<i>Model 1</i>						
same party	1.083	0.146	0.918	0.054	1.386	0.078
<i>Model 2</i>						
same party	1.088	0.150	0.922	0.064	1.388	0.099
same sex	0.129	0.086	0.054	0.054	0.127	0.049
(absolute) age difference	0.035	0.007	0.000	0.003	0.001	0.004
same visible ethnic minority status	-0.390	0.152	0.073	0.055	0.121	0.083
<i>Model 3</i>						
same party	0.755	0.189	0.406	0.106	1.106	0.093
same sex	0.130	0.087			0.115	0.056
(absolute) age difference	0.034	0.007				
same visible ethnic minority status	-0.410	0.145			0.134	0.094
retweets	1.718	0.536	0.454	0.212		
reciprocity with retweets	0.677	0.483	0.245	0.181		
following			0.400	0.072	0.647	0.092
reciprocity with following			0.158	0.066	0.251	0.076
@-mentions					0.801	0.228
reciprocity with @-mentions					0.988	0.231
<i>Model 4</i>						
same party	1.215	0.157	0.804	0.060	1.386	0.079
period*same party	0.957	0.278	-0.448	0.099	0.265	0.056

## 5. Conclusion

In this study we brought together the online network literature (Boutyline and Willer 2017; Hofstra et al. 2017; Lin and Lundquist 2013; Wimmer and Lewis 2010) with that on the political consequences of the digital architecture of social media platforms and their political use (Bossetta 2018; Jacobs & Spierings, 2016). This enabled us to study more groundedly to what extent the full network of Dutch MPs was characterized by party-based segregation in the different layers of twittersphere (i.e.

following, retweeting and @-mentioning relations) and whether these are partly formed as by-product of preferences to interact with socio-demographic similar others, network dynamics, and the twitter architecture in a political context. Below we will discuss our main results and their implication for the four issues central to this paper. Our results, altogether, highlight the importance of combining these literatures and studying the different layers of Twitter interrelatedly, as this allows us to understand party-based segregation among MPs on Twitter as a function of the political rules of the game in parliament which is facilitated, or even aggravated, by the architecture of the platform, while social inbreeding homophily – an important driver of social segregation in the offline world – hardly plays a role. The latter lays bare that Twitter is not used by women or ethnic-minority MPs to create cross-party solidarity networks.

To what extent are the Twitter networks among MPs segregated? Our analyses show that among MPs, Twitter relations with MPs of the same political party are substantially more common than with MPs of other parties. This holds true for all network layers within Twitter – followers, retweets, @-mentions – and at all three time points. This provides further evidence for conclusions from previous descriptive studies (e.g. Del Valle and Bravo 2018; Hsu and Park 2012). Our Dutch case here, not only provides additional evidence based on more stringent tests (e.g., also taking into account differences across MPs in Twitter activity and popularity and structural network dynamics), but also does so for a least likely case to find segregation, given the consensus-oriented politics and large number of small parties in parliament.

More in-depth we also show that the degree of segregation in the different networks does align with how the architecture of the platform and the nature of politics are related. Concretely, we showed the segregation is strongest for retweets, then for follower ties and finally for @-mentions, which cross party boundaries most. This provides further evidence that retweets mainly function as political endorsements, whereas @-mentions are more a way to hold micro discussions. However, as said, also in the @-mention network layer MPs favour intra-party ties over inter-party ties. This aligns

with the insight that Twitter is considered mainly as a campaigning tool, while the other opportunities it offers – such as creating deliberative spaces – may be underutilized.

To what extent are the observed segregation patterns along party membership lines on Twitter a by-product of the preferences to form ties with similar others? While we found distinct patterns in terms of social-demographic differences and preferences, we found no consistent indication of the MP Twitter networks to be segregated by age, sex or ethnicity, and party-based segregation is thus not a by-product of social inbreeding homophily. In other words, while there is ample evidence that socio-demographic factors constitute power relations and political hierarchies, within parliament, this does not lead to online in-group preferences and segregation. While several decades ago, (informal) female and ethnic-minority networks were a tool for MPs from marginalized groups to empower themselves, such cross-party solidarity has waned (Dahlerup and Leyenaar 2013; Van Scherrenburg 2006) and social media reflect this even though they offer unique opportunities to form such network.

Having this said, our analysis at the same time do show cross-over between the offline and online world. In terms of hierarchies, we found that there is ingroup favouritism regarding whether the MPs are new (non-incumbents) to parliament or not (incumbents), with the latter in addition being following and retweeted less. This might indicate that in a way new MPs stick together and use social media to gain a foothold. Moreover, we found that the actual physical distance between seating positions of MPs matters. Accounting for list position and party affiliation, MPs who sit closer to each other are more likely to follow and retweet each other. What both results indicate is that while the Twitter networks of MPs hardly mirror the general socio-demographic cleavages in society, they are clearly a function of the ‘rules of the political game’.

To what extent do the segregation patterns within the three network layers formed by following, @-mentioning and retweeting relations reinforce each other? Clearly, they are interrelated and the design features of Twitter stimulate interaction: following and being followed stimulated the other interactions; @-mentioning another MP increases the chance of a retweet of that MP; and retweeting a colleague is linked to start following and @mentioning that colleague (i.e., coming across

a post worth retweeting feeds into more interaction); and being retweeted increases the likelihood to start following the retweeting MP. Crucially, however, these interrelations between the layers also lead to more segregation. The observed party-based segregation in each of the respective Twitter network layer is partly the result of the degree of segregation in the other network layers.

The structure of Twitter in combination with the functioning of politics thus contributes to the maintenance of online echo chambers. It are of course the MPs who decide who to engage with online, but the initial preferences for own party connections and pushing their messages are not countered by the platforms architecture; they are actually reinforced. While this might not sound surprising, it is noteworthy as overview studies and voter studies have concluded that social media political echo chambers are far from established or even argued against their existence (Jeroense et al. 2021; Matuszewski and Szabó 2019).

Finally, to what extent do segregation patterns change over time? Unsurprisingly, the density of the follower network increases over time, which aligns with the architectural discouragement to unfollow people and the rewards for following. The density of the retweet and @-mentioning network decreased over time, which reflects the move away from the elections, as we have seen before that activities spike around elections (e.g., Vergeer, Hermans, and Sams 2013). In terms of party-based segregation, we observed that segregation decreased in the following layer and increased in the @-mention layer. However, focusing on the development of the networks, we reached the exact opposite conclusion, preferences to form ties with co-party members became more important to explain the network structures in the following and retweet layer, but less important in the @-mention layer. This brings us to one of the main limitations of this study. Our longitudinal perspective was restricted by the data and we would have been able to draw more detailed conclusions on the development of segregation over time if we had access to the development of the networks on a monthly basis over a longer time period.

In multiparty systems, some parties are closer to each other than others, which often aligns with electoral choice sets. As a consequence, parties that are closer have incentives to work together

to get things done, but may also want to contrast themselves to each other as they compete over subsets of voters, especially during elections. How these two aspects balance out and what the impact thereof is for MPs Twitter network segregation is hard to say at this point. Making the big data of Twitter thick with publicly available information on (offline) collaboration networks (e.g., being member of the same committee), or with (full) MP survey data could provide important new avenues for research.

Altogether this paper sheds new light on the degree and origin of party-based segregation of MPs on twitter, which is not only of academic relevance, but also has direct bearing on democratic politics. Above we already alluded to this when reflecting on our results. Most importantly, while Twitter offers much democratic potential in terms of forging new connections, also to dissimilar others, the medium does not live up to this potential among MPs: while they can already talk to each other quite easily within their own party or given that they are ideologically or physically closer in the actual parliament, Twitter networks do not actively counter these dynamics, they mainly replicate them. Even the @-mention layer shows within party preferences. Moreover, the primary use of Twitter does not seem to be to perform public micro-deliberation or create cross party solidarity networks.

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**Supplementary Material A.** Composition of parliament in the Netherlands (2017)

Political Party	social dimension	N / mean	prop. / SD
<i>gender</i>			
parliament	male	96	0.64
parliament	female	54	0.36
parliament	<i>age</i>	45.13	9.32
<i>minority status</i>			
parliament	no visible minority	134	0.89
parliament	visible minority	16	0.11
<i>political party</i>			
parliament	VVD: People's party for Freedom and Democracy	33	0.22
parliament	PVV: Party for Freedom	20	0.13
parliament	CDA: Christian Democratic Appeal	19	0.13
parliament	D66: Liberal Democrats	19	0.13
parliament	GroenLinks: GreenLeft	14	0.09
parliament	SP: Socialist Party	14	0.09
parliament	PvdA: Labour Party	9	0.06
parliament	CU: Christian Union	5	0.03
parliament	Partij voor de Dieren: Party for the Animals	5	0.03
parliament	50Plus: 50Plus	4	0.03
parliament	DENK: THINK	3	0.02
parliament	SGP: Reformed political Party	3	0.02
parliament	FvD: Forum for Democracy	2	0.01
<i>gender</i>			
VVD	male	23	0.70
VVD	female	10	0.30
PVV	male	14	0.70
PVV	female	6	0.30
CDA	male	13	0.68
CDA	female	6	0.32
D66	male	12	0.63
D66	female	7	0.37
GroenLinks	male	6	0.43
GroenLinks	female	8	0.57
SP	male	9	0.64
SP	female	5	0.36
PvdA	male	4	0.44
PvdA	female	5	0.56
CU	male	3	0.60
CU	female	2	0.40
PvdDieren	male	2	0.40
PvdDieren	female	3	0.60
50Plus	male	2	0.50
50Plus	female	2	0.50
DENK	male	3	1.00
SGP	male	3	1.00

FvD	male	2	1.00
	<i>age</i>		
VVD	age	44.03	6.72
PVV	age	46.05	10.09
CDA	age	44.79	7.84
D66	age	43.84	10.16
GroenLinks	age	47.14	10.08
SP	age	38.36	6.99
PvdA	age	44.89	7.99
CU	age	46.80	4.38
PvdDieren	age	45.20	8.26
50Plus	age	64.75	8.02
DENK	age	42.33	5.51
SGP	age	52.33	7.57
FvD	age	53.50	27.58
	<i>minority status</i>		
VVD	no visible minority	30	0.91
VVD	visible minority	3	0.09
PVV	no visible minority	19	0.95
PVV	visible minority	1	0.05
CDA	no visible minority	18	0.95
CDA	visible minority	1	0.05
D66	no visible minority	17	0.89
D66	visible minority	2	0.11
GroenLinks	no visible minority	11	0.79
GroenLinks	visible minority	3	0.21
SP	no visible minority	12	0.86
SP	visible minority	2	0.14
PvdA	no visible minority	8	0.89
PvdA	visible minority	1	0.11
CU	no visible minority	5	1.00
PvdDieren	no visible minority	5	1.00
50Plus	no visible minority	4	1.00
DENK	visible minority	3	1.00
SGP	no visible minority	3	1.00
FvD	no visible minority	2	1.00

**Supplementary Material B.** Multiplex RSiena model to predict twitter relations among (147) Dutch MPs in 2017: full results Model 1

	b	se	b	se	b	se
	<i>following</i>		<i>@-mentions</i>		<i>retweets</i>	
<i>rate parameters</i>						
period 1 (April – June)	4.626	0.293	66.540	48.362	18.468	1.760
period 2 (June – September)	2.035	0.130	13.365	0.943	17.263	1.437
<i>structural effects</i>						
outdegree	-13.307	1.871	-4.215	0.140	-3.923	0.164
reciprocity	0.847	0.114	1.402	0.090	0.615	0.094
transitive triplets	0.037	0.007	0.066	0.036	0.157	0.025
shared popularity	-0.001	0.000	-0.008	0.010	-0.014	0.005
indegree - popularity (sqrt)	0.351	0.062	0.395	0.051	0.393	0.045
outdegree - popularity (sqrt)	-0.186	0.034	-0.096	0.039	-0.271	0.059
outdegree - activity (sqrt)	1.328	0.250	0.256	0.025	0.162	0.027
<i>ego characteristics</i>						
Liberal Democrats					-0.427	0.074
Populist Radical Right					-0.180	0.084
Green party			0.135	0.070		
party leader			-0.300	0.096		
incumbent					-0.114	0.045
position on election ballot	0.542	0.154				
<i>alter characteristics</i>						
Liberal Democrats			-0.104	0.071		
Green party			-0.171	0.084		
Incumbent	-0.507	0.087			-0.082	0.046
position on election ballot			-0.012	0.003	-0.012	0.004
party leader			0.129	0.092	0.122	0.079
<i>dyad characteristics</i>						
same incumbency status	0.165	0.083				
seating distance	-0.022	0.007			-0.031	0.006
same party	1.083	0.146	0.918	0.054	1.386	0.078

Notes: Overall maximum convergence ratio: 0.2471; parameter estimates with a *t-value* < 1 have been dropped.