

## Communication Dynamics in Twitter During Political Campaigns: The Case of the 2011 Spanish National Election

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*The irruption of social media in the political sphere is generating repositories of “Big Data,” which can be mined to gain insights into communication dynamics. The research reported here relies on a large data set from Twitter to examine the activity, emotional content, and interactions of political parties and politicians during the campaign for the Spanish national elections in November 2011. The aim of this study is to investigate the adaptation of political parties to this new communication and organizational paradigm originating in the evolution of the Internet and online social networks. We analyze the reply and retweet networks of seven political parties with significant offline differences to assess their conversation and information diffusion patterns. We observe that political parties, and especially the major traditional parties, still tend to use Twitter just as a one-way flow communication tool. Moreover, we find evidence of a balkanization trend in the Spanish online political sphere, as observed in previous research for other countries.*

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**KEY WORDS:** Twitter, politics, political parties, Spanish elections, online political campaigns

### Introduction

Social media has played an increasingly important role in electoral campaigns in recent years. The new functionalities provided by these technologies range from their use as a platform for spreading propaganda (e.g., retweets) to opportunities for generating spaces of debate among politicians and/or citizens (e.g., replies). On Twitter the content of most messages is publicly accessible to everyone and users are able to interact with each other without prior agreements, such as friend requests. This design encourages message exchange and converts Twitter into a large space of debate.

As seen in other studies on social media, patterns of political communication online are mainly characterized by strong polarization and balkanization, with little interaction between parties (Ackland, 2005; Adamic & Glance, 2005; Conover, Gonçalves, Flammini, & Menczer, 2012; Feller, Kuhnert, Sprenger, &

Welpe, 2011; Hargittai, Gallo, & Kane, 2007; Lawrence, Sides, & Farrell, 2010). Furthermore, and probably as a consequence of the lack of experience in online campaigning, social networks still seem to be mainly used as one-way flow broadcast media, despite their great potential to facilitate an interactive and two-way discussion flow (Criado, Martínez-Fuentes, & Silván, 2012). In this sense it is of great interest to carry out a deep analysis of the communication patterns on Twitter in order to detect different patterns embedded in the broader context of electoral laws and the regulated presence of parties and their electoral campaigns in the mass media.

The present study is focused on the 2011 Spanish national election. Since the early 1980s the Spanish Parliament has been made up of three types of parties:

- Two major national parties: PSOE (progressive) and PP (conservative).
- Some minor/new parties. In this study we analyze IU (communist/progressive), UPyD (liberal), and EQUO (green/progressive).
- Regionalist/nationalist parties. In this study we analyze CiU (conservative) and ERC (progressive).<sup>1</sup>

There are several points that justify Spain as a case study. One important point is the regulation of access to traditional media by the Spanish electoral law. The presence of political parties in the mass media is established according to previous election results, where major national and regionalist/nationalist parties have greater coverage in the traditional media than minor/new parties. These limitations and the lack of state regulation for party campaigning on Twitter in Spain generate an open scenario to be analyzed. Another point is that the usage of Twitter in Spain for political communication has grown considerably after the emergence of the 2011–13 Spanish protests. This movement, referred to as the 15M Movement, the Indignados, and/or #spanishrevolution, has highlighted the potential of online social networks for coordinating massive political actions.

### Social Media in Election Campaigns

The Internet and social media, for example the microblogging service Twitter, have been widely used in recent years to support electoral campaigning (Davis, 1999; Hendricks & Kaid, 2010; Klotz, 2004; Selnow, 1998; Webster, 2001). The use of social media as a communication platform played an essential role in the 2008 U.S. presidential election, with some claiming that Barack Obama's use of social media played a key role in his victory (Hendricks & Denton, 2010; Williams & Gulati, 2008). In recent years a number of studies have examined the use of social media in political campaigns. Some have highlighted the limitations for effecting social change in countries such as Iran (Burns & Eltham, 2009) while other studies have proved the potential of social media to facilitate the interaction between users and candidates in countries such as Romania (Holotescu, Gutu, Grosseck, & Bran, 2011). The activity and the networks generated within Twitter during electoral campaigns have also been studied to validate their reliability as

data sources for predicting elections results (Bermingham & Smeaton, 2011; Livne, Simmons, Adar, & Adamic, 2011; O'Connor, Balasubramanyan, Routledge, & Smith, 2010; Skoric, Poor, Achanuparp, Lim, & Jiang, 2012; Tjong Kim Sang & Bos, 2012; Tumasjan, Sprenger, Sandner, & Welpe, 2010). However, recent studies have questioned these results (Jungheer, 2010; Metaxas, Mustafaraj, & Gayo-Avello, 2011). The volume of activity in microblogging networks is strongly influenced by events in the offline world (Lehmann, Gonçalves, Ramasco, & Cattuto, 2012); previous studies have shown that during electoral campaigns, peaks of activity occur during election debates (Bruns & Burgess, 2011).

Social media have been adopted in electoral campaigns more slowly in Spain than in the United States. The first Spanish studies were conducted on the 2008 national elections, with blogs and online social networks like Facebook and YouTube as the main platforms (Dader, 2009; Peytibi, Rodríguez, & Gutiérrez-Rub, 2008). The first study focusing on Twitter did not appear until the 2010 Catalan elections (Congosto, Fernandez, & Moro, 2011), where a correlation was found between the number of mentions and votes received for each political party. Criado et al. (2012) showed for the 2011 Spanish local elections that mayoral candidates mainly used Twitter as a broadcast medium, with a simple one-way flow, and ignoring its potential for two-way communication. They confirm Roy's (2012) finding that technology cannot bring about change unless there is also a change in the underlying institutional arrangements. Further studies have examined the influence of resources on different online modes of political participation (Anduiza, Gallego, & Cantijoch, 2010), as well as on recent Spanish grassroots movements, such as the 15M movement. They have found that their communication networks on Twitter reveal complex and self-organized structures with a relatively large number of information sources (Borge-Holthoefer et al., 2011; González-Bailón, Borge-Holthoefer, Rivero, & Moreno, 2011).

Much of the research has shown that political interaction online tends to be polarized. In their pioneering study on the political blogosphere, Adamic and Glance (2005) examine linking behavior among political blogs in the months leading up to the 2004 U.S. presidential election. They found that conservative and liberal political blogs primarily linked to other blogs with the same political orientation, while linking far less to blogs belonging to the other political community. Further studies (Ackland, 2005; Hargittai et al., 2007), based on different data sets and a different methodology, confirm Adamic and Glance's results (2005). Further evidence for this polarization in the political blogosphere can be found in work on blog readership (Lawrence et al., 2010) that shows that people tend to read blogs that reinforce, rather than challenge, their political beliefs.

This trend for polarization has also been observed in Twitter, for different national contexts. For a German sample of Twitter users, Feller et al. (2011) confirmed patterns of preferential interaction among users who shared the same party affiliation. For the United States, Conover et al. (2012) analyzed tweets containing politically valenced hashtags relating to the 2010 midterm congressional elections. They found evidence of political polarization in the retweet

network, with users more likely to retweet users with whom they shared the same political ideology.

These studies provide evidence for a trend toward balkanization of political interaction online, where users are fragmented into different enclaves or echo chambers, in which people are “mainly listening to louder echoes of their own voices” (Sunstein, 2007, p. 13) and their own views are permanently reaffirmed. Sunstein (2007) problematizes this tendency as being a threat to democracy, and argues for a system that ensures exposure to competing perspectives.

### **Background on the Spanish Election**

The 2011 Spanish national elections took place on November 20, after two legislatures with PSOE (Spanish Socialist Workers Party) holding the Government. The first legislative elections in the current democratic system took place in 1979 with the victory of the centrist UCD party (Union of the Democratic Center), later disbanded. Three years later, in 1982, PSOE won the elections. Since then, PSOE and the conservative PP (Popular Party) have become the two major national parties, alternating electoral victories and, therefore, the Spanish Government. There are also some new/minor national parties with a notably minor legislative representation, such as the communist/progressive political coalition IU (United Left) and the recently created liberal party UPyD (Union, Progress and Democracy). Finally, some peripheral nationalist and regionalist parties (primarily located in Catalonia and the Basque Country) have obtained a certain power because of the need of alliances by PP and PSOE governments to achieve legislative majorities.

The Spanish national elections determine the representatives in two chambers: the Senate and the Congress. By law, the 350 deputies of the Congress, who elect the prime minister, are distributed (in proportion to the population) in 52 districts of very different sizes. The minimum representation per district is set to two deputies, except for the autonomous cities Ceuta and Melilla where it is fixed to one. This system has been frequently accused of favoring nationalist parties, which concentrate their candidates on a small set of districts, and especially the two major national parties, PP and PSOE. The representation of these two parties is oversized in relation to the percentage of total votes. This occurs because many votes for smaller national parties in districts with a low number of assigned deputies do not lead to representation in the Congress.

The electoral law in Spain regulates traditional media coverage of each party during the campaign according to its number of deputies before the elections. Due to this system, some minor and new parties have claimed lack of coverage. Thus, there were some criticisms of holding a debate exclusively between the leaders of PSOE and PP on November 7, 2011. Two days later another debate was held among five parties: PSOE, PP, IU, and the nationalist parties CiU (Democratic Convergence of Catalonia—Democratic Union of Catalonia) and PNV (Basque Nationalist Party), but with representatives of PSOE and PP instead of the real candidates.

## Research Hypotheses and Methodology

As seen in the previous sections on the role of social media in election campaigns and the specificities of the Spanish electoral system, major topics of academic and general discussion include the interrelation between offline and online events during electoral campaigns (e.g., Bruns & Burgess, 2011), the balkanization of online political interaction (e.g., Ackland, 2005; Adamic & Glance, 2005; Hargittai et al., 2007), the (strategic) use of social media by politicians (e.g., Criado et al., 2012), and the regulation of mass-media coverage as determined in the Spanish electoral law.

Based on these previous studies and theoretical concepts, we formulate four hypotheses, which we aim to assess in this work:

*Hypothesis 1: The volume of activity and the emotional load of the messages over time reflect the involvement of different parties in the key moments of the electoral campaign.*

*Hypothesis 2: Interaction in the Spanish political Twittersphere is polarized and balkanized, leading to scarce communication between parties, and a highly clustered network structure.*

*Hypothesis 3: Political parties and their leaders tend to use Twitter more as a one-way flow broadcast medium than as a space for engaging in conversations.*

*Hypothesis 4: Minor and new parties, which have lower coverage in the traditional media, will show a higher propensity to exploit the potential of Twitter as a new unregulated space for promoting their messages.*

We study these hypotheses focusing on the activity of political parties and their members on Twitter during the 2011 Spanish national elections.

To address the first hypothesis, we look at the evolution of the daily volume of tweets produced by each party, and assess whether significant variations occur that correspond with special events such as debates, the reflection day, and the election day. We furthermore study the emotional load of the tweets, looking for evidence of a correlation between the development of the campaign and the mood expressed by the members of the two major national parties. To assess the second hypothesis on political polarization, we inspect the amount of communication between parties in the networks of retweets and replies. To confirm the hypothesis, we should find that most of the communication does not cross party borders. For the third hypothesis, we study interaction patterns based on replies to shed light on the behavior of political party members. We focus in particular on the candidates and the official party accounts, counting the number of replies received and sent to see to what extent they actively engage in conversations with the general public on Twitter. Finally, we assess the fourth hypothesis by comparing the intraparty communication patterns of different parties. For each of the seven most active parties we analyze the corresponding retweet and reply subnetworks separately. The hypothesis will be confirmed if we find evidence for minor and new parties showing more cohesive and less centralized communication structures.

## Data Collection

The analysis described in this study relies on data collected from Twitter on November 4–24, 2011. The collection consists of 3,074,312 political tweets published by 380,164 distinct users. Tweets were selected if they:

- (1) Contained a hashtag linked to the campaign. Some of them emerged and were included during the campaigning period in order to increase the coverage of collected tweets, for example:
  - Descriptive: #20n, #elecciones20n, #debate2011.
  - Parties' slogans: #votapsoe, #votapp, #votaiu, #20nupyd, #votaequo.
  - Citizens' slogans: #15m, #nolesvotes, #ppsoe, #spanishrevolution.
- (2) Belonged to a profile declaring itself to be an official party account or held by someone holding a position in one of the political parties listed in the Table 1.
- (3) Were written by a user previously identified as an activist (408 in total), journalist (226 in total), mass-media channel (97 in total), or radio/television program (38 in total) focused on the campaign.
- (4) Mentioned the following political party/candidate profiles:
  - PSOE: @PSOE, @conRubalcaba.
  - PP: @PPopular, @marianorajoy.
  - IU: @iunida, @cayo\_lara.
  - UPyD: @UPyD.

**Table 1.** Number of Users and Collected Tweets for Each Political Party (We Analyze the Parties in Bold Which Are the Ones with More Than 10K Tweets in Total)

Category	Party	Orientation	Number of Users	Number of Tweets
<b>Major national</b>	<b>PSOE</b>	<b>Progressive</b>	<b>888</b>	<b>103,257</b>
	<b>PP</b>	<b>Conservative</b>	<b>489</b>	<b>63,650</b>
Minor/new	<b>UPyD</b>	<b>Liberal</b>	<b>235</b>	<b>60,738</b>
	<b>iunida</b>	<b>Communist/progressive coalition</b>	<b>188</b>	<b>24,037</b>
	<b>EQUO</b>	<b>Green/progressive</b>	<b>50</b>	<b>13,558</b>
Regionalist/nationalist	ppirata		12	1,414
	<b>ERC</b>	<b>Progressive</b>	<b>544</b>	<b>36,197</b>
	<b>CiU</b>	<b>Conservative</b>	<b>331</b>	<b>19,829</b>
	Compromis		83	4,752
	pa		36	2,636
	fac		17	1,981
	bng		13	1,767
	eaj-pnv		29	1,424
	na-bai		12	1,346
	cha		13	1,275
	cc		10	924
	upn		10	247
par		9	130	

- EQUO: @ProyectoEquo, @juralde.
- CiU: @ciu, @ciuduran2011.
- ERC: @Esquerra\_ERC, @AlfredBosch.

## Results

In this section we present analyses of the evolution of the number of tweets, their emotional load, and diffusion and conversation patterns.

### *Evolution of the Number of Tweets*

To assess our first hypothesis, we analyze the volume of tweets per day to identify the events leading to a relevant variation in Twitter activity. Once we have identified these events, we study the specific activity of the selected parties to evaluate their behavior during the corresponding event days. Figure 1 shows the daily volume of tweets in the data set. We observe that more than 500,000 tweets were created on the day of the debate between the two leading candidates, Mariano Rajoy (PP) and Alfredo Pérez Rubalcaba (PSOE), corresponding to 18.9 percent of the data set. The day with the second largest activity in terms of number of tweets is November 20, the election day, with more than 400,000 tweets, representing 14.0 percent of the data set. The third major peak occurred on November 18, the closing day of the electoral campaign. These results are in line with the ones reported in other studies of the 2011 Spanish national electoral campaign on Twitter (Barberá & Rivero, 2012; Congosto & Aragón, 2012).

The electoral law in Spain establishes an election silence on the day preceding the election, known as the reflection day. This intends to promote reflection prior to voting, without influence from political parties. Parties are barred from diffusing messages or program electoral campaign activities intended to engage

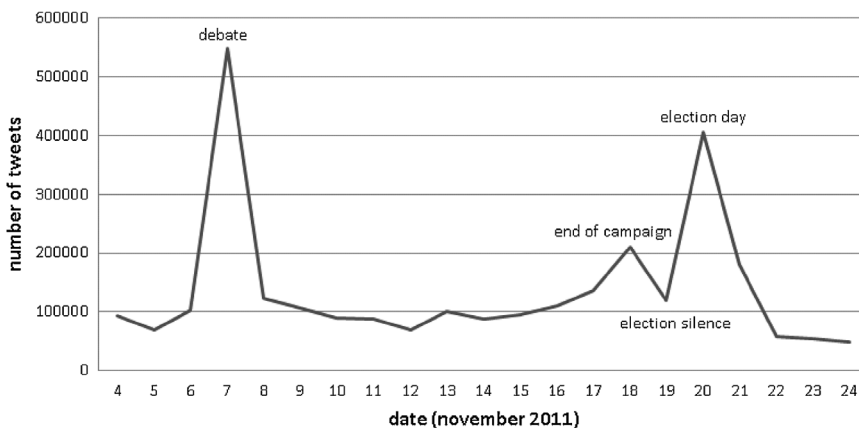


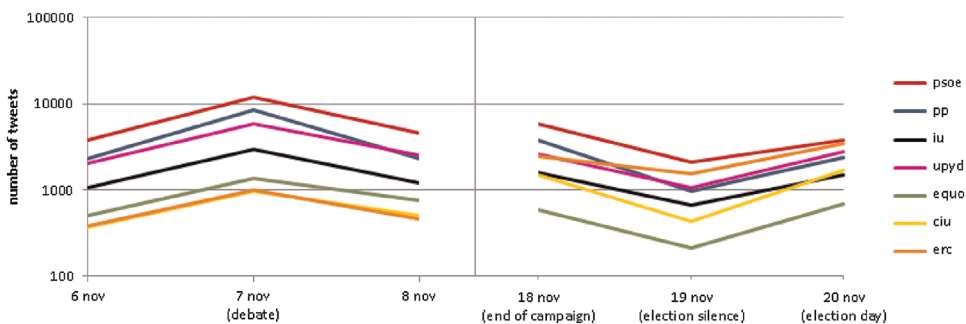
Figure 1. Number of Tweets Published Per Day.



new voters through traditional media channels during the reflection day. Figure 1 shows a significant decrease in Twitter activity between the end of the campaign and the election day, confirming that Twitter users were less active during the reflection day, at least regarding tweets relating to political issues. This means that even in the “unregulated” space of Twitter, the so-called reflection day was followed.

As we mentioned earlier, the largest peak was produced on the day of the debate between Mariano Rajoy (PP) and Alfredo Pérez Rubalcaba (PSOE). We analyze separately the volume of tweets published by users identified as members of the political parties on this day. In Figure 2 we observe a common pattern among parties, producing a peak of activity on that day. According to the ratio between the volume of tweets on the day of the debate (November 7) and the average of the adjacent days (November 6 and 8), the only two parties involved in the debate, PP and PSOE, produced the largest increase: PP 3.72, PSOE 2.83. However, the other parties also more than doubled the number of messages produced by party members: IU 2.63, UPyD 2.55, ERC 2.38, CiU 2.23, and EQUO 2.14. Figure 2 also shows that all parties demonstrated a decrease in the volume of tweets produced during the election silence on the day before the election day.

To summarize the findings of this section, we observe that, as reported in previous studies of election campaigns, debates and the election day produce most of the activity on Twitter (Bruns & Burgess, 2011); on the other hand, we find a drop in the level of activity on the day of electoral silence. Both results are found in the tweets posted by members of all the analyzed political parties; the parties participating in the debates acquire higher levels of activity during the peak day. Consistent with our first hypothesis, these results show evidence of a strong correlation between activity in Twitter and offline events relevant for the development of the campaign and the activity on Twitter. While until now we have only considered the evolution of the number of tweets per day, in the next section we will further explore the relationship between digital traces and offline events by taking into account the emotions expressed in the messages.



**Figure 2.** Number of Tweets Published by Parties Between November 6–8 and 18–20 (Logarithmic Scale).



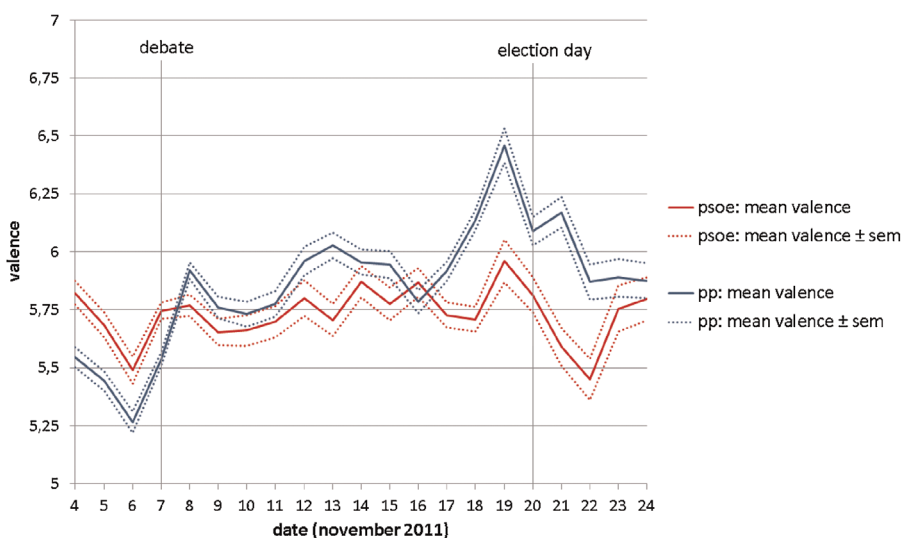
*Evolution of the Emotional Load*

Specific events, for example political debates or election results, can affect the emotional load of the users over the course of the campaign. Analysis of the affective content of the tweets represents an interesting methodology to compare the course of the campaign with emotional variations within different parties.

In this analysis we use an annotated corpus of words (Redondo, Fraga, Padrón, & Comesaña, 2007), the Spanish equivalent of ANEW (Bradley & Lang, 1999). This lexicon contains 1,034 Spanish words annotated along three dimensions: valence, arousal, and dominance. We analyze the valence of the tweets, indicating the degree to which the words express feelings of happiness, satisfaction and hope, or its opposite as sadness or disappointment.

We only focus on PSOE and PP because of the large volume of tweets they generated in comparison with the rest of parties, and the historical antagonism they represent as major national parties. Figure 3 shows the evolution of valence, including two dotted lines to describe the standard error around the mean value. We observe that, although PSOE leads in the beginning of the campaign, PP obtains higher values on the days after the debate (November 7). This difference increases considerably on the days prior to election day (November 20), with messages from PP, the party that went on to win the election, becoming more positive until the reflection day. After that day, we note a decrease in both parties.

From these results, we find it interesting that the highest values of valence occur among members of the winning party on the days prior to the election day.



**Figure 3.** Evolution of the Valence of the Tweets Published by PSOE and PP.

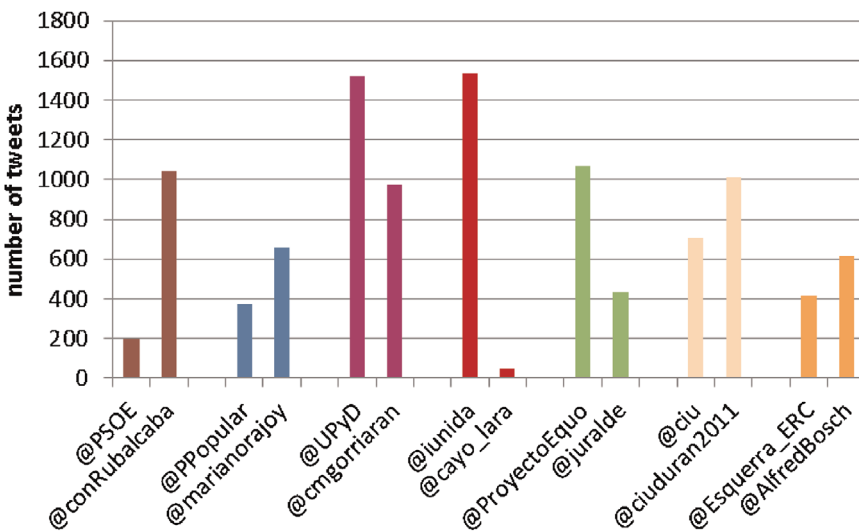
Note: Solid lines represent the average valence of the messages written by members of PP (blue) and PSOE (red).

Throughout the course of the campaign, most polls declared PP as the clear winner of the election; the affective results could therefore be a consequence of a feeling of confidence in victory.

### *Diffusion Patterns*

Twitter has become a platform where political parties can spread content and engage voters. Propagation mechanisms provided by Twitter, for example retweets, can expand content visibility within the network. In order to study the information diffusion patterns during the campaign, we first evaluate the activity of the profiles of the candidates for prime minister and the official party profiles in generating content that could be spread on Twitter during the campaign. Second, we analyze the internal retweet network of each party through graph theoretical measures to assess the differences in information diffusion patterns between parties.

The UPyD party candidate for prime minister, Rosa Díez, had no Twitter profile, so we choose @cmgorriaran: co-founder of the party, second candidate to the Parliament on the list for Madrid after Rosa Díez, and member of parliament after the elections. We observe in Figure 4 that the number of tweets posted by candidates is higher than the volume generated by the official party accounts during the campaign, with the exception of parties with limited mass-media coverage: UPyD, IU, and EQUO. We note a preference of the major parties to generate content from the account of the candidate rather than the official party account. Indeed, @conRubalcaba, @marianorajoy, and @ciuduran2011 (PSOE, PP, and CiU) made explicit in the profile's description that a professional team co-



**Figure 4.** Number of Tweets Published by the Profiles of the Candidates for Prime Minister Versus the Official Party Profiles.

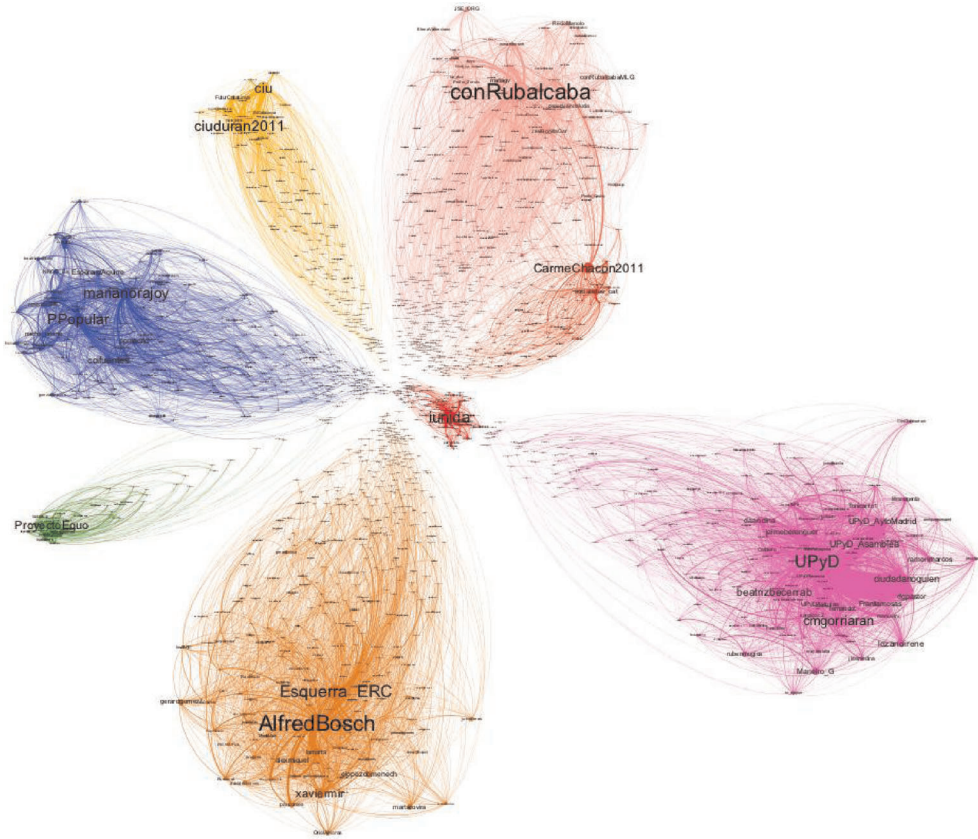
managed the account. Finally, we note the extraordinarily low activity of @cayo\_lara (IU) in comparison with the rest of the prime ministerial candidates and with the profile of his party, @iunida.

After evaluating the performance of candidates and party accounts as message generators, we analyze the patterns of party members retweeting and propagating political content. For this purpose, we define a retweet graph  $G^{\text{ret}}$  ( $V^{\text{ret}}, E^{\text{ret}}$ ) comprising a set  $V^{\text{ret}}$  of vertices and a set  $E^{\text{ret}}$  of edges. Here,  $V^{\text{ret}} = \{v_1^{\text{ret}}, \dots, v_n^{\text{ret}}\}$  is the set of users identified as members of selected parties that retweeted or were retweeted at least once during the campaign. We build a directed edge from user  $v_i^{\text{ret}}$  to  $v_j^{\text{ret}}$  if user  $v_i^{\text{ret}}$  retweeted user  $v_j^{\text{ret}}$ .

We apply the Louvain method (Blondel, Guillaume, Lambiotte, & Lefebvre, 2008) to extract the community structure of the retweet graph, obtaining 16 clusters, where eight of them are just composed of a single pair of nodes. The remaining eight groups correspond to the political parties, with the exception of PSOE, whose members are split into two different clusters: one formed by the politicians from the Socialists Party of Catalonia (Partit dels Socialistes de Catalunya—PSC) and one including the rest of the PSOE members. This result might be due to the fact that, although PSC is part of PSOE, it is also a strong group with a high level of autonomy. However, because PSC belongs to the PSOE federation and both shared the same objectives during the campaign, we consider the two parties as one in the following analysis. Figure 5 represents the retweet graph, created by applying the layout algorithm Force Atlas 2 (Bastian, Heymann, & Jacomy, 2009). The color and size of each node corresponds to the cluster it belongs to and its in-degree (number of head endpoints adjacent to a node), respectively.

From the results obtained on the community detection algorithm we infer that members of political parties tend to almost exclusively propagate content created by other members of their own party, in line with our second hypothesis on the balkanization of the Spanish political Twittersphere. This is clearly confirmed by Table 2, which shows the number of tweets propagated by each party: in over 97 percent of cases, retweets among members of political parties were within the same party.

Given that the parties generate independent networks of diffusion with almost no connections between them, we now consider them separately, defining seven retweet graphs, one per party, where the nodes of each graph are exclusively members of the same party. For each graph we first calculate some basic macroscopic metrics: clustering coefficient, the size of the giant component, and the average distance. The clustering coefficient measures the level of cohesiveness of the network, and is defined as the probability that two nodes with a common neighbor are connected; we use its directed version (Watts & Strogatz, 1998). The giant component is the largest subgraph where there is a path between any pair of nodes. The size of the giant component means the largest number of nodes that are directly or indirectly connected (Bollobás, 2001). The average distance between two nodes of the graph assesses if the network accomplishes the small world property (Milgram, 1967). Low values in the



**Figure 5.** Retweet Graph.

*Note:* The size of each node represents its in-degree, while the color corresponds to the cluster it belongs to.

average distance imply that all nodes are interconnected through a very small number of steps.

The results, presented in Table 3, show that parties with limited mass-media coverage (EQUO, UPyD, and IU) generate networks of diffusion with higher clustering coefficients than parties with greater attention from national and/or local mainstream press (PP, CiU, ERC, and PSOE). However, while most

**Table 2.** Retweets Between Parties

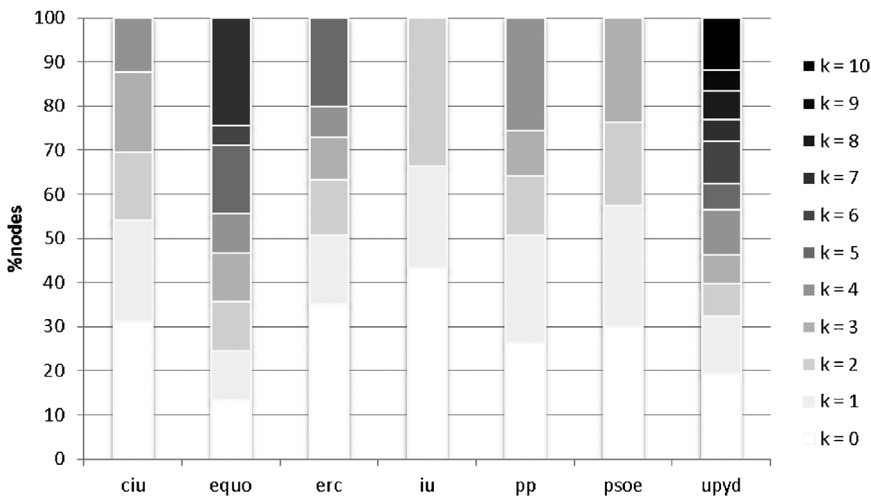
From/To	CiU	EQUO	ERC	IU	PP	PSOE	UPyD	Own Party (%)
CiU	<b>1,748</b>	0	31	6	4	7	2	97.22
EQUO	0	<b>960</b>	0	6	0	4	3	98.66
ERC	22	2	<b>4,040</b>	7	4	10	0	98.90
IU	9	2	16	<b>964</b>	1	3	2	96.69
PP	8	0	2	0	<b>4,186</b>	0	3	99.69
PSOE	3	3	8	3	8	<b>4,729</b>	13	99.20
UPyD	0	2	0	40	3	13	<b>7,013</b>	99.18

**Table 3.** Macroscopic Measures of the Parties’ Retweet Graphs

Party	Nodes	Edges	Clustering Coefficient	Nodes in the Giant Component (%)	Average Distance
EQUO	45	960	0.50	82.22	2.02
UPyD	186	7,013	0.37	73.12	2.43
IU	95	964	0.24	44.21	3.07
PP	298	4,186	0.19	57.38	3.32
CiU	170	1,748	0.18	52.35	2.79
ERC	343	4,040	0.18	56.56	3.02
PSOE	501	4,729	0.12	53.49	4.13

members of EQUO (82 percent) and UPyD (73 percent) are part of the giant component, less than half of the members of IU form part of its giant component (44 percent). This observation may be explained by the fact that IU is a political coalition formed by different parties. The average distance shows the small world nature of all parties’ social graphs. The most clustered parties (EQUO and UPyD) present the smallest values, with an average distance of less than three steps (Table 3).

To obtain a deeper understanding of the structure of the diffusion networks we perform a  $k$ -core decomposition (Seidman, 1983). The  $k$ -core of a graph is the maximum subgraph in which each node is connected to at least  $k$  other nodes in the subgraph. In Figure 6, the  $k$ -core decomposition of the parties’ retweet graphs reveals that the UPyD network ( $k_{max} = 10$ ) and the EQUO network ( $k_{max} = 7$ ) reach higher levels of nested  $k$ -shells than the remaining parties. The maximum levels are: CiU  $k_{max} = 4$ , ERC  $k_{max} = 5$ , IU  $k_{max} = 2$ , PP  $k_{max} = 4$ , and PSOE  $k_{max} = 3$ . The political coalition IU exhibits the flattest network according to



**Figure 6.**  $k$ -Core Decomposition of the Parties’ Retweet Graphs.  
 Notes: Darker values stand for higher levels of nested  $k$ -shells.

the  $k$ -core decomposition, and the one with the largest percentage of users (44 percent) within the outermost  $k$ -core ( $k = 0$ ).

For each retweet graph, we calculate the betweenness centrality of every node. The betweenness centrality counts the number of shortest paths between other users passing through that node. This metric describes the node's importance in the network as a center of information propagation. To improve readability of the results, they are normalized by setting the maximum value in each network to 100 (Table 4). We note that in every party's network, except for IU, there is a hub formed by the account of the party and/or the candidate: CiU (@ciuduran2011 + @ciu), EQUO (@ProyectoEquo + @redequojovent), ERC (@AlfredBosch), PP (@PPopular + @marianorajoy), PSOE (@conRubalcaba), and UPyD (@UPyD).

In summary, we observe for traditional parties (PSOE, PP, CiU, and ERC) a trend to generate more content from the personal account of the candidate rather than from the party's official account. However, most of these parties have opted for co-managing the account of the candidate with a professional communication team. The analysis of content diffusion reveals that members of political parties propagate content coming almost exclusively from members of their own party, providing evidence of the balkanization theorized in our second hypothesis. The propagation networks also show remarkable differences for the graph macroscopic metrics, and bring support to our third hypothesis: parties with limited mass-media coverage (EQUO and UPyD) form more clustered networks and their giant components comprise a greater percentage of users. This result indicates stronger community cohesion because fewer users appear to be isolated from the main party network. On the contrary, we find it interesting that this phenomenon of isolation occurs most intensively in IU, a party representing a coalition of parties. The higher cohesion of EQUO and UPyD with respect to IU is also reflected in the values of the  $k$ -core decomposition. More cohesive parties generate more complex network structures with higher levels of nested  $k$ -cores, while the political coalition IU only generates two levels of  $k$ -cores. The results of the betweenness centrality in the propagation network reveal that, except for IU, the parties and candidates remain central elements in the diffusion patterns over the election campaign.

### *Conversation Patterns*

In this section we focus on the conversation patterns generated by members of political parties, based on replies. First, we evaluate how the candidates for prime minister used the reply mechanism on Twitter. Next, we study the conversation networks of the parties to examine their structure and to assess if the microblogging network is balkanized or is characterized by cross-party debate.

While retweets are a common mechanism for spreading content within the network, Twitter enables replies for establishing direct and public communication between users. We analyze the ratio between sent and received replies by the party candidates (Table 5). In national parties we observe an important gap



Table 4. Twenty Most Central Users by Betweenness in the Parties' Retweet Graph.

CiU	EQUO	ERC	IU	PP	PSOE	UPyD
<b>Ciuturan2011</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>ciu</b>	<b>ProyectoEquo</b>	<b>AlfredBosch</b>	<b>PaulaRuMar</b>	<b>PPopular</b>	<b>conRubalcaba</b>	<b>UPyD</b>
FuturCatalunya	94.18 redequojoven	86.75 lamarta	48.31 hugomabarca	67.18 marianorajoy	94.90 osvalbuena	44.06 beatrizbecerrab
AlbertLM	28.14 isabanes	25.99 xaviermir	34.95 Ainhat	62.35 ppmadrid	50.64 ismaelbosch	41.87 jaimeberenguer
JNCatalunya	27.94 alesanper	23.70 Esquera_ERC	24.17 lalivaquero	59.81 mariuromero	45.97 socialistes_cat	41.03 cmgorriaran
ramonvibo	16.31 Equo_Cadiz	21.69 Pumocat	19.78 Elba_Celo	47.14 nacho_uriarte	43.50 EnricPerez	31.58 Tonicantoi
carlescampuzano	13.37 equomadrid	15.16 DiguezdeVic	19.26 iuandalucia	46.62 ChiquilloBarber	42.59 CarmeChacon2011	25.24 lilimmagenta
peremaciasiarau	9.48 juralde	15.09 isaacperaire	17.91 JAGarciaRubio	44.20 LuisSalom	28.12 garciaretegui	24.47 ciudadanoquien
ciumartorell	9.32 EquoBurgos	11.80 Raulmuto	17.57 NUET	43.18 PPCatalunya	25.81 FundacionIdeas	22.82 UPyD_AytoMadrid
rpuigvi	9.17 equosevilla	11.08 paucomes	17.18 pabloprietio	27.15 PPGalapagar	23.11 david_donaire	18.40 UPyD_Asamblea
carlotamafa	8.58 ramonlinaza	9.18 gerardgomezf	15.03 agarzon	25.94 juvenes_afd	19.37 psoeburgos	17.08 manuelhi
titonlailla	8.46 EquoCanarias	8.78 oscarperis	13.69 Gllamazares	24.22 marhuevar	18.63 conRubalcabaMLG	15.76 cristinaandreun
morellsau	7.97 MarioOrtega	5.30 jbigorra	13.30 IUUCM	23.29 NNGG_Es	18.60 JaviBonillaGar	15.93 MoratoGomezJL
ramontremosa	6.81 echa_morro	4.82 AnnaSimo	13.23 desdelacanter	21.14 ElenaaaBonet	17.31 DeSoleMartinez	15.26 Junquera_
lciuro	6.18 eQuoCipuzkoa	4.14 PauVilassar	12.46 Krisdekolores	20.88 popularesfuenla	16.62 CarmenMonton	14.74 Maneiro_G
margapayola	6.12 EquoHuesca	3.85 jsanglas	11.50 MaiteMolinaU	20.12 patriestevez	14.06 Raul_lanjaron	14.73 sergioac2
cloteipitita	6.04 carlosrierra	2.82 lesJERC	9.49 alternativajove	14.73 pp_jaen	13.47 alcaldehuevar	14.35 covita666
ignasifreixa	5.45 reyesmontiel	2.81 yuribcn	7.93 iescudero	13.64 ppandaluz	13.12 txabito	13.46 Calbarro
uniodojoves	5.44 EquoOurense	2.52 ERCSantfeliu	7.86 iblanco_eu	10.75 pptetuan	12.66 rosasiempereja	12.70 pinedaandalucia
meritxellroige	5.23 eQuoPontevedra	2.10 erc_fedgrona	7.03 Roberto_Rovira	10.47 palomaadradros	12.29 jssburgos	11.67 anabel_castell
	5.02 EquoAsturias	1.38 peresabat	6.98 iujerez	10.36 NNGGTresCantos	12.11 Amgarcia01	11.18

Note: Party and candidate accounts appear in bold.



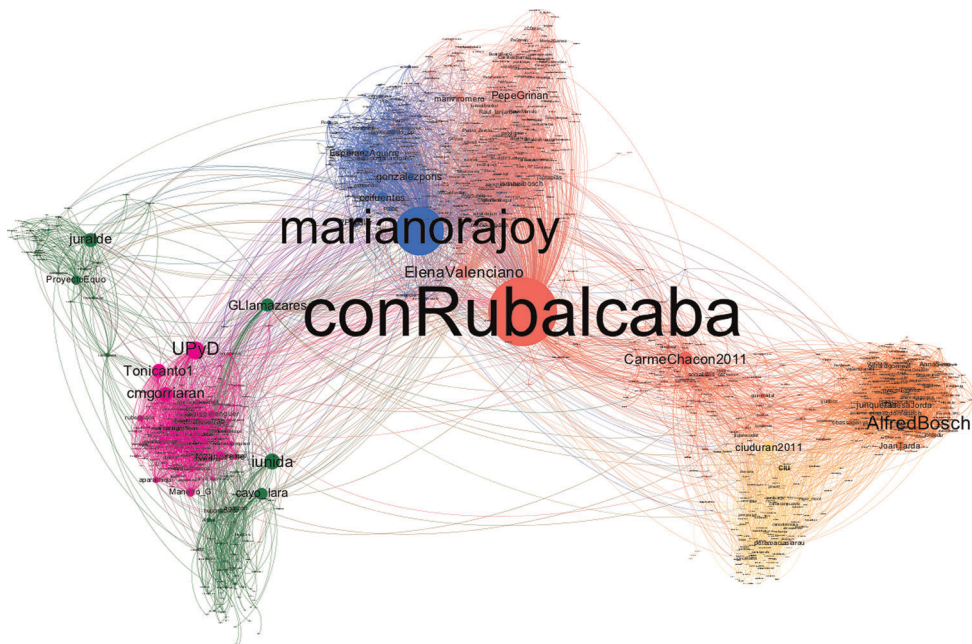
Table 5. Replies Sent and Received by Candidates

Party	Candidate	Sent	Received	Sent/Received
UPyD	@cmgorriaran	47	80	0.59
EQUO	@juralde	10	31	0.32
CiU	@ciuduran2011	18	61	0.30
PSOE	@conRubalcaba	26	397	0.07
IU	@cayo_lara	2	36	0.06
PP	@marianorajoy	14	280	0.05
ERC	@AlfredBosch	3	109	0.03

between the candidates of UPyD and EQUO (@cmgorriaran 0.59 and @juralde 0.32) in comparison with the candidates of PSOE and PP (@conRubalcaba 0.07 and @marianorajoy 0.05, respectively). The low ratio of the candidates of the major parties, PP and PSOE is conditioned by a considerably large number of received replies; this effect is not compensated by the existence of a team of communication professionals who co-managed the account. @cayo\_lara (IU), whom we observed in the previous section to hardly participate in the patterns of diffusion, only published two replies. In the Catalan nationalist parties there is an important distance between the CiU candidate @ciuduran2011 (0.30) and the ERC candidate @AlfredBosch (0.03). This can be partly attributed to the previously mentioned fact that the account @ciuduran2011 is co-managed by a professional team, while @AlfredBosch was exclusively managed by the candidate. However, we note that the numbers of replies written by the candidates are generally not high, and seem to indicate that both politicians and their teams conceive Twitter more as a place to diffuse their political messages than to engage in conversation with citizens.

Similarly to the previous section focused on information diffusion patterns, we denote as  $V^{\text{rep}} = \{v_1^{\text{rep}}, \dots, v_n^{\text{rep}}\}$  all users in our data set (i.e., users we identified as members of political parties according to their description on Twitter) who replied to or were replied by other users in the data set. Next, we generate a reply graph  $G^{\text{rep}}(V^{\text{rep}}, E^{\text{rep}})$  with a set  $V^{\text{rep}}$  of vertices and a set  $E^{\text{rep}}$  of edges. The directed edge  $e_{ij}^{\text{rep}}$  indicates if user  $v_i^{\text{rep}}$  replied to  $v_j^{\text{rep}}$  at least once during the campaign.

Again, we apply the Louvain method to extract the community structure of the reply graph. We detect 31 clusters, six of which are composed of at least 130 nodes, while the rest are formed by no more than five nodes. We visualize the network in Figure 7 with the layout algorithm OpenOrd (Martin et al., 2011) setting the color and size of each node according to the cluster it belongs to and its in-degree, respectively. The layout algorithm distributes spatially the nodes depending on the relationships with other nodes, that is, the communication interactions that take place between political profiles through replies. We observe that the largest cluster is mainly made up of users identified as member of PSOE. We note its closeness to the fourth biggest cluster, formed by members of PP, indicating intense conversation between these parties. We also observe that a subset of the cluster of PSOE is clearly distant from PSOE and PP, while it



**Figure 7.** Reply Graph.

*Notes:* The size of each node corresponds to its in-degree and the color represents the cluster it belongs to. PSOE, red; PP, blue; IU-EQUO, green; UPyD, pink; CiU, yellow; ERC, orange.

approaches the two clusters formed by members of CiU and ERC. This subset is essentially formed by the members of the Socialists’ Party of Catalonia (PSC), who seem to communicate more with politicians of Catalan nationalist parties than with members of PP or national PSOE. In fact, the visualization shows PSC acting as a kind of bridge between Catalan politics and Spanish politics, to which it is connected via PSOE. The fifth cluster is made up of users identified as members of UPyD. Interestingly, IU and EQUO, two minor left-wing parties that share views on many aspects, form one only cluster. However, the layout algorithm disposes members of IU and members of EQUO separately, with the user @isabanes acting as a bridge. Inés Sabanés (@isabanes) is currently part of the core of EQUO but she previously belonged to IU. We also note the presence of @GLlamazares, IU candidate in the two previous elections, who appears to be isolated because of the large number of connections with different clusters. The closeness of UPyD and IU-EQUO, parties with limited mass-media coverage, is also evident in Figure 7.

While diffusion patterns based on retweets occurs almost exclusively among members of the same party, conversation patterns based on replies present more diversity. Table 6 lists the number of received and posted replies between party members. We observe that intraparty replies are between 79 and 93 percent, while for retweets the ratio was above 97 percent for all parties. The numerical results correspond to the information displayed in Figure 7, where we observe a

**Table 6.** Replies Between Parties

From/To	CiU	ERC	PSOE	PP	UPyD	EQUO	IU	Own Party (%)
CiU	<b>2,260</b>	273	245	68	0	0	14	79.02
ERC	371	<b>4,155</b>	181	51	2	0	5	87.20
PSOE	111	120	<b>14,913</b>	2,203	74	8	112	85.02
PP	46	24	1,782	<b>10,222</b>	80	1	19	83.97
UPyD	2	2	177	150	<b>8,955</b>	61	304	92.79
EQUO	0	0	18	42	30	<b>1,452</b>	57	90.81
IU	8	0	102	22	147	53	<b>2,295</b>	87.36

certain amount of intercluster interactions. In particular, PP and PSOE receive perceptible attention from the other parties; Table 6 shows that they tend to write fewer replies than they receive from the other parties. Nevertheless, most of the replies to members of PP and PSOE come from those two parties. Also, the Catalan parties CiU and ERC exhibit an important amount of communication between them. We also note some conversations among parties with limited mass-media coverage: EQUO, IU, and UPyD.

As in the previous section, we define a reply graph for each party in order to analyze the structure of the conversation networks. While in the retweet graphs the edges link exclusively members of the same party, here we include an edge in the reply graph of a party if it corresponds to a reply between two users identified as members of political parties, and at least one of them belongs to that party. For each reply graph we calculate the clustering coefficient, the number of nodes in the giant component and the average distance between nodes (Table 7). We observe that EQUO and UPyD present again the most clustered networks according to conversation patterns, followed by IU that, in turn, is the party with the least number of nodes in the giant connected component.

We also calculate the betweenness centrality of users of the reply graphs. Table 8 lists the 20 most central users in each party. We observe that for most of the parties the most central users are the candidates: @ciuduran2011 (CIU), @juralde (EQUO), @marianorajoy (PP), @conRubalcaba (PSOE), and @cmgorriaran (UPyD). We previously noted that @AlfredBosch (ERC) and @cayo\_lara (IU) only posted three and two replies, respectively. @AlfredBosch appears in the

**Table 7.** Macroscopic Measures of the Parties' Reply Graphs

Party	Nodes	Edges	Clustering Coefficient	Nodes in the Giant Component (%)	Average Distance
EQUO	89	1,722	0.23	48.31	2.85
UPyD	259	9,834	0.23	69.50	2.99
IU	196	3,138	0.12	34.18	3.63
ERC	442	5,184	0.10	63.12	3.70
CiU	330	3,444	0.10	63.64	4.07
PSOE	874	20,046	0.07	55.26	4.13
PP	601	14,710	0.05	42.26	4.26

Table 8. Twenty Most Central Users by Betweenness in the Parties' Reply Graph

CiU	EQUO	ERC	IU	PP	PSOE	UPyD
ciuduran2011	100	100	100	100	100	100
jidiaz87	80.44	elopezdomenech	hugomabarca	84.11	conRubalcaba	cmgorriaran
peremaciasiarau	54.54	jordedu	GLlamazares	77.33	CarmeChacon2011	UPyD
carlescampuzano	47.68	<b>AlfredBosch</b>	Ainhat	43.41	robrindo	jaimeberenguer
lluisrecoder	43.07	AnnaSimo	enriqueenormand	38.22	mariviromero	Tonicantol
marta_llorens	40.51	gerardgomezf	iunida	25.2	ismaelbosch	Maneiro_G
s_grifell	36.03	amanebre	agarzon	19.95	japtapias	fernandot
ctu	35.91	equosevilla	laliyaquero	18.06	Raul_Lanjaron	pinedaandalucia
somapereda	32	perearagones	Krisdekolores	16.63	alexsavez	Paco_Glez_
OriolRistol	31.29	valencianna	<b>cayo_lara</b>	32.74	EnriqueMoratalz	lozanoirene
mapallares	28.67	yuribcn	Dominbenito	24.31	trinitro	aparachiqui
carlotamaf	22.61	marcpuigperez	JovenesIU	22.44	santiagocervera	manuelhi
ramontremosa	22.51	jbigorra	MaitieMolinaIU	17.97	beatrizjuradofc	rubenjuans
lciuro	22.39	joanpuig	angelsmcastells	17.62	JoseAngel_SJ	robgrg
Beggo79	21.77	isaacperaire	PaulaRuMar	17.19	maruhuevar	Franllamosas
jordixucla	21.49	holoturoideu	IUMalaga	16.99	JAMonago	Junquera_
xtomas	20.45	OriolClusells	pabloprieto	16.43	PP_CALASPARRA	mayteolalla
ignasifreixa	17.99	ramonfernu	RamonLuque1	14.8	gonzalezppons	ancerverus
titonlaila	17.79	xaviermir	dseidelacanter	14.47	nacho_urriarte	quintanapaz
alexastre83	17.55	miferres	Elba_Celo	13.12	ismaelbosch	ManuelCustodiOM
		DieguezdeVic	iblanco_eu	8.75	PopularesCyL	beatrizbecerrab
				6.69	sanchezcastejon	

Note: Candidate accounts appear in bold.

third position, after two active members of ERC, while @cayo\_lara is the ninth most central user. Finally, we note, in comparison with the retweet graphs, an important predominance of profiles that represent real persons. From this result we infer that users prefer to dialogue with real people, in opposition to the diffusion patterns, which involved official party accounts of the parties to a greater extent.

In conclusion, the generally low numbers of sent replies and the low ratio between sent and received replies confirm our third hypothesis showing a prevalently one-way flow usage of Twitter by the candidates. However, we observe differences among parties, with EQUO and UPyD exhibiting the most conversational behavior. This supports our fourth hypothesis that minor and new parties are more prone to exploit new communication mechanisms offered by Twitter. Moreover, we find that the networks of EQUO, UPyD, and IU present the most clustered structure. Finally, regarding our second hypothesis on balkanization, we observe some level of communication between members of different parties, especially between parties of the same type: PP-PSOE, IU-UPyD-EQUO, and ERC-CiU. Nevertheless, also in this setting the large majority of communication occurs between members of the same party, showing a tendency to polarization.

## Discussion

The analysis of the usage of Twitter by the main Spanish political parties during the national election in 2011 confirms our four hypotheses. The first hypothesis, stating that activity in Twitter reflects the involvement of different parties in the key moments of the electoral campaign, is confirmed by the study of the number of tweets per day, and by the analysis of the evolution of the emotional load of messages. The results showed important peaks in the activity of all parties, corresponding to important events such as the debates and the election day. The impact of television debates on the overall evolution of tweets during the campaign indicates strong interaction dynamics between different kinds of mass media, as observed by Bruns and Burgess (2011), and opens up to a new and promising line of investigation in media studies. Meaningfully, the electoral silence, imposed on traditional media for the day before the election day, was also largely observed in the unregulated space of Twitter, confirming a coupling between traditional and social media.

Beyond the pure “counting of tweets,” our analysis demonstrates that the emotional content of messages can reveal further insights into the development of electoral campaigns. The results of the sentiment analysis indicate a more positive tone in the messages posted by members of the most voted-for party, compared with the party coming second, starting in the days immediately before the election day and increasing as the day was approaching. This result may have been influenced by the fact that the winning party was leading the election polls. The (emotional) transmission, reaction and reflection of the preliminary polls to tweets generated by party members and voters may be a key aspect in the

development and improvement of social media and “big data” based electoral predictions. To further shed light on this aspect, we aim to perform similar analyses in future electoral campaigns with greater uncertainty about the final results.

Our second hypothesis, suggesting the balkanization of the (online) political sphere in Spain, is confirmed by the analysis of diffusion and conversation patterns. The extremely low occurrence of retweets between members of different political parties clearly indicates that, although there may be shared ideological points among parties, their members do not propagate content that is not generated within their own party network. In contrast, our analysis of conversation patterns, based on replies, shows a more diverse picture. Interparty communication happens, especially between members of parties that belong to similar parties in terms of size and/or geographical focus (national major: PSOE-PP; minor/new: IU-UPyD-EQUO; nationalist: ERC-CiU); however most of the interactions still occur within the party.

To address our third hypothesis, which states that political parties tend to use Twitter as a one-way flow broadcast medium, we have explored conversation patterns. The small number of replies written by candidate and party profiles, and the low ratio between sent and received replies, give a general confirmation of this hypothesis. Also in this context political parties use communication mechanisms provided by Twitter mostly for internal communication, which may be interpreted as closer to “electronic autism than to actual communication” (Castells, 2009, p. 1545). This is particularly true for major and traditional parties. Centrality measures in most cases indicate the candidates as the central elements in their parties’ reply networks, showing a preference for dialoguing with politicians rather than official party accounts.

Finally, in our fourth hypothesis we argued that minor and new parties, with lower coverage in traditional media, would show a higher propensity to exploit the potential of Twitter to promote their messages. The analysis of the retweet networks unveils remarkable differences among parties, showing that indeed new and minor parties tend to be more clustered and better connected, which implies a more cohesive community. While the strategies of the major parties to spread their messages tend to be strongly centralized around their prime ministerial candidates, in the networks of minor and new parties the leaders have a lower importance and the most central nodes tend to be the party profiles. The analysis of conversation patterns, based on replies, also points out a higher propensity of minor and new parties to establish conversations with the public, and their tendency to create more cohesive communities according to the macroscopic metrics.

We aim to focus our future research on exploring in-depth the topological patterns of party networks in order to characterize the different party apparatus: centralized, decentralized, or distributed networks following De Ugarte’s work (2007). We also intend to contrast the topological patterns of the networks created by political parties with the networks produced by recent political grassroots movements, and to assess the effect of emotions on information diffusion dynamics in both scenarios. By this, we hope to shed light on (online) political



communication patterns and their degree of dialogue and openness, contributing to the current and highly polemic discussion of the relationship between political parties and citizens.

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1. We denote national parties those with candidates in most Spanish electoral districts. We denote nationalist parties those with candidates just in the districts corresponding to the specific peripheral nationalism and/or regionalism.

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