
Article:
Asher, M, Leston Bandeira, C orcid.org/0000-0002-6131-4607 and Spaiser, V orcid.org/0000-0002-5892-245X (2019) Do Parliamentary Debates of e-Petitions Enhance Public Engagement With Parliament? An Analysis of Twitter Conversations. Policy and Internet, 11 (2). pp. 149-171. ISSN 1944-2866

https://doi.org/10.1002/poi3.194

Do Parliamentary Debates of e-Petitions Enhance Public Engagement with Parliament? An Analysis of Twitter Conversations

Molly Asher, University of Leeds - Leeds Institute for Data Analytics, Leeds, UK

Cristina Leston-Bandeira, University of Leeds - School of Politics and International Studies, Woodhouse Lane, Leeds LS2 9JT, UK

Viktoria Spaiser [v.spaiser@leeds.ac.uk], University of Leeds - School of Politics and International Studies, Woodhouse Lane, Leeds LS2 9JT, UK

The UK Parliament introduced an e-petitions system in 2015 with the aim of significantly enhancing its relationship with the public. We explore whether this aim is being met through the analysis of Twitter data from conversations on e-petitions debated in Parliament. We use natural language processing, machine learning and social network analysis of Twitter data to explore what it shows about the extent of people's engagement, the contents of Twitter e-petition conversations, who is taking part and how they interact. Our findings provide interesting insights into how people perceive the e-petition procedures in terms of fairness and responsiveness, suggesting that petition parliamentary debates should be more inclusive of the original petitions' aims. The results also point to homophily tendencies present in the Twitter e-petition discussions.

KEY WORDS: e-Petitions, UK Parliament, Twitter, public engagement, Natural Language Processing, Social Network Analysis

Introduction

Recent decades have witnessed a rising of public dissatisfaction with formal political institutions, concomitant to an expansion of forms of political participation besides traditional methods (Dalton, 2004, 2017; Stoker, 2006; Hay, 2007; Norris, 2011). e-Petitions are amongst these new and increasingly popular forms of political participation, with many parliaments developing their own e-petitioning systems (Hough, 2012; Riehm et al. 2014). Despite their popularity though, questions remain whether this mechanism enhances the relationship between parliament and the public. As Carman demonstrated (2010), more than

the existence of e-petitions, it is the parliamentary process through which these are considered that matters in terms of enhancing engagement with parliament.

In 2015 the UK Parliament and Government launched their collaborative e-petitions system, through which members of the public can lodge petitions. Although government e-petitions sites had existed for several years, this was a markedly new system, crucially integrating parliament. The new system hoped to redress flaws identified with previous versions, whilst expanding the scope of traditional petitioning to parliament, a practice in place for centuries. A key change was the introduction of a specific parliamentary Petitions Committee to oversee the process and liaise with petitioners, and a clearer channel for responses to e-petitions, with those reaching 100,000 signatures being considered by the Committee for a debate. This was in response to assertions that the previous, government-led, system was failing to deliver on its promises, and was risking "an exacerbation of public disillusionment with the political system in the long-term" (Hansard Society, 2012, 5). The 2015 e-petitions system would have "the potential to bring about a significant enhancement of the relationship between petitioning public and their elected representatives" (Procedure Committee, 2014, 31). Since then, the e-petitions system has mediated very significant activity and the Petitions Committee has developed a plethora of public engagement activities utilizing diverse tools such as Twitter, the focus of this article. However, we still know little about the extent to which the new system has indeed enhanced the relationship between public and representatives, namely whether the new system promotes a better parliamentary process to consider the issues raised by petitions.

This article analyses Twitter data to assess this issue. We explore what Twitter conversations tell us about the ways the public engages with the UK Parliament's e-petitions system, specifically with their debates in parliament, seen as a key step in the petitions' consideration process. Whilst acknowledging that Twitter data are not representative of the view of the general public (Duggan and Brenner, 2013; Ruths and Pfeffer, 2014; Blank, 2017), we explore them because Twitter is the main tool used by the Petitions Committee to engage the public with parliamentary debates of e-petitions. However, we also acknowledge that individuals engaged in e-petition Twitter discussions may not necessarily have signed its respective e-petition. Nevertheless, the data provide real-time reactions to a parliamentary event, giving a useful thermometer of how people interested in the issues of a specific petition react to a key moment in Parliament's petition consideration process. Specifically, we examine three questions:

1. What can Twitter conversations tell us about the extent to which individuals with a Twitter account engage with e-petitions?
2. What do the Petitions Committee induced discussions on Twitter reveal about people's reactions to the e-petitioning process?

3. Who gets involved in Twitter conversations about e-petitions and how do they interact with each other through retweets?

Our Twitter data relate to conversations on the 28 e-petitions that were granted a parliamentary debate between March 2016 and May 2017. Over 33 parliamentary sessions, there were 28 debates, four oral evidence hearings, and the launch of one inquiry report. Although we make an overall analysis of the data for these 33 sessions, our in-depth analysis then focuses on one e-petition calling for a ban on driven grouse shooting. This makes an interesting case study for two reasons. Firstly, as the practice is both fiercely protected *and* strongly opposed, it refers to something specific publics feel passionately about, being more likely therefore to spark discussions. This e-petition generated very active discussions on Twitter, providing for rich data to enable deeper insights into how people react to a parliamentary session. Secondly, besides a debate, this e-petition also led to an oral evidence session. This enables us to compare public reactions to how e-petitions are addressed by Parliament between two different types of parliamentary sessions. This matters, because perceptions of petitioning vary according to how its processes are judged by petitioners (Carman, 2010). The comparison of the public's reaction to two different parliamentary processes helps us to better understand the extent to which the new system has enhanced the consideration of petitions. In the online supplementary data, we provide further in-depth analyses of another, quite different, case study (the e-petition on giving meningitis B vaccine to all children), which backs up the conclusions of our case study on grouse shooting.

We proceed by outlining the theoretical discussions that have informed our analysis. We then explain our data and methodological approach, and finally discuss our results, answering the three questions outlined above.

e-Petitions, Process and Parliament

As already discussed in the introduction, recent decades have witnessed a general decline of political support in traditional representative democratic institutions, in Britain and elsewhere (Dalton, 2004; Stoker, 2006; Hay, 2007, Norris, 2011; Whiteley, 2012). Political institutions have responded to this trend in various ways, including with advocacy democracy initiatives. Advocacy democracy refers to initiatives whereby "citizens directly participate in the process of policy formation or administration, although the final decisions are still made by elites" (Dalton et al., 2003, 11). Petitions fall into this type of initiative. The World Values Surveys show that petitions are one of the most used tools of political activism (WVS, 2017), a phenomenon confirmed in the UK by the Audits of

Political Engagement (Hansard Society, 2018). The expansion of online petitions in late 20th century happened first through informal e-petitions platforms, such as PetitionOnline, and Change.org, but recently formal institutions have tapped into this in order to strengthen their linkages with the public. It is within this context that many governments and parliaments have introduced e-petitions systems (Hough, 2012; Riehm et al., 2014), including the UK Parliament and Government collaborative e-petitions system launched in 2015.

Petitions have existed for centuries (Ormrod, 2009), pre-dating representative institutions. They are the simplest means for a citizen to present a concern and/or a request to political authorities, though they went into decline over the last century, as representative democracy institutions expanded. Their online form, however, has led to a resurgence in their use (Coleman and Blumler, 2009; Wright, 2012). After the Scottish Parliament launched its own e-petitions system in 2004 (Carman, 2006), other parliaments followed, including the German Bundestag in 2005 (Lindner and Riehm, 2011) and most recently, in 2016, the Irish Parliament. These systems hope to provide citizens with a direct channel to parliament, rather than through mediators such as MPs or parties. However, there is great variance between these systems (Hough, 2012; Bochel, 2013, 2016; Riehm et al., 2014), from the possible existence of a Petitions Committee, to an array of procedures to consider petitions, such as petitioners' hearings and parliamentary debates. The actual practice of how parliamentary e-petitions systems are implemented is particularly important.

Indeed, several studies have demonstrated the importance of petition consideration processes in shaping the public's expectations and perceptions of political institutions. In his seminal study, Carman (2010) showed that evaluations of procedural fairness are crucial in shaping the extent to which petitions can enhance trust in parliament. Regardless of the outcome of their petitions, if petitioners felt their petition had been considered through a fair process, their trust in parliament rose. Bochel (2016) supports this assumption, and Wright's study of Downing Street e-petitions shows that petitioners' perceptions varied according to how their case was dealt with by officials (Wright 2016). A petitions system can therefore contribute towards improved perceptions of parliament, if petitioners judge that they have been fairly listened to. As the Hansard Society (2012, 13) has summarized, "petitioners' journey through the process is therefore deemed almost as crucial as the issue raised in their petition." Indeed, the setting up of the new e-petitions system in 2015 aimed in itself to establish fairer processes to consider e-petitions, in the hope of enhancing the public's perceptions of Parliament.

As the then Leader of the House stated, this was "a major change and should be the catalyst for a fundamental change in the relationship between parliament and petitioner" (Hague, HC Debates 24/02/2015, col.256). Two key differences of the new system would lie in the creation of a Petitions Committee,

to lead the moderation, processing and engagement with petitions, and in a better integration of e-petitions into parliamentary procedures, namely in improving its associated parliamentary debate. After the much-criticized government e-petitions sites (Hansard Society, 2012; Bochel, 2013, 2016; Wright, 2016),[1] there was a clear intent that the new system would encompass fair and transparent processes, as well as opportunities for engagement with Parliament. As the Chair of the House of Commons' Procedure Committee stated, "The Petitions Committee will seek to improve engagement with petitioners. Often, those submitting and supporting a petition will not get the exact outcome they want, but they will hopefully feel that their concerns have been appreciated and heard through constructive engagement with the Committee" (Walker, HC Debates 24/02/2015, col.250). Clarity of process and engagement were therefore established as key aims of the new system, intended as an improvement on the previous Coalition Government's e-petitions system.

As demonstrated in the Hansard Society's review of the Coalition Government e-petitions system (Hansard Society, 2012), its poor processes contributed to a heightening of unrealistic public expectations. This was due in particular to the promised parliamentary debate of petitions reaching 100,000 signatures; a promise which did not materialize in an actual corresponding formal parliamentary procedure. As Bochel points out (2013, 804), the few debates taking place under that system did not even focus on the actual petition, but on related motions. The 2012 review by the Hansard Society recommended a much-enhanced parliamentary debate procedure for petitions, as well as the inclusion of other procedures such as oral evidence sessions. Their review would form the blueprint for the new system launched in 2015.

Once accepted, e-petitions submitted to the 2015 platform (petition.parliament.uk) are accessible online where supporters can sign them. Once an e-petition gets 10,000 signatures, the government has to respond to it within 21 days (Petitions Committee, 2016). Once it reaches 100,000 signatures, the Petitions Committee considers whether to debate it; most are debated, unless their topic has been recently debated in Parliament. Although the Committee could apply for a debate in the Commons' main Chamber, all e-petition debates so far have taken place in the Westminster Hall, a parallel debating chamber,[2] within a specified slot for e-petitions, Mondays 4.30-7.30pm. All petition signatories receive updates from the Committee for every new action taken, such as a government response. On occasions the Committee leads inquiries and hosts oral

[1] Prior to the 2015 UK Parliament and Government e-petitions system, two government-led systems (e.g. without Parliament's involvement) had existed: the 2006 Downing Street e-petitions system, and the 2011 Coalition Government upgraded version.

[2] Commonly referred to as Westminster Hall, this is in fact the Grand Committee Room, located off Westminster Hall.

evidence sessions, web forums etc. Each petition's webpage lists all the actions taken, including the links to respective transcripts and web streaming of relevant parliamentary sessions. The process therefore seems to be clearly set out and transparent, and there is regular communication with signatories.

The new system went live in July 2015, with nine petitions submitted on its first day and 60,580 signatures added (Leston-Bandeira, 2016), since when it has continued to attract significant interest. By the end of the 2015–2017 parliament, 10,950 petitions had been accepted, signed by over 14 million unique email users (Caygill and Griffiths, 2018, 325). The 2016 Audit of Political Engagement stated that e-petitions were the "new front door of Parliament" and the "single most important route to engage the public that Parliament currently has at its disposal, apart from direct contact with a representative" (Hansard Society, 2016, 28), with the 2017 Audit reporting that 23 percent of those surveyed had used the system. Besides the very high volumes of e-petitions and signatures, the Committee also developed two full enquiries and a wide range of public engagement initiatives (Leston-Bandeira, 2017). The new system has therefore witnessed considerable activity. What we know less about is whether it has also led to effective engagement, and the public's reaction to key elements of the process such as the debates, which have already been identified as key to shaping people's perceptions of the petitioning process (Hansard Society, 2012; Bochel, 2013, 2016).

Indeed, we must distinguish between activity and engagement; as Wilson established back in 1999 "more participation is not the same thing as more democracy" (Wilson, 1999, 258). More recently Puschmann et al. (2017) also found great variance in the extent to which petitioners engage with the German Bundestag's petitioning process, with Escher and Riehm (2016, 20-21) showing that this system, one of the most well-established parliamentary petitions systems, actually does little to promote trust and that "the vast majority of petitioners are dissatisfied with the treatment of their petition." However, Carman (2010) found that when experiencing a more transparent and inclusive system such as the Scottish Parliament's, petitioning led to an increase in trust in the institution when processes were perceived as fair. Establishing whether e-petitions enhance political engagement with parliament is a complex issue, but their existence on a digital platform opens up research possibilities. e-Petitions leave an extensive online imprint, from their creation, to their presentation, dissemination and eventual debate (Hale et al., 2013a). Part of this online imprint lies within discussions of e-petitions in Twitter, some of which is easily identifiable through the use of a specific hashtag. Crucially, the Twitter data enable us to listen in real-time to what the public is saying while a petition parliamentary debate is taking place. In short, it gives us an insight into first-hand reactions from a public that is particularly interested in specific e-petitions. Considering how important

procedural fairness is for the evaluation of petitions, these Twitter conversations allow us to determine what the public thinks about the unfolding petition debate, and/or oral evidence session, such as how fairly they think their petitioned issue is being portrayed and handled within the parliamentary procedure.

Signing an e-petition is a small participation act, the beginning of an issue profile raising process. However, the act of signing an e-petition can actually be seen as too easy to provide a real hook for engagement (Jungherr and Jurgens, 2010). This is reflected in the description of e-petitions as mere "clicktivism," "slacktivism" or "a trivial form of advocacy that doesn't accomplish anything" (Beato, 2014, 23). However, engaging in Twitter conversations around a petition debate and raising its prominence is one means by which public engagement can be maintained. Analysis of these Twitter conversations can therefore also inform understanding of the extent to which engagement is maintained beyond signing.

Finally, the online availability of e-petitions is hoped to help broaden engagement to disengaged groups and to provide an ideal platform for political discussion (Dahlgren, 2005); this would lead to "more democracy." Conversely, it could in fact accentuate political fractures in the population (Galston, 2002; Escher and Riehm, 2016). The Internet may allow individuals to selectively interact with those who are similar to them, therefore resulting in an echo chamber, which reinforces prior political views (Colleoni et al., 2014). This is expressed in homophily: the tendency of individuals to seek out interaction with others who they perceive as similar to them. This can result in fractionalization of citizens into politically polarized, homogeneous groups (Hoffman, 2012). Homophily has been found in political conversations on Twitter (Himelboim et al., 2014), so it is particularly relevant to explore this in the context of conversations about e-petitions, to understand whether these promote a diverse discussion of specific e-petitions or whether they simply reinforce pre-existing views.

Methods

Twitter Data Collection

We collected Twitter data between March 2016 and May 2017 using the Twitter Streaming API, which allowed us to scrape in real time all Tweets made to a hashtag defined by Parliament's Petitions Committee to coordinate discussion of e-petitions on Twitter. Harvesting this data allows the creation of a data set containing a traceable log of every individual who used the hashtag to interact with e-petitions on Twitter and a record of what they actually said (Hale et al., 2013a). All data tagged with the specific e-petition hashtag were collected the day

before the parliamentary session in Parliament, the actual day, and the day after. Overall, Tweets were collected for 33 parliamentary sessions, including 28 e-petition debates, four oral evidence hearings and one inquiry report publication, totaling 34,822 tweets in all. The data collected include the tweet text, its author, whether or not it was a retweet, and information on users, including profile description.

Although Twitter data constitute a rich source providing insights into people's genuine opinions, they have their limitations (Ruths and Pfeffer, 2014). Most importantly, they are not representative, being based on self-selection on several levels. In our study, data refer to people who have a Twitter account and who decided to contribute to the respective hashtag thread. Nevertheless, the data are useful to assess how people—that is, those who have a Twitter account and who are sufficiently interested in a specific e-petition topic to participate—engage with parliamentary debates; particularly bearing in mind that the Petitions Committee actively uses this tool to promote engagement with parliamentary processing of e-petitions. One may question whether Twitter is a suitable tool to engage with the public, but this would go beyond the scope of this article (see Effing et al. 2011 for further discussion). By using social media, we are thus likely to capture particularly the opinions of people who feel strongly about a certain issue. On the other hand, their opinions are important because the very fact they are engaging in a Twitter conversation about the e-petition shows they have a strong interest for the issue petitioned, and are likely to have signed it. It therefore matters to know what they think about how the respective e-petition is being considered by Parliament. It also contributes to an understanding of how well the e-petitions system works in establishing links between people and Parliament. If the system alienates those who are willing to engage, then it is even less likely to encourage the disengaged to get involved. Nevertheless, we acknowledge that more general hashtags may attract tweets unrelated to the e-petition (e.g. advertisement in the #ChildCare debate, see Table 1). In our case study we removed tweets that were obviously unrelated to the e-petition prior to computational text and social network analyses.

Twitter data can also be problematic for another reason; namely the presence of social bots. Social bots can distort the data, for instance by simulating support for an issue by retweeting every tweet tagged with a specific hashtag or by generating random opinions through syntactically correct combinations of words (Murphy et al., 2016). It is not a trivial task to detect bots in large amounts of data and bot detection is an ongoing area of research (Davis et al., 2016; Morstatter et al., 2016). We have some evidence of limited use of social bots in our dataset (see Supplementary Information S2.1). Although our main focus is on Twitter data analysis, our analysis is complemented by verbatim transcripts of the

parliamentary sessions for our case study,[3] which we mainly used as a reference for sentiment analysis of the Twitter data.

Twitter Data Analysis

Twitter data come in JSON format and require heavy processing prior to analysis. For each debate the tweets were compiled into a corpus, and R Natural Language Processing and text mining tools were used to process and analyze their textual content (see Supplementary Information S1.1 and S1.2).

When analyzing the tweet content in our case study we were particularly interested in establishing the main topics people were talking about. To infer the nature of the latent topics embedded in each collection of tweets a bigram-based semantic network analysis was carried out (Wang et al., 2007; Drieger, 2013). The text was represented as a network with the nodes referring to words and the weighted, undirected edges between these words indicating a relationship between them. In the construction of the network, the relationships between words were indicated by their structural proximity to one another, based on the linguistic assumption that "words with similar meanings will occur with similar neighbours if enough text material is available" (Schütze and Pedersen, 1995). Thus, if two words co-occurred in a tweet with at most three words separating them, then an edge connected these two words in the semantic network. The edges were weighted by the frequency of the co-occurrence of the two respective words. We used the Force Atlas 2 algorithm to structure the semantic network (Jacomy et al., 2014). To detect topics, we employed the Louvian method for community detection (Blondel et al., 2008, Gerlach et al. 2018). We found that this approach detected topics better than the more common Latent Dirichlet Allocation topic modelling approaches (Hong & Davison, 2010) or the structural topic modelling approach (Roberts et al., 2013; see Supplementary Information S1.3).

We also performed an automatic sentiment analysis to gain an overview of the emotions expressed in the Twitter conversations, and to determine whether the discussions were predominantly negatively or positively framed. For that purpose, the corpus was split into individual word tokens and a word frequency table was constructed, which was then joined to the AFINN-111 online lexicon (Nielsen, 2011) containing sentiment words with pre-coded sentiment scores. Scores were extracted for words in the lexicon that matched the words in our corpus, generating a table with words, their frequency, and sentiment score. Based on the distribution of negative and positive words the overall valence of the conversation framing can be estimated (see Supplementary Information S1.4).

[3] Taken from https://hansard.parliament.uk/.

As we are interested in who gets involved in these Twitter discussions and how, we also examined the retweet patterns of Twitter users through social network analysis (Scott, 2013; Cherepnalkoski and Mozetic, 2015). A directed edge was defined between two users (nodes) if one had retweeted the other. The edge was weighted by the frequency of retweet interactions in the same direction, i.e. when multiple tweets were retweeted. The Force Atlas 2 algorithm was used to structure the social networks. Communities in the social network were detected using the Louvian method. To determine and visualize influential users within the network, we used eigenvector centrality. Eigenvector centrality evaluates the importance of a node based upon both how many incoming edges they have from other nodes, and how important the nodes are that they are connected to (Hanneman and Riddle, 2005). The size of the nodes of users was proportional to their relative influence in the network (see Supplementary Information S1.5).

Finally, we were interested in understanding the extent to which clustering patterns happen in the social networks based on retweets in our case study. We used the Naïve Bayes Classifier (NBC) approach to classify Twitter users by making use of their profile descriptions. NBC is a supervised machine learning technique, which uses probabilistic learning methods based upon Bayes's theorem assuming independence between the features (in this case, words) (Han et al., 2012; Murphy, 2012). A training set was manually constructed containing 200 Twitter users and their profile description (features) tagged with a specific label. Learning from the training data the algorithm then predicted the labels (classes) in the remaining dataset based on the features, i.e. words extracted from the profile description. To determine the accuracy of the prediction, we used a validation dataset of 200 other, manually labelled Twitter users. The NBC label prediction for these 200 users was then compared with the manual labels to calculate the accuracy score and to obtain the F1-score (see Supplementary Information S1.6).

Having classified users into two camps (supporting and opposing the petition issue), plus a neutral / unknown camp, we wanted to know whether Twitter users within a camp were significantly more likely to retweet each other than to retweet users from another camp. This would indicate homophily patterns in the social network. The Quadratic Assignment Procedure (QAP) method (Krackhardt, 1988) was used to test the homophily assumption. Firstly, the correlation between the adjacency matrix for user-characteristics and user-interaction was calculated. To determine whether the correlation is higher than we would expect by chance, the QAP uses a non-parametric permutation method to permutate the rows and columns of the user interaction matrix and calculate the correlation for each permutation. Repeating permutations 5,000 times results in a distribution of correlation coefficients against which the correlation for the actual social network is compared to decide whether there is a significant homophily effect (Lee et al., 2016) (see Supplementary Information S1.7).

Results

Learning about Engagement Patterns from Twitter

Previous research has identified several factors explaining an e-petition's success in terms of attracting high numbers of signatures. Hale et al. (2013b) and Yasseri et al. (2013) suggest that the biggest determinant of e-petition success is the number of signatures it receives on its first day. Receiving good coverage on both traditional (Wright, 2016) and social media (Cihon et al., 2016) has also been shown to be a key determinant of success. Both of these factors support the idea that an individual will be more likely to sign an e-petition if they know that others have already done so (Berg, 2017). But to what extent do people engage with e-petitions beyond signing? Table 1 shows the number of individuals who signed a petition, and the number of those who got involved in their respective Twitter conversations (Bruns and Stieglitz, 2013) for the 28 petitions debated in parliament between March 2016 and May 2017. These figures show high variability, from the petition on UK Aid with 7,474 tweets to the one on term-time holidays which generated a mere four tweets. This suggests that the sustaining of online engagement with petitions varies considerably across e-petitions.

Table 1. e-Petitions Debated in Parliament Between March 2016 and May 2017.

e-Petition	**Hashtag**	**Number of signatures**	**Number of tweets**	**Number of users**
GCSE English Literature	not defined	110,876	2	1
Badger cull	#BadgerDebate	108,320	4,970	2,037
Young people car insurance	#YoungDriversInsurance	185,175	56 (168)	39 (43)
April's Law	#AprilsLaw	127,296	44	24
High heels at work	#HeelsatWorkDebate (#HeelsAtWork)	152,420	317 (272)	236 (75)
Attacks on NHS Medical Staff	#NHSstaffsafety	118,056	52	47
Donald Trump State Visit	#UKTrumpDebate	1,863,707	928	815
Ivory market	#IvoryDebate	108,530	923	546
NHS staff pay	#NHSPayDebate	106,409	27	18
Non-recyclable	#RecyclingDebate	101,941	13	10

packaging				
Boxing day retail	#BoxingDayDebate	148,327	106	72
Child cancer funding	#ChildCancerDebate	117,183	207	107
Free childcare	#ChildCare	133,921	1,412*	883
Police Dogs as Officers'	#PoliceDogs	127,729	51	43
Grouse shooting ban	#GrouseShooting	123,077	7,364 (1,662)	2,704 (761)
Local Government Pension Scheme	#LGPS	105,772	25	23
Invoke Article 50	#ExitingTheEUDebate	127,111	32	23
Dog meat trade	#DogMeatTrade	102,131	2,997	1,113
2nd EU Referendum	#EURefDebate	4,149,757	6	4
Student loans agreement	#StudentLoanDebate	133,969	86	81
Holiday school penalties	#termtimeholiday	204,790	4	4
Arts subjects in Ebacc	#EbaccDebate	102,499	3,283	1,451
Foreign Aid 0.7% spend	#UKAidDebate	235,979	7,474	3,092
Fireworks restrictions	#FireworkDebate	104,038	92	50
Pro-EU Referendum leaflets	#EUReferendumLeaflet	221,866	48	41
Meningitis B vaccine	#MenB	823,348	141 (497)	87 (143)
Brain tumours research funding	#BraintumourResearch	120,129	630 (709)	282 (253)
NHS contract negotiations	#JuniorDoctors	110,065	224	176

Note: Values in brackets refer to extra sessions (e.g. oral evidence)
* Included advertisement tweets for child care.

Furthermore, Table 1 demonstrates that obtaining a high number of signatures does not equate to sustained engagement through participation on Twitter. The petition with the highest number of signatures (#EURefDebate) at over four million, attracted just six tweets from four Twitter users. However, other e-petitions do attract lively Twitter conversations on topics as diverse as the #EbaccDebate or the #DogMeatTrade, and so in some cases interest is maintained and developed, with Twitter providing an effective platform for encouraging continued participation. The results suggest that e-petitions focusing on very

specific issues that certain groups feel very strongly about (e.g. animal rights, the health service, etc.) tend to inspire engagement beyond signing a petition. On the other hand, other petitions, such as those with more of a protest nature (e.g. EU referendum), do not always inspire further engagement. To note though that the single set hashtag may not capture all of the relevant Twitter traffic, with users potentially also using other hashtags (e.g. #Brexit) to discuss e-petitions. The numbers in Table 1 hence also reflect how well organized and channeled the debate on Twitter is, and that some interest groups (e.g. animal rights group) seem better at this than others (Karpf, 2010). It also reflects the Petitions Committee's choice of hashtag, and the extent to which it is able to steer the Twitter conversation.

Using Twitter to Gauge Citizen Evaluation of the e-Petitions System

We also used the Twitter data to explore the extent to which citizens were happy with the parliamentary procedures being used to consider e-petitions and the level of consensus or polarization expressed. For most e-petitions, a bulk of tweets simply broadcasted information about the debate taking place, mostly issued by the Petitions Committee. Many conversations also featured tweets from the public directed at MPs, putting pressure on them to attend debates and sharing information about e-petitions and their arguments. In the case of the e-petition to ban grouse shooting, Twitter was also used to share opinions about the manner in which the debate was carried out.

Figure 1 helps us better understand the topics covered in the Twitter discussions about the petition to ban grouse shooting, by depicting its respective semantic network. The network is split into topic clusters identifiable by their different colors. Among these clusters, several reflect clear criticism of the petition debate procedure. The yellow cluster references Stephen Double MP, who led the debate,[4] and describes the debate as polarized, frustrating and biased. This reflects the criticism that far more time was given to the counter arguments opposing the ban (and therefore opposing the e-petition), than those in support of it. This is also referenced in the red cluster, which displays reactions to the fact that Caroline Lucas MP speaks up in the debate to highlight specific arguments for a ban, but that she is largely ignored. The focus of this Twitter conversation shifts from a discussion of the facts (the purple cluster constitutes the only

[4] E-petition debates are initiated, led and closed by a specific MP from the Petitions Committee. Any MP can participate in these debates though. The debate also always includes a response from the corresponding minister and the spokespeople from the opposition parties. As explained above, these debates are held in Westminster Hall, the Commons' parallel debating chamber, where debated motions are non-amendable and not subject to votes.

discernible factual topic covering aspects of environmental impact) to a critique of the fairness of the debate procedure.

The dark green cluster contains the Twitter user names of campaigners, such as Chris Packham, a BBC wildlife presenter. There are negative words around these names, such as "attack" and "vitriol." The cluster in light grey demonstrates that the e-petition opposition group, who supports grouse shooting and opposes the ban, were also present on Twitter; the opposing petition had been included in the parliamentary e-petition debate, event though it had not reached 100,000 signatures. The words found here reflect the idea that hunting is a primal activity allowing bonding between father and son, and a right that should be protected. These clusters clearly show that this e-petition attracted opposing groups, both of whom maintained engagement with the process through their presence on Twitter.

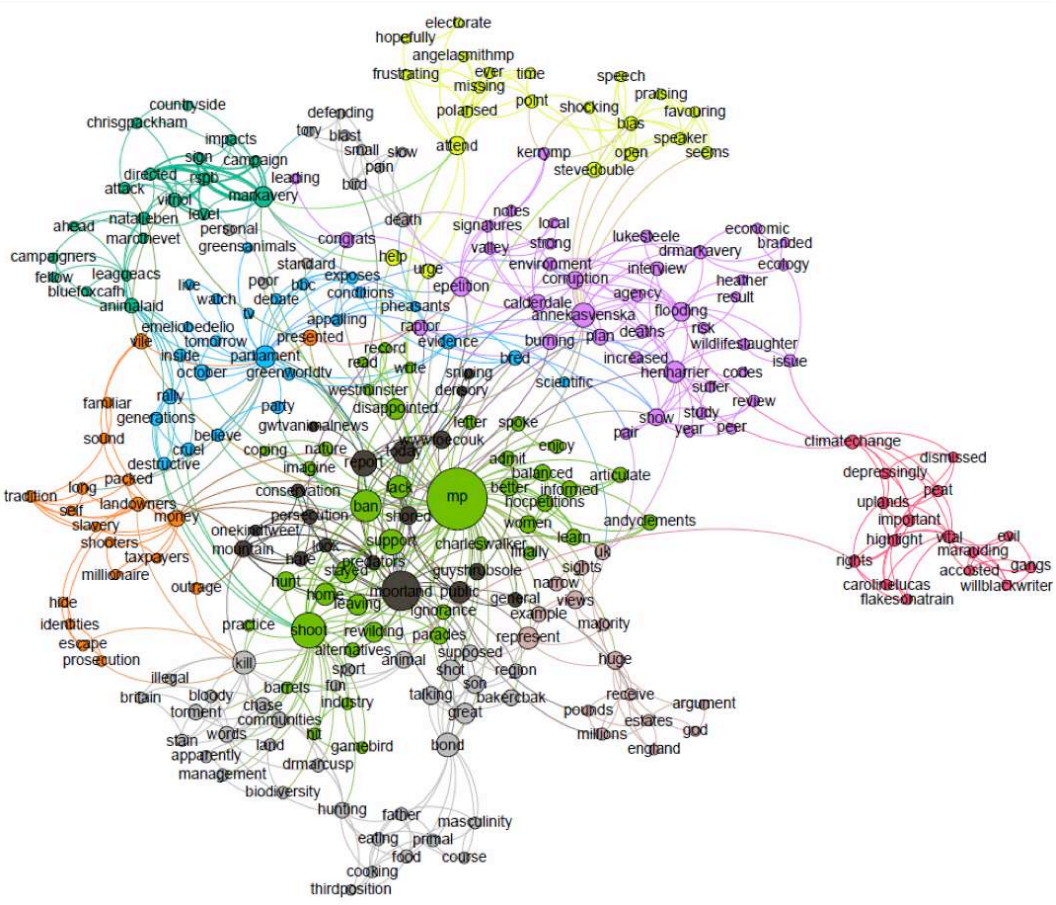

Figure 1. Semantic network based on tweets on the "Banning Grouse Shooting" e-petition parliamentary debate (31 October, 2016).

We also constructed a semantic network for the oral evidence session on this e-petition, which preceded the parliamentary debate. Figure 2 shows that this session's Twitter conversation remained more factual, less polarized and with little critique of the parliamentary process. Twitter was used more as a tool to relay information and facts, which were presented in Parliament to a wider audience during the oral evidence session. It suggested, for instance, that more evidence is needed to fully assess the impact of grouse shooting. The orange cluster in Figure 2 illustrates this, with calls for more transparency about who owns grouse moors, and in the light blue cluster, which suggests more information is needed about the impact on the environment of burning heather moorland. The dark grey cluster, however, represents comments praising the quality of evidence presented by those opposing the ban. This cluster also contains the Twitter user names of various pro-hunting groups, such as the Countryside Alliance. This shows that despite this conversation seeming less polarized, both sides of the debate were taking part.

Comparison of the Twitter conversations in Figures 1 and 2 suggests that, at least in this instance, the parliamentary debate may not be conducive to fostering trust in the process. There are clear differences in procedure between a parliamentary debate and an oral evidence session. The latter focuses on the interrogation by MPs of evidence and facts presented by witnesses. In the case of this e-petition, the witnesses were the e-petition's creator, Mark Avery, and an RSPB[5] representative, followed by supporters of an opposing e-petition (representing the Countryside Alliance and the Moorland Association). A petition parliamentary debate, however, is a discussion amongst MPs alone. And given that a large number of conservative MPs (i.e. opponents of the grouse shooting ban), attended this specific debate, it quickly turned into a party politics debate. Furthermore, seeing the low numbers of opposition MPs attending the debate, it soon became mainly a critique of the main e-petition being discussed (HC Debates, 31/10/2016, col.229WH). The semantic network analysis (Figure 1) suggests that members of the public felt that this process took insufficient account of the views of the public and of the main petitioner, and that it granted unfair weight and bias towards specific groups perceived to hold political favor. This is not limited to this e-petition though, as we observed similar differences between the debate and the oral evidence hearing for the e-petition on the Meningitis B vaccine for instance (see Supplementary Information S2.2).

[5] The Royal Society for the Protection of Birds.

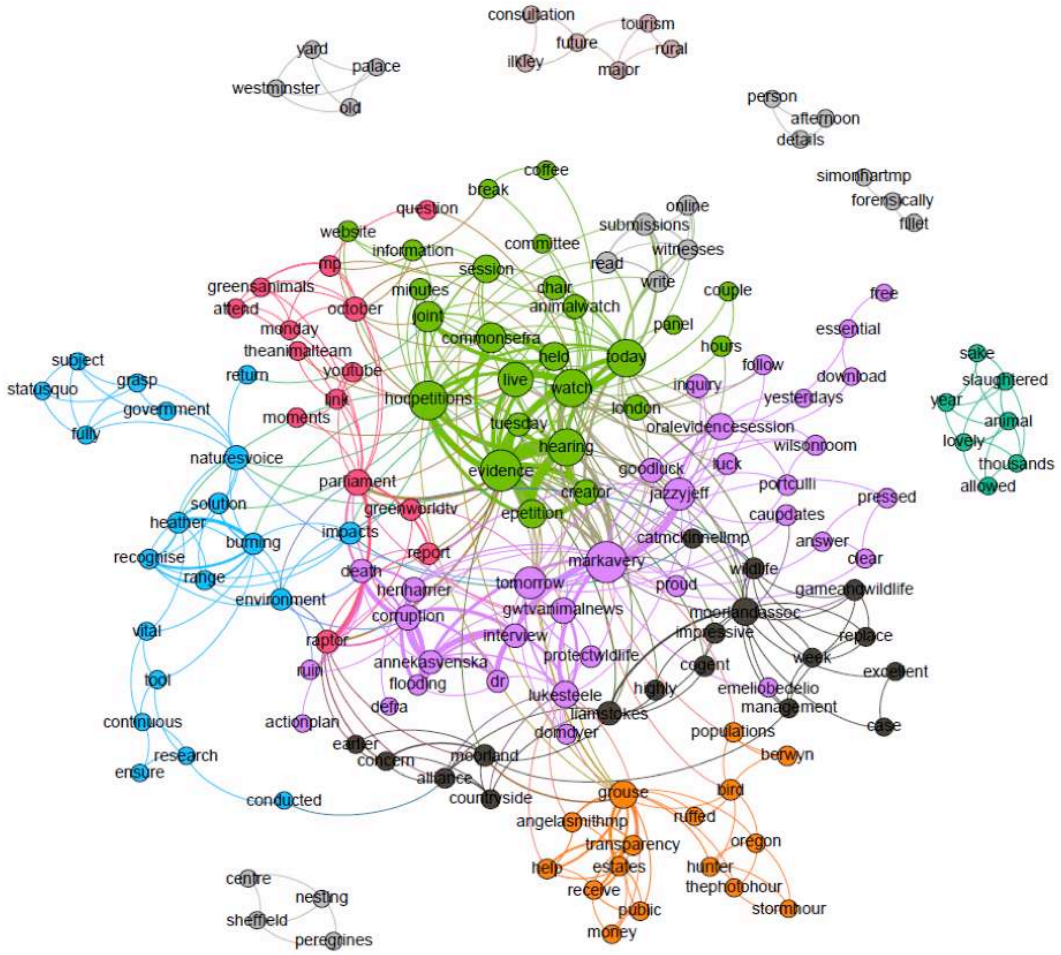

Figure 2. Semantic network based on tweets about the oral evidence session on the Banning Grouse Shooting e-petition (18/10/16).

Comparison of the sentiment analysis for the two sets of Twitter conversations on the ban grouse shooting e-petition, with one of the actual sessions' transcripts (parliamentary debate and oral evidence), is also instructive about perceptions of the process (see Figure 3). The majority of the sentiments expressed in the Twitter conversation on the parliamentary debate were negative. This is in stark contrast to the transcript content of the parliamentary debate itself, which is far more positive. Moreover, whereas almost all of the negative words highlighted in the debate transcript are objective words related to the topic, such as "shoot" and "ban/banned," in the Twitter conversations the negative words are more emotive such as "frustrating," "appalling" and "ignorance." These negative

emotive words are not found in the Twitter conversations on the oral evidence session, where the language is more objective and negative words used related to descriptive terms of grouse shooting. In fact, in the case of the oral evidence session, the Twitter conversation is actually more positive than the session's transcript.

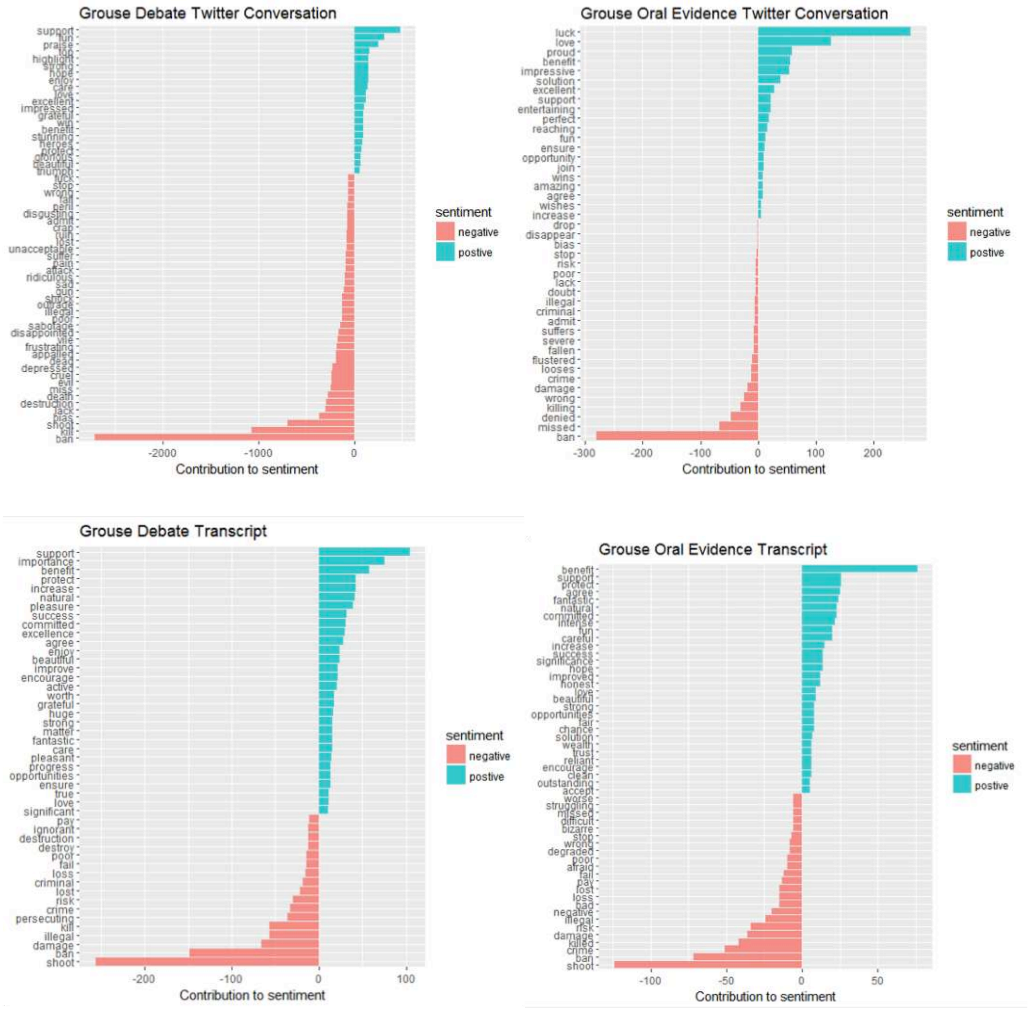

Figure 3. Sentiment analysis of Twitter conversations and of transcripts: parliamentary debate and oral evidence session on banning grouse shooting

Who Gets Involved?

Following up on the hope that e-petitions and their wider Twitter discussion could diversify the group of people engaging with Parliament, we also investigated who

got involved in these discussions. We started by interrogating whether there is overlap in the users taking part in different e-petition Twitter discussions. This showed that only a few users get repeatedly involved across four or more petitions, mostly users affiliated with Parliament. Overall, the vast majority of individuals getting involved in Twitter discussions are only involved in the one e-petition that matters to them (see Supplementary Information S2.3).

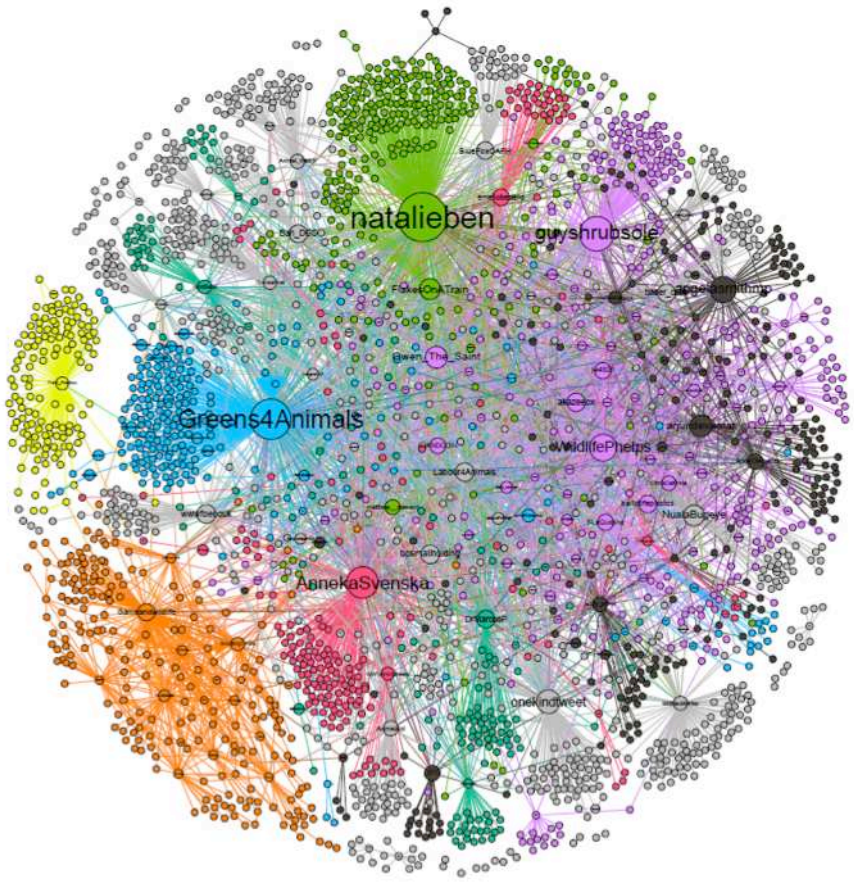

Figure 4. Social network for the Twitter conversations on the parliamentary debate on banning grouse shooting.

Focusing on our case study again, we show the social networks of Twitter users who tweeted during the parliamentary debate (Figure 4) and the oral evidence session (Figure 5). Both are based on retweets. The social network in Figure 5 appears less dense because the oral evidence session involved fewer Twitter users (761) than the parliamentary debate (2,704). Both figures show the most influential Twitter users (larger node size) and clusters based on retweets (colors). Figures 4 and 5 show that within these retweet communities, specific

influencers tend to be key in the discussion network and to dominate the conversation. It is also clear that many of the communities are not made up of individuals conversing amongst themselves, but rather comprise a set of users who are all retweeting a common, influential individual.

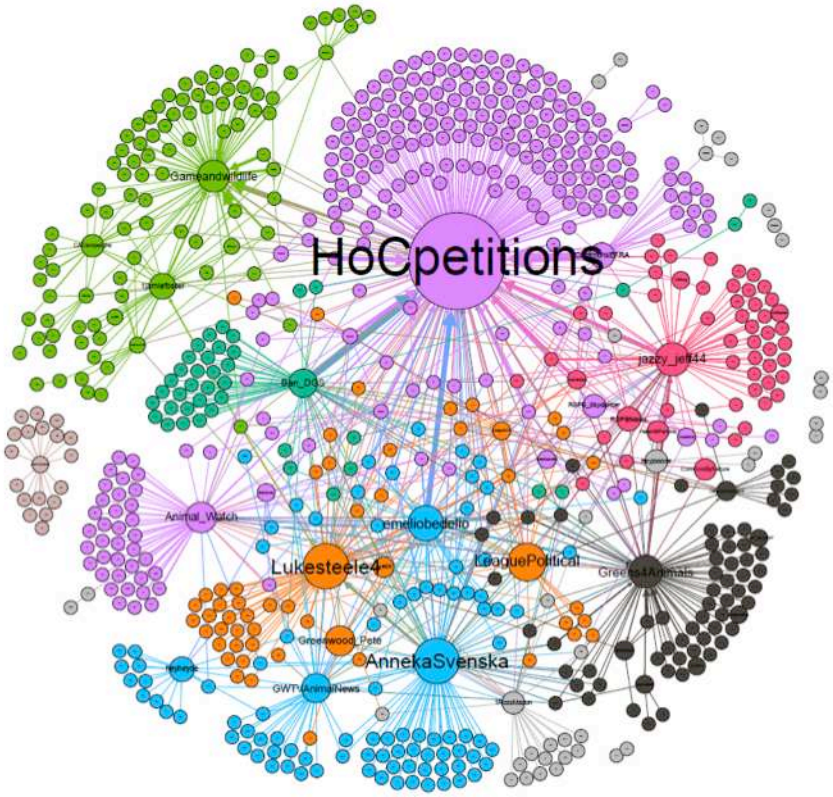

Figure 5. Social network for the Twitter conversation about the oral evidence session on banning grouse shooting.

In Twitter discussions it is common for users to organize themselves into distinct groups that are more likely to interact with similarly minded Twitter users (Smith et al., 2014). The social networks in Figures 4 and 5 show that this pattern is found here. In each of the communities displayed in different colors, there is more interaction between members within the community, than with outside members.

We also found statistical evidence of homophily in the social network, meaning that individuals preferentially interact with those who share similar opinions. A simple measure of similarity was used based upon whether two individuals were both against or both in favor of grouse shooting. Of the 2,704 individuals who took part in the Twitter conversation about the parliamentary

debate, 925 were identified by the Naïve Bayes Classifier (NBC) to be anti-grouse shooting and 161 as pro-grouse shooting. The remaining 1,618 user profiles did not contain sufficient information to allow classification into either of these camps. The NBC had an accuracy of around 72 percent and a moderate F1-score of 47 percent. Our analysis included only interactions between users with a known classification. For these interactions there was a positive correlation of 0.57 between the classification of one user and the classification of the other, if the two interacted through retweets. A Quadratic Assignment Procedure (QAP) test was carried out to test the significance of this result. The results of this found a correlation of 0.022 ($p<0.01$), thus the correlation for our actual, empirical, network is significantly higher than the correlation distribution resulting from random permutations. This correlation is lower than that quoted above because the QAP includes pairs of users with no interaction. We can therefore conclude that this Twitter network exhibits homophily, with those against grouse shooting users and those in favor both interacting preferentially with users of a similar opinion.

Conclusion

Our article shows that the analysis of Twitter conversations does help us better understand how the public engages with e-petitions and with the way these are processed in parliament. Hale et al. demonstrated in 2013 that the analysis of social media in generating support for e-petitions is a powerful tool to better understand online activism. Here we go a step further by showing that it also helps us to better understand how the public reacts to the way parliament considers their e-petitions. This matters for a number of reasons.

First, because processes affect the way the public perceives the value of petitions (Carman, 2010). Secondly, because "more participation does not necessarily mean more democracy" (Wilson, 1999, 258), and grounding our evaluation of the success of e-petitions merely on quantifiable indicators (number of signatures, number of tweets) fails to capture the key issue of whether it actually achieved its aim of deepening engagement. This brings us to the third reason why it matters: because the new e-petitions system was introduced to lead a significant enhancement of the relationship between public and Parliament. This implies the development of a perception that the institution listens to the public's concerns expressed in an e-petition. The parliamentary debates of e-petitions with over 100,000 signatures are seen as the pinnacle of the system, but there has been little consideration as to what actually happens within the debates. Twitter discussions enable us to tap into real-time public reactions to how their petitions are being considered by Parliament.

While our analysis is mainly focused on a case study, our results suggest important findings. Overall, they show that just because an e-petition has obtained a very high number of signatures, it does not mean that the public sustains strong engagement with the issue; those that do, tend to relate to more specific e-petitions. This is an indicator of different types of e-petitions, submitted for different purposes. In short, we divide them between protest petitions and substantive petitions. Protest petitions tend to refer to ad-hoc events and aim mainly to demonstrate dissatisfaction; substantive petitions refer to more specific issues linked to longer-term concerns about which petitioners develop deep attachments. Twitter engagement suggests that substantive petitions tend to lead to more sustained engagement from the public.

The in-depth analysis of our case study suggests two important findings to better understand public reaction to how parliament considers e-petitions. Firstly, a well-attended parliamentary debate with considerable MP participation does not necessarily equal an outcome that will be well received by the public. The voices expressed in the debate and the extent to which these reflect the intentions of the e-petition in question are far more important. Petition debates tend to be conducted as any other parliamentary debate. Our analysis suggests that they should reflect more their distinct nature, which derives from the originating e-petitions, by for instance acting more as an advocate for the petition and focusing more explicitly on petitioners' aims. This relates to a wider issue, which is how political institutions integrate the voice of the public into their processes. Bolting the public's voice onto established practices seldom leads to a genuine representation of the public's view.

Secondly, the public tends to react in a more polarized way to parliamentary debates than to oral evidence sessions. This will be of no surprise to those familiar with Westminster. Debates are conducted under long embedded traditions of adversarial politics. In contrast, oral evidence sessions, which take place in committee (which are cross-party), tend to be conducted along consensual lines. The focus is on the witnesses and on their interrogation to establish facts and evidence. Our analysis of Twitter conversations confirms that the public reacts more negatively to parliamentary debates than to oral evidence sessions; this chimes with the Hansard Society's findings on public's attitudes towards Prime Ministers Questions (2014), which indicated the public reacted negatively to adversarial debates. One could argue that this is only natural and merely reflects the nature of these parliamentary procedures. However, the reaction on Twitter shows the extent of the frustration amongst the public caused by a debate that was overwhelmingly in opposition to its originating petition. These findings suggest that more care should be taken over the extent to which these debates reflect the original purpose of their petitions. It is worth noting that other parliamentary petition systems (e.g. in the European, German and Scottish

parliaments) do not put as much focus on debates, prioritizing instead evidence sessions with petitioners.

Finally, our analysis also shows that Twitter discussions on e-petitions tend to take place within similar networks, with homophily predominating in Twitter conversations. Still, although homophily was found to be significant, it was not strong enough to conclude that the Twitter conversation network was polarized, as some level of homophily is to be expected in political debates, simply indicating expressions of solidarity and mobilization between activists. Moreover, the moderate homophily shows that there was some interaction between opposing political camps.

Our article also demonstrates the value of big data analysis to understand modern tools such as e-petitions, as they enable us to observe public reactions in real-time. Whilst parliaments are increasingly using these tools to enhance their engagement methods, our findings show that evaluation of how these tools are used and received by the public is key in order to harness their potential for engagement.

References

Beato, G. (2014) From Petitions to Decision. *Stanford Social Innovation Review*, 12(4), pp.20-27.

Berg, J. (2017) The dark side of e-petitions? Exploring anonymous signatures. *First Monday,* 22(2), doi:10.5210/fm.v22i2.6001

Blank, G. (2017) The Digital Divide Among Twitter Users and Its Implications for Social Research. *Social Science Computer Review*, 35(6), pp.679-697.

Blondel, V.D., Guillaume, J.-L., Lambiotte, R. and Lefebvre, E. (2008) Fast unfolding of communities in large networks. *Journal of Statistical Mechanics: Theory and Experiment*: P10008.

Bochel, C. (2013) Petitions Systems: Contributing to Representative Democracy. *Parliamentary Affairs*, 66(4), 798-315

Bochel, C. (2016) Process Matters: Petitions Systems in Britain's Legislatures. *The Journal of Legislative Studies*, 22(3), pp.368-384.

Bruns, A. and Stieglitz, S. (2013) Towards more systematic Twitter analysis: metrics for tweeting activities. *International Journal of Social Research Methodology*, 16(2), pp.91-208.

Coleman, S. and Blumler, J. (2009), *The Internet and Democratic Citizenship*. Cambridge, Cambridge University Press

Cain, B., Dalton, R. and Scarrow, S. (eds.) (2003) *Democracy Transformed?* Oxford: Oxford University Press.

Carman, C. (2006), *The Assessment of the Scottish Parliament's Public Petitions System 1999–2006*, Edinburgh: Scottish Parliament Information Centre for the Public Petitions Committee, http://archive.scottish.parliament.uk/business/committees/petitions/reports-06/pur06-PPS-assessment-01.htm, accessed 06/04/2016

Carman, C. (2010) The Process is the Reality: Perceptions of Procedural Fairness and Participatory Democracy. *Political Studies*, 58(4), pp.731–751.

Caygill, T. and Griffiths, A-M (2018) Parliament and Petitions, in Leston-Bandeira, C. and Thompson, L. (eds) *Exploring Parliament* Oxford: Oxford University press, pp.322-332.

Cherepnalkoski, D. and Mozetic, I. (2015) A Retweet Network Analysis of the European Parliament. *Proceedings of the 11th International Conference on Signal-Image Technology & Internet-Based Systems (SITIS)*, pp.350-357.

Cihon, P., Yasseri, T., Hale, S. and Margetts, H. (2016) Tweeting for the cause: Network analysis of UK e-petition sharing activity. *Proceedings of the IPP Conference,* pp.1-30.

Dahlgren, P. (2005) The Internet, Public Spheres, and Political Communication. *Political Communication* 22(2), pp.147-162.

Dalton, R. (2004) *Democratic Challenges Democratic Choices*. Oxford: Oxford University Press.

Dalton, R., Cain, B. and Scarrow, S. (2003) Democratic Publics and Democratic Institutions, in Cain, B., Dalton, R. and Scarrow, S. (eds.). *Democracy Transformed?* Oxford: Oxford University Press, pp.250-275.

Davis, C.A., Varol, O., Ferrara, E., Flammini, A. and Menczer, F. (2016) BotOrNot: A System to Evaluate Social Bots. *WWW'16 Companion Proceedings - 25th International Conference Companion on World Wide Web*, pp.273-274.

Drieger, P. (2013) Semantic Network Analysis as a Method for Visual Text Analytics. *Procedia – Social and Behavioral Sciences* 79, pp.4-17.

Duggan, M. and Brenner, J. (2013) *The Demographics of Social Media Users – 2012*. Pew Research Center, Washington.

Effing, R., van Hillegersberg, J. and Huibers, T. (2011) Social Media and Political Participation: Are Facebook, Twitter and YouTube Democratizing Our Political Systems? In: Tambouris, E., Macintosh, A. and de Bruijn, H. (eds.) Electronic Participation. ePart2011. Lecture Notes in Computer Science, 6847, pp.25-35.

Galston, W.A. (2002) If political fragmentation is the problem, is the Internet the solution? In: Anderson, D.M. and Cornfield, M. (eds.): *The Civic Web*.

Gerlach, M., Peixoto, T.P. and Altmann, E.G. (2018). A network approach to topic models. *Science Advances* 4(7), eaaq1360.

Hale, S.A., Margetts, H. and Yasseri, T. (2013a) *Understanding the dynamics of internet-based collective action using Big data: analysing the growth rates of internet based petitions*. Annual Conference of the UK Political Studies Association.

Hale, S.A., Margetts, H. & Yasseri, T. (2013b) Petition growth and success rates on the UK No. 10 Downing Street website. *Proceedings of the 5th Annual ACM Web Science Conference*, pp.132-138.

Hale, S.A., John, P., Margetts, H. and Yasseri, T. (2014) *Investigating Political Participation and Social Information Using Big Data Natural Experiment*. Annual Meeting of the American Political Science Association.

Han ,J., Kamber, M. and Pei, J. (2012) *Data mining*. 3rd edition. Amsterdam: Morgan Kaufmann.

Hanneman, R.A. and Riddle, M. (2005) *Introduction to social network methods*. Riverside: University of California, Riverside.

Hansard Society (2012) *What next for e-petitions?*, URL: https://assets.contentful.com/u1rlvvbs33ri/4cT21Ncc6kk8eWAASSA2eu/88137e59f4fa085075beefa6fe96b598/Publication__What-next-for-e-petitions-2012.pdf/

Hansard Society (2014) *Tuned In or Turned Off? Public Attitudes towards PMQs*, URL: https://assets.ctfassets.net/u1rlvvbs33ri/v5KOp60C6Os0y2MYiMYyg/da0ce4465c346bb592fde93de3550b3c/Publication__Tuned-in-or-Turned-off-Public-attitudes-to-PMQs.pdf

Hansard Society (2016) *Audit of Political Engagement 13*, accessible at URL: https://www.hansardsociety.org.uk/projects/research/audit-of-political-engagement

Hansard Society (2017) *Audit of Political Engagement 14*, accessible at URL: https://www.hansardsociety.org.uk/projects/research/audit-of-political-engagement

Hansard Society (2018) *Audit of Political Engagement 15*, URL: https://www.hansardsociety.org.uk/publications/audit-of-political-engagement-15-2018

Hay, C. (2007) *Why We Hate Politics*. Cambridge: Polity Press.

Himelboim, I., Sweetser, K.D., Tinkham, S.F., Cameron, K., Danelo, M. and West ,K. (2014) Valence-based homophily on Twitter: Network Analysis of Emotions and Political Talk in the 2012 Presidential Election. *New Media & Society* 18(7), pp.1382-1400.

Hoffman, L.H. (2012) Participation or Communication? An Explication of Political Activity in the Internet Age. *Journal of Information Technology & Politics* 9(3), pp.217-233.

Hong, L. and Davison, B.D. (2010) Empirical Study of Topic Modeling in Twitter. *Proceedings of 1st Workshop on Social Media Analytics*, pp.1-9.

Hough, R. (2012), 'Do Legislative Petitions Systems Enhance the Relationship between Parliament and Citizens?', *The Journal of Legislative Studies*, 18 (3/4), 479-495.

Jacomy, M.; Venturini, T.; Heymann, S. and Bastian, M. (2014) ForceAtlas2, a Continuous Graph Layout Algorithm for Handy Network Visualization Designed for the Gephi Software. *PLoS ONE* 9(6), e98679.

Jungherr,A. & Jürgens,P. (2010). The Political Click: Political Participation through E-Petitions in Germany. *Policy & Internet*, 2(4), pp.131-165.

Karpf, D. (2010). Online Political Mobilization from Advocacy Group's Perspective: Looking Beyond Clicktivism. *Policy & Internet*, 2(4), pp.7-41.

Krackhardt, D. (1988) Predicting with networks: Nonparametric multiple regression analysis of dyadic data. *Social Networks* 10(4), pp.359-381.

Lee, W.J., Lee, W.K., Sohn, S.Y. (2016) Patent Network Analysis and Quadratic Assignment Procedures to Identify the Convergence of Robot Technologies. *PLoS ONE* 11(10), e0165091.

Leston-Bandeira, C. (2017) 'The Role of Parliamentary e-Petitions in the 21st century: reflections drawing from the House of Commons e-petitions system' *Thirteenth Workshop of Parliamentary Scholars and Parliamentarians*, Wroxton July 2017. Online at: http://wroxtonworkshop.org/wp-content/uploads/2017/07/2017-Session-1B-Leston-Bandeira-1.pdf [accessed 31 August 2017].

Leston-Bandeira, C. (2016) A year on, the new Petitions Committee has much to celebrate, *Constitution Unit Blog*, URL: https://constitution-unit.com/2016/07/20/a-year-on-the-new-petitions-committee-has-much-to-celebrate/

Lindner, R. and Riehm, U. (2011), 'Broadening Participation through E-Petitions? An Empirical Study of Petitions to the German Parliament,' *Policy & Internet*, 3 (1), Article 4

Morstatter, F., Wu, L., Nazer, T.H., Carley, K.M. and Liu, H. (2016) A new approach to bot detection: Striking the balance between precision and recall. *Proceedings of the 2016 IEEE/ACM International Conference on Advances in Social Network Analysing and Mining (ASONAM)*, pp.533-540.

Murphy, K.P. (2012) *Machine Learning. A Probabilistic Perspective*. Cambridge: MIT Press.

Murphy, D., Powell, A.B., Tinati, R., Anstead, N., Carr, L., Halford, S.J. abd Weal, M. (2016) Automation, Algorithms, and Politics | Bots and Political

Influence: Sociotechnical Investigation of Social Network Capital. *International Journal of Communication* 10, pp.4952-4971.

Nielsen, F.A. (2011) *A new ANEW: Evaluation of a word list for sentiment analysis in microblogs*.arXiv:1103.2903

Norris, P. (2011) *Democratic Deficit*. Cambridge: Cambridge University Press.

Ormrod, M., Dodd, G. and Musson, A. (eds) (2009) *Medieval Petitions – grace and grievance*, York, York University press.

Petitions Committee (2016) *Your Petitions: one year of action*, URL: http://www.parliament.uk/documents/commons-committees/petitions/Your-Petitions-A-Year-of-Action.pdf

Procedure Committee (2014). *E-Petitions: a collaborative system*, HC235, 2014-15, London, Stationery Office.

Puschmann, C., Bastos, M.T., & Schmidt, J.-H. (2017). Birds of a feather petition together? Characterizing e-petitioning through the lens of platform data. *Information, Communication & Society*, 20(2), pp.203–220.

Riehm, U., Böhle, K and Lindner, R. (2014), *Electronic petitioning and modernization of petitioning systems in Europe*, Berlin, TAB—Office of Technology Assessment at the German Bundestag. www.tab-beim-bundestag.de/en/pdf/publications/books/riehm-etal-2013-146.pdf [accessed 09 September 2017]

Roberts, M., Stewart, B.M., Tingley, D. and Airoldi, E.M. (2013), The Structural Topic Model and Applied Social Science. *Proceedings of the Neural Information Processing Systems (NIPS) 2013 Workshop on Topic Models: Computation, Application, and Evaluation*, pp. 1-4.

Ruths, D. and Pfeffer, J. (2014) Social media for large studies of behaviour. *Science*, 346(6213), pp.1063-1064.

Schütze, H. and Jan, O.P. (1995) Information Retrieval Based on Word Senses. *Proceedings of the 4th Annual Symposium on Document Analysis and Information Retrieval*, pp.161-175.

Scott, J. (2013) *Social Network Analysis*. London: SAGE.

Smith, M.A., Rainie, L., Shneidermann, B. and Himelboim, I. (2014) *Mapping Twitter Topic Networks: From Polarized Crowds to Community Clusters*. Pew Research Center Report, URL: http://www.pewinternet.org/2014/02/20/mapping-twitter-topic-networks-from-polarized-crowds-to-community-clusters/

Stoker, G. (2006) *Why Politics Matters*. Basingstoke: Palgrave.

Wang, X., McCallum, A and Wei, X. (2007) Topical N-Grams: Phrase and Topic Discovery, with an Application to Information Retrieval. *Proceedings of the Seventh IEEE International Conference on Data Mining*, pp.697-702.

Whiteley, P. (2012) *Political Participation in Britain*, Basingstoke: Palgrave.

Wilson, D. (1999) Exploring the Limits of Public Participation in Local Government. *Parliamentary Affairs*, 52(2), pp.246-259.

Wright, S. (2012). Assessing (e)democratic innovations: "Democratic goods" and Downing Street epetitions *Journal of Information Technology & Politics*, 9, 453–470

Wright, S. (2016) Success and Online Political Participation: The Case of Downing Street E-petitions. *Information, Communication & Society* 19(6), pp.843-857.

WVS. (2017). Political action: signing a petition, URL: http://www.worldvaluessurvey.org/WVSOnline.jsp.

Yasseri, T., Hale, S.A. and Margetts, H. (2013) *Modeling the Rise in Internet-based Petitions*. URL: https://arxiv.org/pdf/1308.0239.pdf