

Slow Down: Studying Online Political Discourse on Twitter through Speed Limit Policy

Abstract

This study hopes to extend the current understanding of political discussions within online spaces by drawing from literature on public opinion and the role of political discussions in deliberative theory, as well as writing reflecting on the logic and technical structures of social media. It then looks to apply some of these theoretical understandings to a local policy - the implementation of a 20mph speed limit - and examine how citizens have interpreted, discussed and negotiated their understanding of this policy on Twitter by applying network and keyword analysis on a corpus of such tweets. The findings here suggest that local policy discussions on Twitter tend to be formed around community clusters, with political actors playing central roles of importance within them. At the same time, it was found that links were not normally shared during discussion, but when they are, petition links and news links tend to be the most common. Similarly, the study did not find a strong presence of language about political action within the dataset. Taken together, it argues that online discussions of local policy may differ from that of national policy or general political talk, warranting further study about how policy context can inform or structure online discussions.

1. Introduction

This study examines the structure and substance of local policy discussions occurring online and whether they correspond to studies about general political talk online. This is done against the context of existing literature about political deliberation and public opinion, as well as writing on social media logic and online networks. As empirical findings about formal political deliberation increasingly reveal the difficulty of meeting traditional, normative ideals (Wyatt et al., 2000; Eveland, 2004), attention must be paid to the capacity and potential of political conversations that occur in more informal settings carried out by citizens in everyday settings (Delli Carpini, Cook & Jacobs, 2004). Political discussions on Twitter offer one such avenue for study - they reflect an informal, unstructured and fragmented environment (Graham, 2015; Wright et al., 2015), but nonetheless still hold the potential to provide benefits of traditional discussion, such as information seeking (Eveland, 2004), opinion development and political engagement (Bennett & Segerberg, 2012).

Although there are a large number of studies that have focused on studying such talk, few have focused on local policy discussions to the same degree. Prior studies have tended to focus on broad level political talk (Smith et al., 2014) or national-level policy such as Brexit (Matteo et al., 2022) or austerity (Graham et al., 2015). In contrast, this study takes an interest in local policy due to its proximity to *minipublics* (Dahl, 1989; Fung, 2007) and its

capacity for political deliberation for problem solving and consensus-seeking on community issues.

This study proposes four hypotheses to study the structure and the substance of such online discussions and seeks to test and compare its findings against prior, similar studies. First, it examines the presence of polarised crowds as identified by Smith and colleagues (2014) in their study of Twitter topic networks where conversations about American politics tended to see a division into two separate, non-interacting groups. Secondly, it looks for the presence of opinion leaders in these discussions, referencing findings by both Smith and colleagues (2014) but also others (Weeks et al., 2017; Lundgaard & Etter, 2022).

Next, it studies the substance of discussion by first examining the links that users may send over the course of discussion to investigate the kind of links a might share and if it could be predicted by the discussion side they belong to (Smith et al., 2014) and if they might be used for justification or even propagating political and civic (Graham et al., 2015; Bennett & Segerberg, 2012) action. Finally, it attempts to find a relationship between political conversations and political action through the use of Call-to-Action language during the course of discussion (Graham et al., 2015).

To do this, a corpus of 6,988 tweets with the keyword “20mph” was collected. Network analysis was carried out via the NetworkX package to study the topology of the tweets, with sentiment and keywords analysis done using NLTK. It was found that in the dataset about local policy discussions, polarised crowds did not form; instead, the presence of community clusters with regional interests were identified instead. At the same time, opinion leaders were found within the network - discussion tended to be dominated by a small minority of influential nodes, usually political actors. Finally, it was found that while just over one third of all outbound links to external sites shared were for a petition page, only 7% of all tweets included such a link. Likewise, references to political activity only surfaced in 0.001% of tweets, therefore failing to reveal a substantial relationship between discussion and activity.

For the purposes of clarity, this paper will continue to refer to the recently-renamed social media platform “X” by its previous name, “Twitter”, along with the corresponding interaction actions and languages of the platform, such as “Tweets” and “retweeting”.

2. Literature Review

2.1. Political Deliberation and Public Opinion

Deliberative democracy is a branch of democratic theory that gives prominence to the role of citizen discussion in policy making. Amongst political science scholars writing on the importance of political discussions and deliberation in civic participation, much has been debated on what these discussions ought to look like and the potential benefits that they might offer. Defining what constitutes political discussion remains an ongoing debate, a difficult task complicated by fluctuations in the language surrounding it (Wyatt, et al., 2000). While most writers understand political deliberation to at least include the participation of

citizens engaging one another in discussion on sociopolitical issues, they disagree in defining the terms of what outcome, process and setting should be (Conover et al., 2002).

In this study, attention will be paid to three aspects of political discussion - the publicness of discussion, the purpose of discussion, and the formality or informality of these discussion processes.

2.1.1. Publicness

The publicness of political discussion can be understood in three regards - of the space in which it occurs in, of the nature of topics discussed, and the manner of discourse used in a participant's justifications.

2.1.1.1. *Space*

The first aspect of publicness concerns space, and is understood as a combination of physical, geographical location as well as access (or lack of due to restrictions) - that is, *where* discussions occur. For Conover and colleagues (2002), publicness of space is best understood as a continuum with one end being a truly public space and the other being a truly private space. Public spaces have traditionally been defined as openly accessible areas, where the deliberate talk of public affairs is carried out by and amongst citizens (Bohman, 1996). In their study of ordinary political conversations, Wyatt et al. (2000) break down this understanding of spaces into different loci, citing the Internet amongst one of them. Subsequent studies of political discussions have also regarded the Internet as one of such spaces in which political discussions can take place, like in Shah and colleagues' study of the Internet's role in civic participation (Shah, Cho, Everland & Kwak, 2005) or in a study on the impact of online exposure to political information on offline contexts (Hampton, Shin & Lu, 2016). As such, this study finds it appropriate to treat the internet as a valid space for policy deliberations.

2.1.1.2. *Nature of topics*

The next two aspects of publicness pertain to the content of these discussions.

To qualify as political discussion, it is also important that the topics talked about allude to issues of public concern - in other words, *what* is being discussed. What is "public" is not necessarily always easy to determine, though attempts have been made to do so. Publicness of topics can be identified through a procedural definition or understood as one which itself requires deliberation (Conover et al., 2002). Casual, social conversations about 'everyday life' such as the weather or traffic, for example, was traditionally regarded as irrelevant in the context of political affairs. Political talk differs from the social because it is made up of topics identified in print and broadcasting, and it is guided by structured norms and civility (Schudson, 1997). For Conover, public topics can be categorised into three aspects - national domestic topics, local topics and foreign affairs topics (Conover et al., 2002).

However, political topics are not discussed in isolation from other topics or treated as distinct as separate. Certain topics such as crime or education may function as "bridge

topics” that transition between being political or personal in nature depending on the context of discussion and the space it occurs in (Wyatt et al., 2000), while political conversations may arise out of nonpolitical contexts, as research into online communities has found (Wojcieszak & Mutz, 2009). This has implications for topics previously dismissed as casual, social issues such as those mentioned above - conversations about the weather can lead into conversations about climate change and environmental policy, while discussions about traffic are closely related to local-level community issues and infrastructure policy.

2.1.1.3. *Manner of discourse*

The final aspect of political discussion places emphasis on the kind of justifications used in public discussions - that is, *how* discussions are conducted. Overwhelmingly, deliberative theorists point to the importance of rational discourse that is not affected by emotion or private interests (Conover et al., 2002). Political discussion must thus be guided by norms of public reasonableness (Schudson, 1997). However, reasonableness can also be difficult to define. Rationality can exist at contradictory levels as described by social dilemma - what is rational at the individual level may be harmful and irrational at the group level (Mendelberg, 2002). Within the online space especially, concerns over incivility or irrationality have been theorised as a possible impediment towards engagement, but research has found that participants of political discussions do not regard it with the same degree of importance (Valenzuela, Kim & Gil de Zuniga, 2012).

Importantly, underpinning this requirement for reasonability is the implied presence of contestation - after all, for deliberative theorists, the value of discussion stems from an exchange of differing ideas and perspectives and its benefit to democracy (Delli Carpini, Cook & Jacobs, 2004). In a study of online political newsgroups that found relative homophily in political opinions, Gregson (1998) critically described conversations there as sequential monologues without any genuine discussion. But difference in perspectives may not be necessary in order for political discussions to be meaningful. Homogeneity of opinions and a lack of opposing pressure can encourage participation by promoting a safe and supportive environment for discussion (Eveland & Hively, 2009; Mutz, 2006) and even create environments that facilitate civic engagement (Mutz, 2002). Sameness of opinions in political discussions may even encourage reasonableness; disagreements, in contrast may result in emotional arguments and social conflict (Conover et al., 2002). Furthermore, as Eveland (2004) writes, elaboration alone, whether from the motivation of expected discussion or from actual discussion with a conversation partner, can produce positive effects on an individual’s understanding of an issue.

As such, the role of reasonableness may not be as critical as initially understood, especially when depending on the context of differing versus similar discussions. This leads tidily into an exploration of the next aspect of political discussion - the purpose of such conversation.

2.1.2. *Purpose*

A traditional understanding of political discussion by deliberative theorists emphasises its role of problem-solving and achieving consensus in democratic societies (Dahl, 1989). While

such value cannot be so easily ignored, research has found that the motivations for political engagement by civilians tend to differ from that normative ideal (Conover et al., 2002; Shah, Cho & Eveland, 2005; Gil de Zuniga, Valenzuela & Weeks, 2016.) Gil de Zuniga et al. (2016), for example, find a difference between civic and social motivations. Civic motivations for discussion refer to that of persuasion, expressing a political view, learning new information or forming an opinion (Conover et al., 2002). In contrast, social motivations related to the pursuit of small talk, personal enjoyment and relationship development (Eveland et al., 2011). Regardless, both civic and social motivations enhance civic participation through frequency of discussions.

2.1.2.1. Civic Motivations

Persuasion

Individuals may be driven to engage in political discussions with the goal of persuasion, especially when they see themselves as opinion leaders. Traditional opinion leaders in offline contexts are described in a two-step flow of information where a minority group wields influence over others through their role in information dissemination (Katz & Lazarsfeld, 1955). There has been some criticism that opinion leaders may no longer be as influential due to increasing social isolation and a tendency to reinforce rather than reframe opinions (Bennett & Mannheim, 2006). However, this perspective has been challenged by studies which find that influencers are still present within online networks (Graham & Wright, 2014) as individuals increasingly turn to their social networks for news and political information (Bode, 2015). Just like their traditional counterparts, highly active social network users with high levels of engagement with political news tend to see themselves as opinion leaders, believing in their own potential for influence both online and offline while also being more likely to attempt persuading their peers (Weeks, Ardevol-Abreu & Gil de Zuniga, 2017).

Information seeking

Individuals may engage in political discussions with the goal of information seeking, as Eveland (2004) describes - interpersonal political communication can promote political knowledge through elaboration and improved understanding. For him, the value of political discussions do not stem from the two-step flow of information in one way information dissemination (Katz & Lazarsfeld, 1955) - instead, they come from the mechanisms of elaboration generated with a conversation partner that creates additional connections between news information and one's larger knowledge structure, thus improving learning and recall. Likewise, Shah and colleagues (2005) find a strong relationship between using the Internet as an information resource and for political discussions, referring to online communication as a means of gaining information and expressing opinions, a sentiment also identified by Conover (2002).

2.1.2.2. Social Motivations

Story-telling

At the same time, participants of political discussions may also do so for more social reasons. Social motivations for discussion are important because they do not require participants to be particularly knowledgeable (Gil de Zuniga et al., 2016), thus lowering the cost of participation. One such motivation identified by Conover and colleagues (2002) relate to story-telling which provides the opportunity for personal education. The importance of respectful listening as a basis for uncovering common ground relates to political talk as an exercise in empathy - by speaking to others, individuals gain an opportunity to contextualise their opinions through understanding others.

Social pleasure

Closely related to this is the act of speaking for social pleasure, where participants in their study described the personal pleasure of expressing their views and the act of talking, with stories of people who enjoyed the process surfacing frequently (Conover et al., 2002). Just as the importance of listening was highlighted, the act of speaking itself serves a function of catharsis in self-expression. In studying the dynamics of political talk of comments on online newspaper and blogs, Mitchelstein (2011) similarly finds such socialisation goals of self-expression and making oneself known as one motivator for participation.

The relationship between motivations for political discussion is further blurred with social media - individuals may go on to Facebook or Twitter for social, nonpolitical reasons, but find themselves exposed to the political opinions of their social circle (Hampton et al., 2016) and thus participate in online discussion. Likewise, the blurring of the personal and the political persist - and in some ways, are emphasised in these online spaces, as the relationship between descriptions of personal, everyday experiences are linked with expressions of identities like race, gender, and sexual orientations (Highfield, 2016).

2.1.3. Formal vs Informal

In exploring the aspects of publicness and purpose, some distinction between formal and informal deliberations can be uncovered. Formal deliberations follow some set of strict rules and normative ideals - citizens are well informed and discussions are open and public with equal access (Schudson, 1977) while occurring in a manner of civility and reasonableness without undue influence (Conover et al., 2002).

But the empirical findings of the discussion above relates to the difficulty of meeting such normative ideals. Citizens are unlikely to be well informed, with average levels of political knowledge being low (Eveland, 2004), while inequalities - structural, institutional or otherwise restrict participation (Conover et al., 2002). The distinction between what makes a topic "political" is also blurred (Wyatt et al., 2000), as is defining what rational debate is (Mendelberg, 2002). Motivations of participation cannot be treated as fixed (Gil de Zuniga et al., 2016), and the value of discussion cannot only be ascribed to either cross-cutting or homogeneous discussions (Eveland, 2004) - both, after all, have their value.

Even so, regardless of its procedural or substantive form, public discussion continues to be consistently linked with civic participation (Katz & Lazarsfeld, 1955; Gil de Zuniga et al., 2016), so importance continues to be assigned to it. Instead, everyday political talk can be

treated as one aspect of a broader deliberative system (Lundgaard & Etter, 2022), with their informalised, unstructured and fragmented nature (Graham, 2015; Wright et al., 2015). Participation in such discussions can still enable citizens to become informed, develop opinions (Graham, 2015; Graham & Wright, 2014) and motivate them for further political engagement (Schmitt-Beck & Grill, 2020).

In this sense, this study adopts a definition of discursive participation akin to the one described by Delli Carpini, Cook & Jacobs (2004). Emphasis is placed on the act of discussion, which is in itself treated as political participation. Furthermore, it is not limited to formal civic institutions or processes and can occur through a variety of media, including internet forums and email exchanges. Finally, it puts focus on public issues at the local, national or international levels.

As such, this study thus looks to examine the role of social media as a space for political discussions.

2.2. Social Media

It is important to first understand and define the scope of the space this study intends to address. Social media refers to a broad term of Internet technologies used for communication, while Social Network Sites (SNS) are a subset of such platforms, where users can create a profile, connect with users, view these connections and share content (boyd & Ellison, 2007). Compared to more traditional Internet technologies such as the interest driven forums like those studied by Wojcieszak and Mutz (2009), SNSs are generally not anonymous, and social cues may be more visible with the exchange of photographs and other media (Hampton et al., 2016). Facebook, for example, is designed around extending existing social ties into a digital space - the result is an ambient environment where users are continuously exposed to the activities of their social group. The scope of this study is focused on the role of SNSs, and more specifically, Twitter.

In this section, attention will be paid to two points of divergence from more traditional understandings of online discourse - the affordances designed into Twitter that make it unique and the networks that explain the relationships between these users.

2.2.1. Affordances

Understanding affordances, especially in how Twitter is designed, is critical in contextualising any study relating to its role in political discussions. This relationship is demonstrated especially in Oltmann, Cooper & Proferes' (2020) study of "alt" or "rogue" government agency Twitter accounts under the Trump administration.

Affordances refer to the perceived, possible actions that a user can infer from their interaction with an interface (Norman, 1988). Affordances relate to perceptions of what an object, or in this context, a feature, might be good for. As boyd (2014) writes, Twitter's affordances can be understood to include persistence, visibility, spreadability and searchability. These features are prompted to people as affordances to help users achieve their goals (Kozinets, 2020). On Twitter, these goals include that of interpersonal

connectivity, which will be discussed in more detail later. This section puts focus on two areas of affordances - visibility and spreadability; and referentiality, though both aspects are closely related and have the potential towards mutual reinforcement. Twitter's design also facilitates quasi-anonymity which has potential consequence for the way interaction occurs on the platform, but have been scoped out from this study to make its tests manageable.

2.2.1.1. Visibility and Spreadability

A key aspect of social media and of Twitter is the ability for a user to not only spread messages to a wide audience easily and cheaply, but to also find content of interest. In their study, Oltmann and colleagues (2020) attribute the dissemination of misinformation as a consequence of the way Twitter's affordances enable certain behaviours, such as the ease of information sharing with a wide audience. The hashtag system, for example, a technical feature of Twitter's design, allows users to produce, find and interact with similar information through easy categorisation and coordination. Lupia & Sin (2003) had previously pointed to this as well, describing how the cost of organisation can be reduced through Internet use. But this affordance works as a double edged sword - it is largely ambivalent as to the intentions of the user, whether that might be (quite subjectively) well-meaning civic participation or malicious dissemination of misinformation – meaning cannot be intrinsically ascribed to its behaviours (van Dijck & Poell, 2013).

This affordance of visibility can also work in reverse by examining the ability for individuals to mute or block another user. An implicit goal in the facilitation of community is the intention of gathering similarly-minded individuals. Muting or blocking users with dissimilar interests, attitudes or perspectives allows users to better construct their desired communities. Participants are, after all, more likely to engage in discussions when agreement can be found (Mutz, 2002; Shah et al., 2005). In other words, not only does Twitter enable a user to surround themselves with like-minded individuals, it also enables them to prevent the permeation of dissimilar opinions into their space, allowing for homogenous spaces where the same opinions are produced, reproduced and shared - an echo chamber of opinions (van Dijck & Poell, 2013).

2.2.1.2. Referentiality

Referentiality is a particularly important affordance for thinking about political deliberation because it enables not just the civic motivations of persuasion and information seeking, but also supports political organisation and activity.

In their study, Oltmann and colleagues (2020) also refer to the affordance of sharing outbound links - in their study, around 52% of their tweet corpus included at least one link. They suggest this as an affordance of referentiality, with the ability to connect a tweet with further information to serve as evidence or substantiate their claims. Since individuals also relate to being deterred from engagement in political conversation due to a lack of knowledge (Conover et al., 2002), or utilise social media with the intention of information seeking (Shah et al., 2005), this affordance helps enable such behaviour. Furthermore, as Lundgaard and Etter (2022) find, participants of everyday talk on Twitter regularly justify their arguments by referring to a source either through quoting or using URLs (both internal

and external), pointing to the role of individual users as sources of justification - in this instance, the social motivations of empathy seeking in personal stories and passionate appeal - also function as “evidence” in discussions. Likewise, the use of social media to seek and provide information also works in the reverse manner, supporting opinion leaders that disseminate information to their followers (Weeks et al., 2017; Smith et al., 2014).

An extension of this affordance, along with visibility and spreadability, is the facilitation of political organisation. Political phenomena such as the Occupy Movement and the Arab Spring have, after all, been associated with having its roots in social media (van Dijck and Poell, 2013), empowering grassroots action and organisation (Leong, Pan, Bahri & Fauzi, 2019). The ability to share links goes beyond just news sites, but also petition links, protest calendars and donation drives (Bennett & Segerberg, 2012). Social media, as they argue, facilitates connective action, where individuals are motivated towards performing acts of public good as a means of self-validation in an environment of reduced participation cost, and they allude to the simple act of sharing as an example.

In other words, content on Twitter need not merely be descriptive or persuasive - call to actions can also be easily embedded and easily spread. This sentiment of propagation is also echoed by Lundgaard and Etter (2022), who find that interactions need not necessarily take the form of reciprocated conversation, but also in the propagation of opinions and perspectives through mentions, retweets and quote-retweets. On Twitter, direct interaction by means of conversation or address tend to generally be low, with the bulk of engagement in everyday talk being propagation of others’ contributions. Since a key understanding in deliberative theory is the positive relationship between political discussion and civic action, this affordance will likely have impact on this dynamic.

2.2.2. Networks

A defining, primary trait of social media is the role it plays in facilitating connectivity. SNSs use algorithms to show users a small, prioritised subset of content that favours congruent information (Hamilton, Karahalios, Sandvig & Eslami, 2014), whilst at the same time, users maintain some degree of agency in shaping and curating their own online experiences of who and what to see. Regardless, the outcome is a salient and articulated social network that takes on several aspects.

2.2.2.1. Consociality

In their study of Lateral Exchange Markets, Perren and Kozinets (2017) offer a definition of consociality to illustrate the relationships between users within a digital space - one in which social actors within a network share physical and/or virtual co-presence with one another, therefore enabling an opportunity for social interaction. Wittel (2001) alludes to a network-based form of social connection as “network sociality”, where it is deeply embedded in technology, informational, ephemeral but intense. This reflects the kind of relationships that may be present on Twitter. Twitter users are not bound within the confines of a specific interest where traditional forums may be - while the logic of Twitter algorithms look to expedite group formation through sameness and shared interests with recommendation engines designed to identify and suggest similar users (Van Dijck & Poell, 2013), there is

much more flux with the boundaries of a community. A user is neither tied nor limited to the initial community or motivations that they may have joined for, and may use a single account for multiple interests, or create multiple accounts for each interest. In this sense, Twitter more closely resembles a manifestation of networked individualism (Wellman, 2002), of sparsely connected individuals existing within a personally customised network that is at the same time more individualistic and opportunistic (Rainie and Wellman, 2012).

2.2.2.2. *Polarised Crowds*

A consequence of congruence and sameness facilitated by Twitter algorithms and user self-selection is the potential for the development of echo-chambers. Research has found that political discussions on Twitter tended to develop into two, distinct crowds that do not talk with each other and usually have little connections between them, even tending to reference entirely different sets of links (Smith et al., 2014). But this network was only true of political topics - in conversations about hobby groups, for example, networks tended to take the form of tight crowds instead, where discussions were characterised by highly interconnected individuals. This has implications on the expectation of contestation - while interest driven forums may have resulted in exposure to cross-cutting political exchanges (Wojcieszak and Mutz, 2009), the malleable and transient nature of communal boundaries on Twitter mean that political discussions result in a form more akin to the homogeneous discussions on political newsgroups described by Gregson (1998). Even though Twitter is a space in which users may not have necessarily entered for the purpose of political discussion, the potential for exchange and exposure to dissimilarly minded people risks being diminished.

The affordance of Twitter in enabling social balance (Hummon & Doreian, 2003) has consequences for the kind of networks that can result from their platform. A preference for likeness and an avoidance of difference can help create homophilous subsets, while a preference for connection to popularity will result in highly-centralised networks with long-tail degree distribution (Light & Moody, 2020). As Smith et al., (2014) found, these preferences may be context-specific and differ between political discussions compared to hobby group conversations. This study attempts to analyse this dynamic in greater detail by investigating whether political discussions on *local* policies differ in social preferences in comparison.

2.2.2.3. *Opinion Leadership*

In their study of opinion leadership, Weeks and colleagues (2017) find that highly active SNS users with high levels of engagement with political news tend to see themselves as opinion leaders and believe they are influential in their social networks. In turn, these opinion leaders are likely identifiable as “prosumers” with high levels of social media use. A platform such as Twitter articulates social ties in quantified terms therefore allowing users to see not just their own follower count but also that of others, facilitating judgements of popularity. The presence of opinion leaders is echoed in the study by Smith and colleagues (2014). They find the presence of discussion leaders at the centre of their polarised clusters, whom they describe as those widely replied to or mentioned. At the same time, Hampton and colleagues (2016) find a strong relationship between the number of Facebook followers and

a willingness to engage in political discussions. Popularity on Twitter, as van Dijck and Poell (2013) find, is a two way traffic that is conditioned by both algorithmic and socioeconomic components that measure what to promote or not, by a technical construction that privileges the content of users with high levels of engagement, as well as an individual user's reliance of such opinion leaders for information (Weeks et al., 2017).

2.2.2.4. Equality in Access

In contrast, Lundgaard and Etter (2022) take an alternative approach in understanding the relational dynamics present on Twitter. They propose two strands of equality - equality of reach, where each opinion should see equal interest and the potential to be heard; as well as the absence of dominating actors. For them, equality in everyday talk on social media should be reflected in participants having equal opportunity in affecting a possible outcome (Mansbridge, 1999). While participants with a larger number of followers obtain more central positions (based on the 100 most central participants) on average, any participant can also obtain this central position, and so they propose that everyday talk on Twitter was characterised by equality.

This conclusion puts it in tension with the findings of Weeks and colleagues (2017), who have proposed that highly active users operate as opinion leaders that disseminate information to their audience through a two-step flow (Katz and Lazarsfeld, 1955). For Lundgaard and Etter (2022), equality in participation by ordinary citizens reflects a bottom-up information flow that can motivate and spark further political engagement (Schmitt-Beck & Grill, 2020). As Lundgaard and Etter (2022) find little indication of dominating actors in everyday talk, further questions about the relational dynamics of policy discussion on Twitter become raised.

2.2.3. Data Non-Neutrality

A final aspect important for contextualising the study of social media is data non-neutrality, with attention paid to constructions of popularity.

Social media, including Twitter, describes its data as "raw" resources where the sentiments of users can be measured (van Dijck and Poell, 2013). However, while Twitter champions connectivity and facilitating interactions amongst like-minded people, it does not do so equally - it privileges highly visible users or opinion leaders as well as paid content (van Dijck & Poell, 2013).

Opinion leaders are in part identified as those with high levels of inter-user engagement - follower count, number of replies, likes, retweets - and promotes them, therefore increasing their visibility and likelihood of further engagement. Unlike traditional opinion leaders (Weeks et al., 2017), Twitter opinion leaders do not need to have high levels of political knowledge from active engagement with mass media news. Popularity on social media is a mutually reinforcing mechanism between users and platform (van Dijck & Poell, 2013) - this means that users too can manipulate and force popularity as an outcome where the quality or substance of the content is irrelevant, only that it drives interaction, for better or for worse. This sentiment is somewhat echoed in Smith and colleagues' (2014) analysis -

conservatives were more likely to share resources linking to websites that were not mainstream news sources. Likewise, even though rogue and alt accounts from the National Park Services and NASA under the Trump administration purported to challenge the censorship of scientific data, those accounts were more likely to link to news content as opposed to sharing datasets or other scientific information (Oltmann et al., 2020).

Another aspect of popularity is paid content. Users can also attempt to manipulate popularity by simply paying to have their content privileged. The line between paid content and advertising can be difficult to discern at times, but in the context of Twitter, any user can pay to have their tweets promoted, regardless of whether they are a company brand or an individual. UK law requires disclosure, and paid content can be identified as the bottom of each tweet subtly flags it as “Promoted”, but this does not relate to tweets that have been algorithmically promoted on the basis of the user’s paid profile. On Twitter, paid subscribers with a premium account are treated as more important users and given prioritised rankings, and this saliency increases their likelihood of visibility and interaction from other users (About X Premium). This too will have an impact on user popularity.

An in-between aspect of this is the role of paid bots, in which users can pay for scripted algorithms to act as users and automate the process of popularity manipulation. The use of such bots in political discussions have already been identified in various contexts, including the Trump - Clinton election debate in the United States (Kollanyi et al., 2016), an American discussion network on investigations regarding Russian interference in the 2016 U.S. elections (Hagen et al., 2022) as well as the UK elections of 2019 (Bruno et al., 2022). In Hagen and colleagues’ (2022) study, for example, bot-like accounts created the appearance of a virtual community whilst influencing network sentiment through downplaying the influence of traditional actors and amplifying pro-Trump messaging.

As such, the distinction between data as an outcome of “organic” activity versus that of manipulation becomes even more difficult to discern. Twitter is, at the end of the day, a corporation with profit making incentive. The mechanisms for its algorithms are kept secret and proprietary, and its continued existence is dependent on relevance. Nonetheless, these inorganic mechanisms of generating popularity have a profound impact for any understanding of the nature of political discussions online.

3. Project Scope

Having examined the debates in deliberative theory and the nature of social media, this study then seeks to study these discussions and findings within the context of a specific policy implemented at local level - the 20mph speed limit policy in United Kingdom. Prior studies on political discussions within online spaces have tended to focus on broad level political talk about national politics (Smith et al., 2014) or national-level policy such as Brexit (Matteo et al., 2022) or austerity (Graham et al., 2015).

In contrast, this study takes an interest in local policy because of how much closer it is to the ideal conception of political deliberation and its purpose in problem solving and consensus-seeking (Dahl, 1989). Fung (2007) echoes this sentiment in describing the importance of

minipublics - despite their modest scale, minipublics offer constructive potential in civic engagement. Minipublics are a mechanism for bringing citizens together to engage them in the processes of learning and deliberation on policy issues, and the policy discussions on social media parallel an informal reproduction of these assemblies. By examining a local level policy, this study will be able to better understand the process of discourse in an issue that directly impacts the community of participants.

Secondly, this study identifies an interest in speed limit policy specifically because of its present and ongoing saliency. In London, the policy plan, Vision Action Zero, was first launched in 2018 with the initial phase to convert roads within the Central Congestion Zone occurring in 2020, but as of writing in 2023, rollout is still ongoing and is expected to continue for the foreseeable future. Speed limit policy, in this sense, is an issue that simultaneously has high levels of visibility within an individual's lived environment (an individual likely encounters this policy and its repercussions on a day-to-day basis) whilst also being one that is almost entirely within the remit of local level government due to the Traffic Management Act of 2004 (unlike housing, for example, where local councils must contend with pressures from national level government and private actors). As such, it straddles the space between a topic of political deliberation and everyday talk in its function as a "bridge" topic that is simultaneously public and private in concern (Wyatt et al., 2000).

RQ: In what ways are local policy discussions on Twitter similar (or dissimilar) to general political discussions online?

4. Hypotheses

In this first and second hypotheses, the goal is to identify the network patterns present in the discussion of speed limits. The study expects to find the presence of polarised groups centred around that of certain influential opinion leaders with high levels of engagement (Smith et al., 2014; Weeks et al., 2017).

H1: Users discussing speed limit policies are organised around polarised groups which can be broadly segmented by sentiment and keyword analysis.

H2: Opinion leaders can be identified based on the presence of influential nodes with high levels of centrality.

The third hypothesis is interested in examining the affordance of referentiality on Twitter and users' interaction with it (Oltmann et al., 2020) and the kind of links that users may send, with the expectation that the group users belong to, identified in H1, predicts the kind of link sent (Smith et al., 2014). On total link count, a threshold of 52% was set based on Oltmann's study.

H3: At least 52% of users discussing speed limit policies also share links during their course of exchange.

H3a: If the network structure reflects a polarised crowd, then users on one side of the discussion are more likely to share links to mainstream news sources.

H3b: If the network structure reflects a polarised crowd, then users on the other side of the discussion are more likely to share links to non-mainstream news sources.

The fourth and final hypothesis is interested in examining the relationship between political discussion and action by testing for the presence of language that relate to political activity (Graham et al., 2015). It does so by searching for the prevalence of keywords such as “vote” or “petition”, with a threshold of 14% set based on Graham’s study.

H4: At least 14% of users discussing speed limit policies also discuss political participation.

5. Methodology

This study aims to test its hypotheses by applying Network Analysis and Keywords Analysis on a corpus of Tweets gathered based on a discussion of speed limit policy. This study is approached through the paradigm of pragmatism (Johnson and Onwuegbuzie, 2004) and has opted for these methods as it believes them to be the best fit for answering the research questions of this study. In doing so, it utilises a quantitative approach in its research design as this study is predominantly interested in understanding participants of local policy discussions on Twitter and what these discussions look like.

5.1. Data Collection

Data for this study was collected using Python and Twitter API to gather a corpus of tweets through a keywords-based approach of searching tweets that included the term “20mph”. For each tweet collected, data about the user that tweeted it as well as the user(s) that retweeted and/or quote-retweet it will also be collected. The code used to collect the data and implement the models used were written and continuously refined and tested on a small sampling of tweets over the time period of June 2023 to July 2023, before being implemented on a database made up of a separate set of Tweets.

In this second set of data used for analysis, Tweets were collected for the time period of 26th August 2023 to 29 August 2023 and compiled into a JSON file with information about the Tweet ID, Tweet text, author ID, author username, public metrics of each Tweet such as the number of retweets, as well as any annotated metadata, including location or identified Named Entities. This separation was done as a best practice to manage the problem of double-dipping and overfitting while ensuring that the data being collected was logistically sufficient for use, especially since one of the methods, Label Propagation, is a semi-supervised model.

There were two critical logistical constraints that are likely to have an impact on the findings. The first is that the amount of data collected has been restricted by Twitter to no more than 10 000 tweets per monthly cycle, and the second is that the time period of data collected has been restricted to no more than tweets beyond the last seven days. Secondly, the

Twitter Search API does not return a comprehensive collection of Tweets based on the search query alone - one reason is that not all Tweets are indexed, which in turn is managed by an unknown algorithm, increasing the risk of a non-representative sample.

In other words, the analysis is conducted on a limited sample of tweets that is at the same time prone to topical influence, such as the arrest of a prominent political figure for speeding, or a recent publication by a newspaper on traffic policy. In a way, this reflects the mutually reinforcing nature of broadcast media and social media highlighted by van Dijck and Poell (2013), and while it can sway the substance of the conversations identified in the corpus, this paper argues that this does not make the findings less relevant and in fact makes it more, not less, representative of the issue to be studied.

Likewise, since the corpus data is explicitly rooted in time, a methodological choice to reduce each interaction into a static constant has to be taken anyway; while this aggregation may make its findings less refined, the nature of the data does not change, and those dyadic events of interactions are still events. By defining networks as temporally aggregated interaction histories, social ties can thus be articulated and observed within a time interval (Kitts and Quintane, 2020 (in Light & Moody)), so it is on this basis that the paper believes this treatment to be appropriate.

5.2. Data Analysis

5.2.1. Network Analysis

The first two hypotheses involve studying the relationships between users tweeting about a subject by looking at the structure of their network. NetworkX, a Python package for network analysis (Hagberg, Schult & Swart, 2008) was used to support the analysis here. To test for polarisation, community detection is done through a Label Propagation (LP) model, which is a semi-supervised model that works by spreading unique identifiers through a network to identify densely connected groups of nodes, and does not require pre-defined functions or information about any latent communities. Furthermore, an LP algorithm is less strict in that it allows for asynchronous relationships, and on the hypothesis of communities, mutual relationships between nodes are not important.

A sentiment analysis is then done using VADER (Hutto and Gilbert, 2004) to find the sentiment score within each community. Next, the body of each tweet was also extracted before being simplified and normalised using NLTK's (Bird, Loper and Klein, 2009) Porter stemmer model while maintaining the words from each Tweet as a unique list. The most common keywords across the dataset were filtered out so that the most common keywords within each community could be identified. Doing so provides a starting point for differentiating between the communities.

Two methods of network analysis to identify "important users" or "opinion leaders" were used in this study, both of which are measures of centrality. One constraint that this paper faced is data availability; since a full corpus of tweets relating to discussions on the 20mph speed limit policies could not be collected, a positional approach to network analysis was used instead. Relationships between users are understood by their relative centrality,

instead of a connectionist approach of locating nodes on a defined path structure and calculating average path length to determine importance.

The multiplexity of the network was also greatly simplified - each node is defined as a Twitter user while ties are defined as mentions or retweets. In the case of the latter, it would be indicated by the presence of "RT: @name" at the start of the tweet text, so using mentions as a proxy for interaction functions by capturing both mentions and retweets.

In an ideal scenario, a vertex from user node A to user node B would be defined as:

User B retweets User A, or
User B mentions User A, or
User B likes User A, or
User B follows User A.

However, given the data available, a proxy of this was used:

User B retweets User A, or
User B mentions User A.

Defining the edges in this manner also helps mitigate the logistical problem of the Follows endpoint being deprecated on Twitter API, preventing a network model based on Followers/Following from being drawn. This is a significant methodological departure from studies such as Smith et al., (2014), which used made use of Follow relationships to develop a network. Finally, the "like" interaction was also omitted from this network analysis for simplicity.

The first method used is a test of degree centrality, where the importance of a node, or a user, is identified by the number of ties, or mentions, emanating from them. In the hypothesis testing for opinion leadership, the graph is necessarily directional as it indicates who mentioned whom. Users that frequently mention others but are not frequently mentioned *by* others should not be regarded as having the same degree centrality as those that are frequently mentioned by others. As such, an out degree centrality model will also be applied to verify the findings of the first model.

The second method is a VoteRank algorithm (Zhang, Chen & Dong, 2016). It is similar to the PageRank model (Brin and Page, 1998) originally used in Google for ranking webpages, in that it is also a recursive method of determining node importance by weighing the importance of relative nodes, but it differs in that it treats the support strength of each tie as being zero-sum through a self-voting mechanism; if node A supports node B, then the support which node A provides to other nodes is decreased. In other words, influential nodes with a large amount of support will be surrounded by nodes with decreased voting ability. The rationale for this vote depreciation is to manage any shared spheres of influence between central nodes. Its usage here makes intuitive sense - like the original PageRank calculation, it identifies ties by means of links cited and the nodes that cited it in turn, so the use of mentions seems analogous.

Prior research studying political conversations in online spaces has typically utilised methods such as surveys or interviews, relying on self-reported data to make sense of their substantive nature and dynamics. For example, in their research to apply the scholarship of offline opinion leadership to an online context, Weeks and colleagues (2017) made use of survey data to identify “prosumers” or online opinion leaders based on levels of engagement with political news and online activity, finding that highly engaged users tended to see themselves as opinion leaders, and were, therefore, more likely to attempt influencing others. In this study, opinion leadership is instead identified by node importance within network topology based on a mentions network, echoing the approach taken by Smith and colleagues (2015) that identified opinion leadership based on node importance within a follower network.

The study has opted to use two algorithms to test for node importance and opinion leadership because its method design has deviated somewhat from prior literature due to a difference in collected data. As such, some experimentation was considered necessary in finding a suitable model with the best fit.

5.2.2. Keyword Analysis

The third and fourth hypotheses involve an attempt to make sense of the substance of the tweets in the corpus.

In the hypothesis of referentiality, a keyword count of the links within the corpus is done to identify the kinds of reference sites users share over the course of their discussions. To ensure that each instance of the keyword’s appearance was an actual link share and was distinct from merely being talked about by a user within their tweet text, the domain name from the outbound URL is extracted from the metadata of each Tweet and then counted.

To test for the presence of call-to-action language intended to drive political action in the fourth hypothesis, a keywords list was developed based on Graham and colleagues’ (2015) paper on conversations about austerity on lifestyle forums. A highly simplified variation of the codes used by them was adapted for the analysis here, allowing for a list of keywords that involve verbs with a specific political inclination:

- Vote
- Volunteer
- Donate
- Campaign
- Protest
- Petition

6. Findings and Analysis

6.1. Descriptive Overview of the Tweet Corpus

The full tweet corpus was made up of a total of 6988 tweets.

Of these, 4460 were retweets while 2528 were new or “unique” tweets. 1288 of these tweets included a link share. Most tweets did not see any replies ($M = 0.78$, $Mdn = 0.0$), even though a large number of them included at least one mention ($M = 1.27$, $Mdn = 1$), suggesting a lack of reciprocal interactions (Lundgaard and Etter, 2022) and are perhaps indicative of social motivations of participation such as catharsis from self-expression (Conover et al., 2002; Mitchelstein, 2011).

Hashtags were infrequently used ($M = 0.11$, $Mdn = 0.0$), even though they were a means of enabling visibility and spreadability (Van Dijck and Poell, 2013). Instead, tweets seem to be propagated through the retweets function ($M = 244$, $Mdn = 25$), suggesting the role of user action in information spread about local policy discussion, as opposed to being entirely due to built in mechanisms for organisation and discovery through hashtagging.

Statistic	Count
Count of tweets	6988
Count of accounts	4373
Count of tweets that are retweets	4460
Count of tweets that are “unique” tweets	2528
Count of replies	5451
Mean number of replies per tweet	0.78
Median number of replies per tweet	0.0
Count of mentions	8873
Mean number of mentions per tweet	1.27
Median number of mentions per tweet	1.0
Count of hashtags	782
Mean number of hashtags per tweet	0.11
Median number of hashtags per tweet	0.0
Count of times tweets in corpus were retweeted	1710857
Mean number of retweets per tweet	244
Median number of retweets per tweet	25
Count of link share	1288

Table 1. Descriptive Statistics of Corpus Overview

Furthermore, 5,388 of these tweets were nodes that connected to other nodes in the corpus by a mention or a retweet, with 1600 of them being self-looping or unconnected nodes. The network density of the graph was low at 0.0004, suggesting loosely-knit, low density networks which is fairly typical as a network of social media data (Smith et al., 2014) and reflecting networked individualism (Wellman, 2002; Rainie and Wellman, 2012). Its network modularity was 0.74, suggesting the likelihood of information circulation between communities.

To create a visualisation of the network, a Kamada-Kaway (fit = 0.79) layout was used to set the position of the nodes on an undirected graph, and variable opacity was introduced so less important nodes were more transparent, allowing for network structures to be revealed. The five most important nodes have also been highlighted in orange.

Network with Kamada Kaway and Variable Opacity

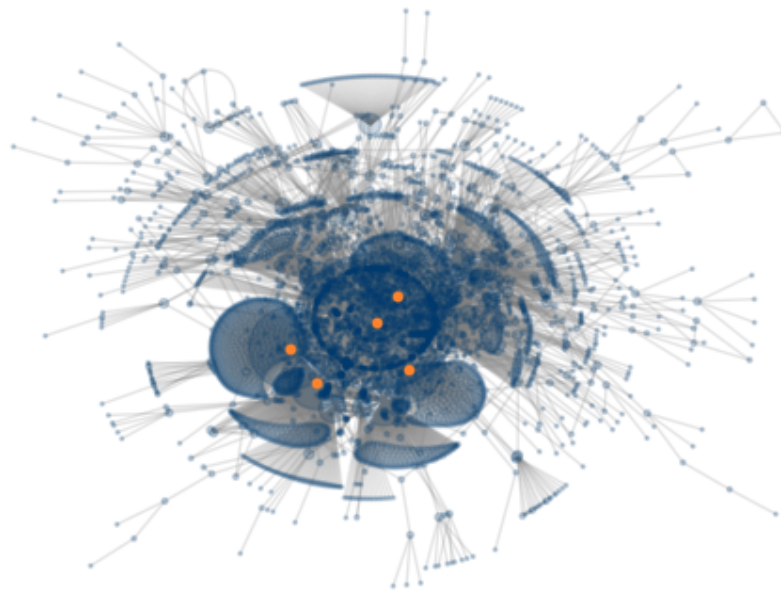


Figure 1. Network visualisation based on an undirected graph for degree centrality, using a Kamada-Kaway layout and variable opacity. The five most important nodes are highlighted in orange.

Statistic	
Mean sentiment score	-0.059
Standard deviation of sentiment scores	0.454
Number of positive tweets (if score > 0)	1788
Number of negative tweets (if score < 0)	2573
Number of neutral tweets	2627

Table 2. Overview of sentiment score across data set

It was also found that across the corpus, tweets tended to have neutral to low sentiment scores ($M = -0.059$) although there was some diversity in opinion amongst them ($SD = 0.454$).

After cleaning twitter text body data using NLTK's Porter Stemmer and removing stop words, the top 10 most frequently surfacing keywords were found to be the following:

Word	Count
20mph	4322
london	2632
limit	2107
uk	2069
ditch	2016
speed	2012
wale	1801
mph	1599
20	1483
ulez	1338

Table 3. Top 10 most common keywords

In previous tests, data being queried through Twitter API was predominantly showing Tweets from London, likely based on geographical proximity of the query location, so having Wales show up in the keywords list was a surprise. The significance of Wales in the dataset is likely due to the an announcement by the Welsh national government looking to introduce default 20mph speed limits on restricted roads in the country (Introducing default 20mph speed limits), which was reported during the time period of the data set's query.

After removing expected common keywords such as "20mph" and all geographical keywords, a new list of the top 10 most frequently surfacing keywords was generated:

Word	Count
ditch	2016
ulez	1338
get	1273
labour	1264
move	1175
to	1169
ltn	1091
road	1029
scrap	1028
onli	1017

Table 4. Top 10 most common keywords with policy and geographical keywords removed

The appearance of "ulez" and "ltn" in the corpus suggest that to some degree, similarly themed policies tend to be discussed in relation with each other, even though the rationale behind each policy may be reasoned or justified differently. For example, the 20mph speed limit policy is motivated towards pedestrian safety (Vision Zero for London), while the policy rationale for the Ultra Low Emissions Zone, also known as ULEZ, was for reducing air

pollution in the city (Ultra Low Emissions Zone). For participants in online discussions about local policy, this distinction may not matter as significantly - all three policies, including Low Traffic Neighbourhoods (LTNs) although proposed and implemented separately, are related to driving and traffic. It may also be indicative of participants' use of related policies to justify their opinions, but further research is necessary for this.

6.2. Hypotheses Testing

6.2.1. Network Structure

The first hypothesis proposed that:

H1: Users discussing speed limit policies are organised around polarised groups which can be broadly segmented by sentiment and keyword analysis.

The Label Propagation model initially identified a total of 859 communities - after trimming off communities with less than 10 nodes, 43 communities remained. The median size of these communities was 23, but only 8 communities within the entire output had at least 100 members, so the list was trimmed a second time at this threshold. Finally, Community 2 should also be rejected for irrelevance, resulting in 7 identifiable communities.

Community Name	Number of Members	Sentiment Score	Standard Deviation	Number of Tweets	Keywords
Community 0	662	0	0.09	623	'ditch' (1196)
Community 1	479	-0.12	0.44	153	'andrewrtdavi' (101), 'conserv' (75)
Community 3	320	-0.56	0.33	132	'wale' (132), 'labour' (128), 'wait' (97)
Community 4	193	0	0	65	'ditch' (130), 'onli' (65), 'reform' (65)
Community 5	166	-0.4	0.1	60	'no' (174), 'driver' (59), 'cyclist' (59), 'citi' (58)
Community 6	124	-0.26	0.52	58	'thejeremyvin' (51)
Community 7	100	-0.4	0.41	100	'wale' (67), 'weve' (53), 'charg' (53), 'year' (52)

Table 5. Communities identified via Label Propagation. Node 2 has been removed for irrelevance.

A summary of the findings is shown in table 5, along with their mean sentiment, the standard variation of its sentiment score and the most important keywords in each community. Words that were common across the entire dataset such as "20mph", "speed", "limit" and "zone" were removed such that only the most common uncommon keywords in each community remained. Regional keywords such as "UK" and "London" were removed, but "Wales" was not as it was believed to be an important community topic due to its contextual saliency for the time period of the data set.

Amongst these communities, there is some size variation observable - the largest community, Community 0, had 662 members, while the next, Community 1, had 479 members. In this sense, despite the discussion being focused on policy discussion, polarised crowds was not found - instead, the topology of the network more closely reflected community clusters, each one a medium sized group with its own influencers and audience.

Furthermore, there is also limited variation in sentiment scores across the communities, with negativity generally being demonstrated - the highest mean sentiment score was 0.0 in Community 0 and Community 4, while Community 3 has the lowest mean sentiment score of -0.54. It was also found that 2 of the communities had a standard deviation sentiment score of 0.0, reflecting low diversity of opinion, while Community 6, with the highest standard deviation sentiment score of 0.5, reflected broader diversity than those other communities.

One reason for this finding could be due to the large proportion of “retweets” in the dataset as opposed to “unique” tweets - since a large number of these tweets are essentially identical, then little variation can be found in them. Nonetheless, while these communities may rally around certain, popular tweets, as Lundgaard and Etter (2022) write, the act of retweeting is itself still interaction, even indicating agreement with the original tweet, so a low standard deviation sentiment score is still a significant and meaningful finding.

Finally, removing common words from each community suggested some pattern of topical hubs. Although these communities were discussing the 20mph speed limit policy, the keywords in Community 5 suggest attention was placed on drivers, cyclists and cities, while Community 3 and Community 7 reflect a more regional orientation with their mentions of Wales. Another pair of interest is Community 1, which shows the saliency of the keyword “Conservative” while Community 3 saw the keyword “Labour”. It is possible that these two communities reflect opposing discussions without interaction, but it is not a strong enough case for the presence of polarised crowds - even though they are respectively the second and third largest communities after Community 0, they are still only two smaller groups in a network of several others. Further investigation may reveal otherwise, but these findings show a topology of community clusters, reflecting the definition provided by Smith et al., (2014), where a common subject sees a diversity of angles based on its relevance to different audiences.

In other words, the first hypothesis of finding polarisation is disproved.

However, a lack of obvious polarisation in local policy discourse is not necessarily a bad thing - optimistically, it may suggest that users holding one perspective are likely to engage with others holding alternative perspectives, and the community boundaries reflect more openness and fluidity since users are not restricted to discussion within an “echo-chamber” such as the ones identified by Smith et al., (2014), which is positive news for scholars on deliberative theory. One possible reasoning for this finding might be due the dataset’s limitation, being restricted to data collected only over a handful of days where topical impact from news events can be at its highest, although the examples of polarised crowds identified in national policy discussion provided by Smith et al., were also based on data collected from a limited number of days. Critically, there is the possibility that local policy

discussions on Twitter is less polarised than those about national policy, and further research based on a comparison of similar topic may prove to be more insightful.

6.2.2. Opinion Leadership

The second hypothesis proposed the presence of opinion leaders within these discussions.

H2: Opinion leaders can be identified based on the presence of influential nodes with high levels of centrality.

Of the 6,988 data points, 5,388 of them were connected nodes. The mean degree centrality score is 0.000463, with a standard deviation of 0.003073, indicating that some variation exists amongst the nodes. The median score was 0.000187, with 75% of nodes having a degree centrality score of 0.000375 or less. The highest value was 0.133970 - in other words, most nodes have a low degree of centrality, with only a few nodes having a significantly higher value. This is visible from the logarithmic frequency distribution chart in Figure 2, as most nodes were clustered on the left hand side of the chart with a few nodes creating a long tail on the right, reflecting a strong positive skew and a preference for connection to popularity (Light & Moody, 2020).

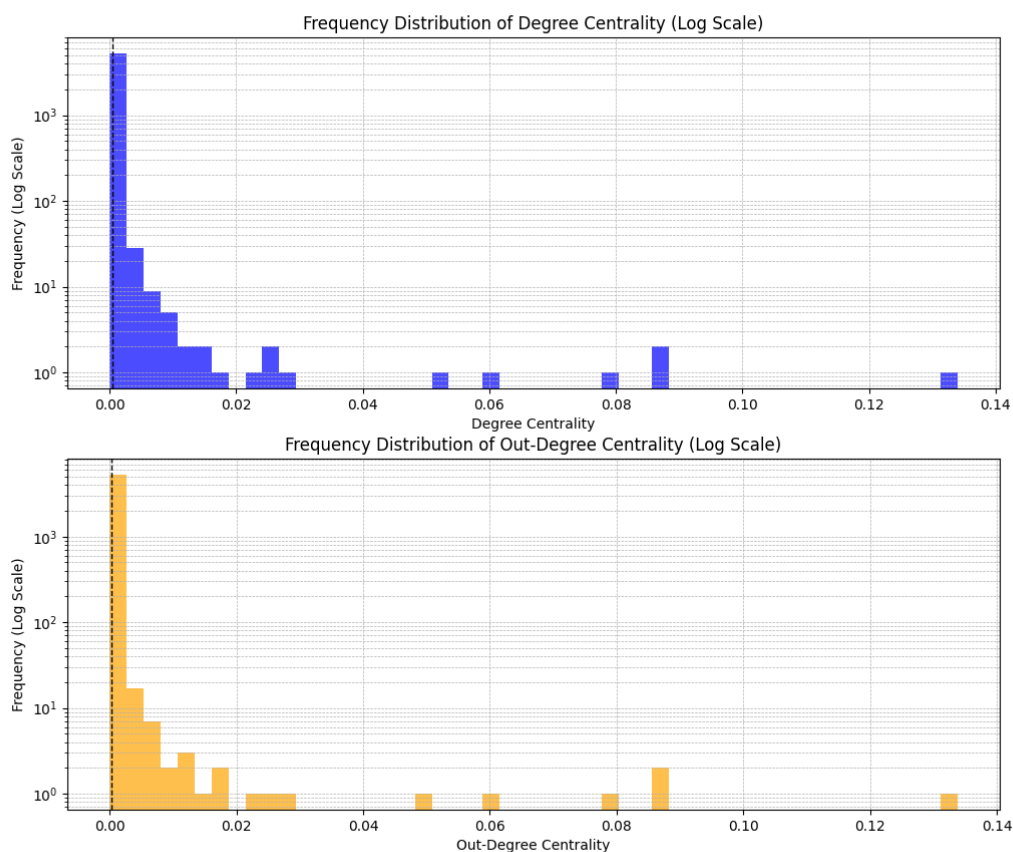


Figure 2. Logarithmic frequency distribution charts for degree centrality and out-degree centrality

The network model graph in Figure 1. shows a similar story, where a few nodes are centrally located in comparison to the rest of the nodes. However, since a basic degree centrality

graph is undirected by default, the out-degree centrality was calculated as well to corroborate these findings. As mentioned previously, edge direction is important in this context because whether a node is being mentioned or if they were the ones mentioning other nodes has an impact on the meaningfulness of its centrality.

The findings from out-degree centrality reflect a similar story. The mean score is 0.000232, with a standard deviation of 0.0003043. However, the median out-degree centrality score was 0.000000, with 75% of nodes with a score of 0.000187 or less. Likewise, the highest score was 0.133783. Degree centrality and out-degree centrality were found to be strongly correlated ($r = .995$, $p < .001$), suggesting that the centres of networks and subnetworks were *influencers*, not the influenced.

As such, these results resonate with the findings by Weeks et al., (2017) and Lundgaard and Etter (2022), where the majority of nodes tend to be the influenced, with a minority of nodes being influencers.

A second approach to studying opinion leadership is by using a VoteRank algorithm. Since VoteRank is effectively a different way of looking at the nodes based on a ranking of their importance, intuitively, there ought to be a high level of correlation between VoteRank and degree centrality. VoteRank is an ordinal variable, where the most important node is ranked at the top with the smallest number, 0, so a t -test was run to compare the means of degree centrality between two groups of nodes: nodes with lower VoteRank values (high importance, rank ≤ 10), and nodes with higher VoteRank values (low importance, rank > 10). It was found that the mean degree centrality is significantly different between the two groups of nodes, $t(4.85)$, $p < .001$, thus suggesting that more important nodes had a significantly higher mean degree centrality compared to less important nodes.

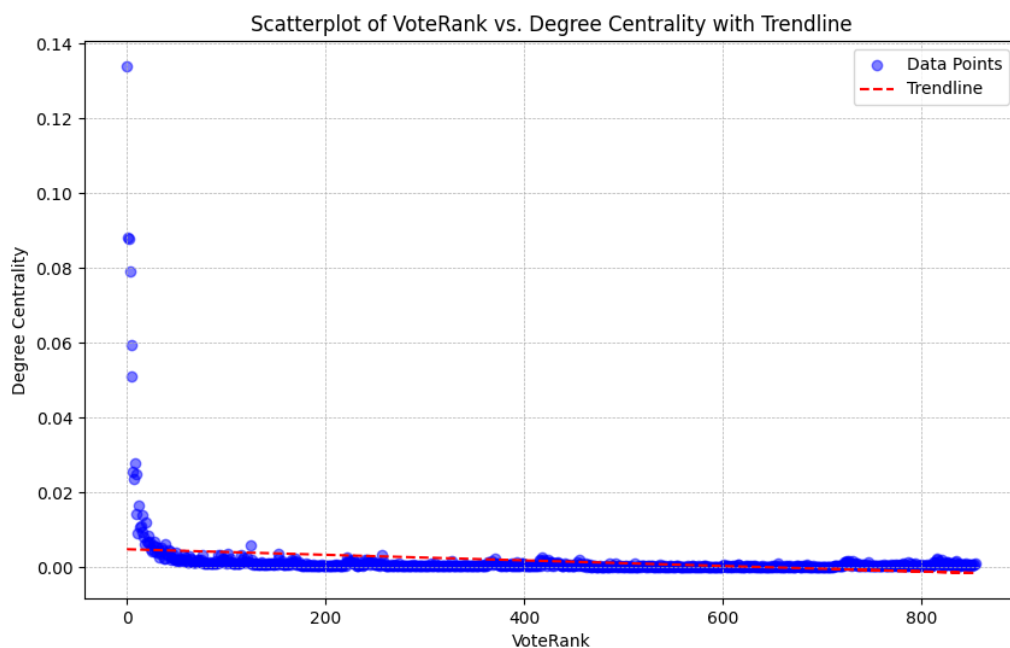


Figure 1.3. Scatterplot diagram showing the relationship between VoteRank and degree centrality

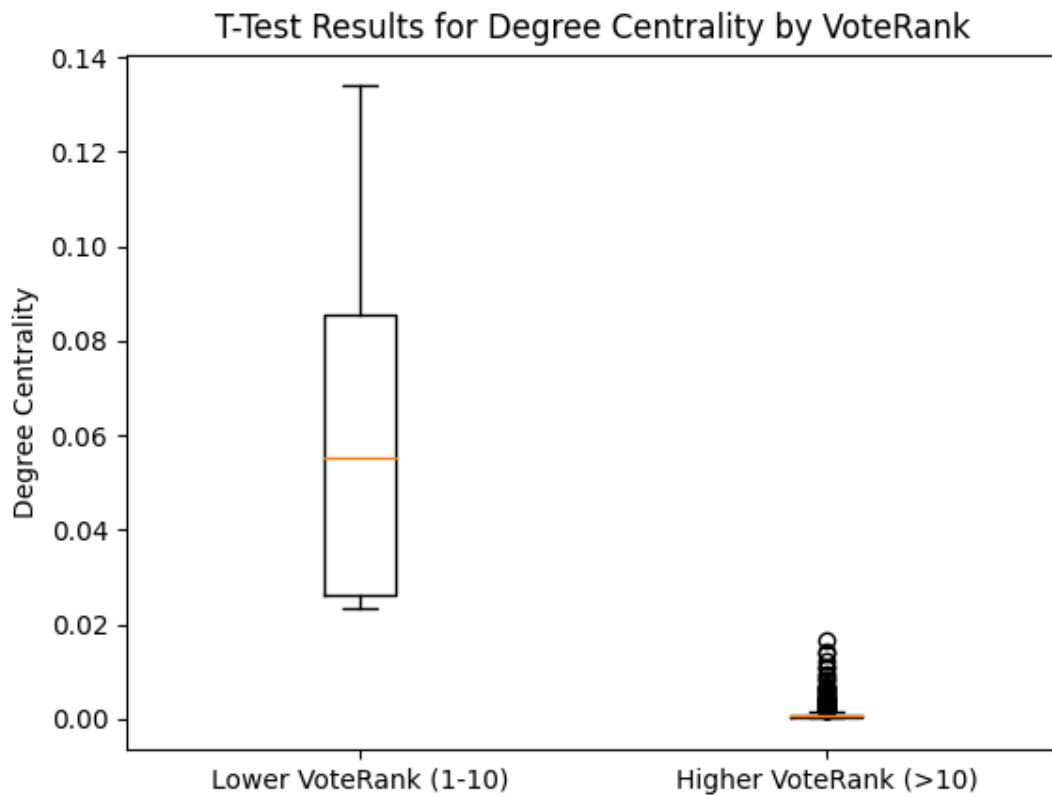


Figure 1.4. Boxplot showing T-test results for degree centrality and vote rank based on VoteRank importance

Likewise, the top nine nodes based on degree centrality are the same as the top nine nodes based on VoteRank, although the bottom four differ slightly in ranking.

Node	VoteRank	Position by VoteRank	Degree Centrality	Position by Degree Centrality
TiceRichard	0.0	1	0.133970	1
AndrewRTDavies	1.0	2	0.088252	2
KEdge23	2.0	3	0.087877	3
reformparty_uk	4.0	5	0.059397	5
boblister_poole	5.0	6	0.051152	6
WelshGovernment	6.0	7	0.025482	8
theJeremyVine	7.0	8	0.023609	10
WelshConserv	8.0	9	0.027918	7
20splentyforus	9.0	10	0.024920	9

Table 6. Top 10 most important nodes. Node at rank 3 has been removed due to irrelevance.

These shows that even at the level of local policy discussions, the presence of some opinion leadership can be identified, providing some support for H2.

At the same time, closer further investigation into this result is warranted. A key premise of deliberative theory is founded on the basis of equality of access, that conversations are not dominated by any particular side or actor. Questions about what constitutes an opinion leader are raised again in this study - for example, should opinion leaders be treated as otherwise “average” citizens that are seeking to persuade their peers? The top nine nodes listed above offer an opportunity for more investigation once a closer look is taken.

Node	Verified Status	Context/Entity
TiceRichard	Yes	Reform party leader and broadcast media presenter
AndrewRTDavies	Yes	Leader of the Welsh conservative party
KEdge23	Yes	-
reformparty_uk	Yes	Political party
boblister_poole	Yes	-
WelshGovernment	Yes	Official Welsh government account
theJeremyVine	Yes	broadcast media presenter
WelshConserv	Yes	Political party
20splentyforus	No	Volunteer organisation

Table 7. Top ten most important nodes with verified status and context information. Node at rank 3 has been removed due to irrelevance.

Based on the table above, four of these nodes either represent the leader of a political party or that political party itself, with one node representing an official government account and another representing a single-policy oriented organisation. Questions about the publicness of space and equality in access surface again - unlike Lundgaard and Etter (2022), positions of centrality in this network are occupied by dominating actors, and the validity of a bottom-up information flow is cast in doubt. In theory, an online space such as Twitter provides an avenue for open participation by mitigating certain traditional constraints, such as geographical restrictions or socialisation from offline political talk (Conover et al., 2002). The findings from this data, however, suggest the influence of political actors in these conversations at the level of local policy, rather than simply conversations amongst citizens.

As a result, local policy discussions on Twitter may more closely reflect a mechanism of top-down information flows by important political actors to citizens, as opposed to an informal gathering of “average citizens” engaged in open discussion, or even top-down information flows from highly informed citizens to less informed ones.

Furthermore, eight out of nine of these nodes have verified status. Verified status has become tricky to pin down over time - the legacy definition gave the blue checkmark to users fitting the criteria of “active, notable and authentic”, but this has since been sunsetted. Today, the checkmark indicates that the user is at least a paid subscriber to Twitter premium (or X Premium). For nodes such as political party leaders or prominent media figures, the verification status is meaningful, but for nodes KEdge23 and boblister_poole that appear to be average users, the verification status raises questions about what it stands for today. On the one hand, they seem to represent the kind of “prosumer” user as written about by Weeks et al., (2017), providing support for the presence of a two-step flow of information

dissemination from these individuals. At the same time, this finding needs to be contextualised against the logic of social media that van Dijck and Poell (2013) described - there is a relationship between algorithmic constructs of what to privilege, and subscribers with premium accounts receive prioritisation in ranking (About X Premium). As such, this puts some doubt on the organic nature of this centrality.

Another insight of interest lies in how the nodes skew conservative on the political spectrum. The politicians and the parties represented both belong to the right, but there is no similar representation by any centrist or left wing political figure. At the same time, the term “labour” ranked highly as a keyword, but “conservative” did not. Furthermore, in Community 3 where the terms “Wales” and “labour” came up as frequent terms, a low sentiment score of -0.56 was also identified, suggesting criticism of the Labour party within that community. The central node in that community is KEdge23, a user with verified status but is not a political actor. Regrettably, without more investigation, it is difficult to draw conclusions about what this suggests for local policy discussions online.

Nonetheless, what stands out here is that even in local policy discussions on twitter, conversations are dominated by actors wielding some degree of political influence, and not by average citizens.

6.2.3. Referentiality

The third hypothesis is interested in examining the affordance of referentiality on Twitter and users’ interaction with it and the kind of links that users may send.

H3: At least 52% of users discussing speed limit policies also share links during their course of exchange.

H3a: If the network structure reflects a polarised crowd, then users on one side of the discussion are more likely to share links to mainstream news sources.

H3b: If the network structure reflects a polarised crowd, then users on the other side of the discussion are more likely to share links to non-mainstream news sources.

To study the most popular links shared, a keyword count based on domain names within the URL fields of each data point was done. Of the 6988 data points in the sample, 1288 links were found - in other words, 18% of all tweets in the data set included a link. A large majority of them were twitter links at 60%, with the remainder 40% being external links at a count of 506, or 7% of all links. A threshold of at least 10 counts for each link was set, and the findings are shown in Table 8.

Furthermore, news articles made up a significant proportion of the remainder of the links shared, resonating with the findings in Oltmann et al., (2020) - although that study was not about “average users” but “rogue accounts with an agenda”, studying the nodes in context revealed that positions of centrality were not occupied by “average users” either, so the comparison remains fair. Of note is that the only major, international publication is [forbes.com](https://www.forbes.com), with a count of just 12. When news were shared, they tended to be local,

regional papers (nation.cymru with 44 instances and walesonline.co.uk with 22 counts). For example, not listed on this table is the BBC, which only had 2 counts. This regional nature lends limited support for the community cluster finding established in the study of the first hypothesis, but the small proportion of incidences relative to the broader data set makes it difficult to conclude whether this is a statistically significant relationship.

Link	Count	Type
twitter.com	782	Twitter
chng.it	159	Petition
nation.cymru	44	News
change.org	26	Petition
walesonline.co.uk	26	News
gov.wales	22	Government
dailypost.co.uk	13	News
forbes.com	12	News

Table 8. Most popular links with a minimum threshold of 10 counts applied.

The most interesting finding is the presence of petition links in this data set - both chng.it and change.org link to the same site, a petition platform, and make up 36% of all outbound links at 185 counts. This confirms that social media such as Twitter has the potential for - and is used for - the kind of connective political action written about by Bennett & Segerberg (2012), thus providing some support for the next hypothesis that online political discussions enables political activity. However, it must again be noted that they are still very much a small proportion of all tweets, and that this count may be influenced by the presence of political actors in central positions in the dataset as found in H2.

Nonetheless, the main hypothesis was disproved, as the proportion of links shared in local policy discussions was much lower than that of the threshold. Furthermore, since polarised crowds were not identified, then H3a and H3b cannot be proven either.

6.2.4. Call-to-Action Language

The fourth and final hypothesis is interested in examining the relationship between political discussion and action by testing for the presence of language that relate to political activity.

H4: At least 14% of users discussing speed limit policies also discuss political participation.

To study the presence of call-to-action political language, a second keyword count was done on the tweet text of each data point. Variations of the words from the keywords list were hard coded in. Language relating to political action appeared a total of 367 times, making up just about 0.1% of all tweets. The threshold set in H4 was 14%.

Although previous studies provided strong evidence for the relationship between discussion and political action, the findings here were not able to substantially reveal that.

Keyword	Count
Petition	158
Donation	116
Vote	61
Campaign	26
Protest	6

Table 9. Keyword search of language relating to political action.

While some users spoke about and shared links to petitions, these individuals make up a tiny proportion of the overall dataset. At best, it demonstrates that the *possibility* of grassroots, connective action is there; at worst, it suggests that the affordance of referentiality is ignored by users in their discussion of local politics.

Hence, the final hypothesis is not supported either.

However, this finding should also be contextualised against the findings in H2 - if discussions are being dominated by political actors, then it is also natural that language about grassroots, citizen action such as “petition” should not surface significantly. The semi-anonymous nature of Twitter also puts it in opposition to the fully anonymous nature of forums studied by Graham and colleagues (2015), and this might offer another reason as to the lack of overt language around political action. While the literature has found some reluctance for participation amongst citizens for the sake of maintaining social cohesion (Hampton et al., 2017), it may be that there is a more complicated relationship between anonymity and participation, with both factors to be regarded as spectrums as opposed to binary absolutes. More research is necessary to explore this satisfactorily.

At the same time, the low count of the keyword “vote” also becomes an interesting finding - if, in a democracy where these political actors receive their authority and mandate from votes, then its lack of mention by these actors suggest a few possibilities for how they interact with other users on the platform. It may reflect a more tactful approach of persuasion that deemphasises the relationship between citizens, politicians, policies and votes. It may also be due to the lack of any upcoming elections, making the use of the word “vote” unimportant. Regardless, this seems to be another area in which further investigation is necessary.

7. Conclusion

7.1. Summary

The primary goal of this research study was to examine the structure and substance of local policy discussions occurring on Twitter and how they compared against the literature about broader political talk online.

In the analysis of structure, two hypotheses were developed - first, it proposed that, like broad political discussions as studied by Smith et al., (2014), local policy discussions about speed limit policies would also reflect polarised crowds of two recognisably distinct discussion groups that do not interact with each other. Using a combination of Label Propagation, sentiment analysis through VADER and keyword count, seven communities were identified instead. The findings more closely reflected a network of community clusters proposed by them, suggesting the formation of smaller discussion groups driven by audience relevance. Next, it tested for the presence of opinion leadership using degree centrality and VoteRank algorithms. This hypothesis was supported by the findings - the discussion in the dataset was dominated by a small minority of influential nodes.

In examining the substance of discussions, two other hypotheses around referentiality and the language of political action were used. Of all the tweets in the data set, only 7% of them included an outbound link elsewhere. Of these links, however, 36% of them linked to a petition page, but as this remains a small proportion of all tweets in the data set, it is difficult to draw a satisfactory conclusion from it. As a whole, the hypothesis for referentiality was not supported. Finally, a keyword count for language of political activity drew a similar finding for the last hypothesis - the data did not reveal a substantial relationship between policy talk and political activity talk.

7.2. Limitations and Reflections

As a starting point for thinking about local policy discourse on Twitter, this study is limited in various aspects. For one, it did not fully consider the criteria of non-tyranny and the expectations that discussions are fair without undue influence in deliberative theory - this is important because as described by Van Dijck and Poell (2013), social media platforms themselves operate with their own logic regarding who can and do shape the boundaries of what a user sees and interacts with. Furthermore, social media platforms are not immune to both internal and external pressures that may also have an impact on the context or content that are shown to users. As described in the literature, worries about the role of bots in hijacking interpersonal conversations or manipulate agendas and frames is non-zero (Kollanyi et al., 2016; Hagen et al., 2022; Bruno et al., 2022), and in treating all users or nodes as equal, the project does not attempt to make a distinction between an “organic” user or a “paid” user, or even one between an “average” citizen or a prominent political actor. This final point is critical for the results of the study, especially since the analysis revealed the strong presence of political actors and “paid” users. Further questions are also raised about the relationship between the presence of language and links towards grassroots political action and the influence of political actors in this study - although such language was only found in a tiny proportion of tweets, is that itself due to such influence? After all, unlike the study by Graham et al., (2015), the semi-anonymous nature of Twitter may disincentivise perceptions of equality in the way anonymous forums might allow. Hence, further study on this intersection is very much necessary.

This study has also made use of aggregated and simplified single-layer data, but an approach utilising a double layer design (with one layer being the relevant tweets identified by a keyword search and a second layer being the authors of each tweet and their follow networks) could provide more granular insight. Defining what opinion leadership means is a

task that itself demands greater scrutiny, and differing definitions might demand differing approaches beyond centrality measures. Where possible, applying alternative network methods that study information diffusion through connectionist approaches on a complete corpus, or information cascades based on hybrid models of degree and content to predict information diffusion can provide for a better understanding of the relevance and mechanisms of opinion leaders within online discussion networks and information flows. With more time, a larger scale study that directly compares online discussions about local, national, and international policy could also help highlight other variations or similarities in discursive patterns.

Furthermore, the findings of this study should also be extended through a qualitative study of the tweets, which can yield valuable insights on participant interactions and expectations. Interviews and close reading of tweets can further an understanding of how discussions occur and the mechanisms for participation or persuasion. In particular, the study of behaviours around policy discourse in online settings through such netnographic methods can help make sense of participant motivations and how online political conversations are perceived, shedding light on certain behaviours like attitudes and reliance (or not) towards tweets from verified users or even the expected outcomes users hold when making a post on Twitter. To some extent, the findings from this data suggests that even at a level of local policy, Twitter functions less like a ground for conversation, but as a place for news seeking and propagation of similar views from political actors. In order to further investigate these claims, qualitative approaches may be necessary.

Despite these limitations, this study has found some evidence that local policy discussions on Twitter may function differently from discussions about broader level politics. The findings here reiterate the importance of situating any study within its context, and finds a case for exploring online discussions at varying policy levels.

8. Bibliography

About X Premium (no date). Available at: <https://help.twitter.com/en/using-twitter/twitter-blue> (Accessed: 10 September 2023).

Bennett, W.L. and Manheim, J.B. (2006) 'The One-Step Flow of Communication', *The ANNALS of the American Academy of Political and Social Science*, 608(1), pp. 213–232. Available at: <https://doi.org/10.1177/0002716206292266>.

Bennett, W.L. and Segerberg, A. (2012) 'The Logic of Connective Action', *Information, Communication & Society*, 15(5), pp. 739–768. Available at: <https://doi.org/10.1080/1369118X.2012.670661>.

Bird, S., Klein, E. and Loper, E. (2009) *Natural Language Processing with Python*. Available at: <https://www.oreilly.com/library/view/natural-language-processing/9780596803346/> (Accessed: 12 September 2023).

Bode, L. (2016) 'Political News in the News Feed: Learning Politics from Social Media', *Mass Communication and Society*, 19(1), pp. 24–48. Available at: <https://doi.org/10.1080/15205436.2015.1045149>.

Bohman, J. (2000) *Public Deliberation*. The MIT Press. Available at: <https://mitpress.mit.edu/9780262522786/public-deliberation/> (Accessed: 30 May 2023).

boyd, danah (2014) *It's Complicated: The Social Lives of Networked Teens*. Yale University Press. Available at: <https://www.jstor.org/stable/j.ctt5vm5gk> (Accessed: 31 May 2023).

boyd, danah m. and Ellison, N.B. (2007) 'Social Network Sites: Definition, History, and Scholarship', *Journal of Computer-Mediated Communication*, 13(1), pp. 210–230. Available at: <https://doi.org/10.1111/j.1083-6101.2007.00393.x>.

Brin, S. and Page, L. (1998) 'The anatomy of a large-scale hypertextual Web search engine', *Computer Networks and ISDN Systems*, 30(1), pp. 107–117. Available at: [https://doi.org/10.1016/S0169-7552\(98\)00110-X](https://doi.org/10.1016/S0169-7552(98)00110-X).

Bruno, M., Lambiotte, R. and Saracco, F. (2022) 'Brexit and bots: characterizing the behaviour of automated accounts on Twitter during the UK election', *EPJ Data Science*, 11(1), pp. 1–24. Available at: <https://doi.org/10.1140/epjds/s13688-022-00330-0>.

Carpini, M., Cook, F. and Jacobs, L. (2004) 'Public Deliberation, Discursive Participation, and Citizen Engagement: A Review of the Empirical Literature', *Annual Review of Political Science*, 7, pp. 315–344. Available at: <https://doi.org/10.1146/annurev.polisci.7.121003.091630>.

Conover, P.J., Searing, D.D. and Crewe, I.M. (2002) 'The Deliberative Potential of Political Discussion', *British Journal of Political Science*, 32(1), pp. 21–62.

Dahl, R.A. (1989) *Democracy and Its Critics*. Yale University Press.

Eveland, Jr., W.P. (2004) 'The Effect of Political Discussion in Producing Informed Citizens: The Roles of Information, Motivation, and Elaboration', *Political Communication*, 21(2), pp. 177–193. Available at: <https://doi.org/10.1080/10584600490443877>.

Eveland Jr., W.P. and Hively, M.H. (2009) 'Political discussion frequency, network size, and heterogeneity of discussion as predictors of political knowledge and participation', *Journal of Communication*, 59, pp. 205–224. Available at: <https://doi.org/10.1111/j.1460-2466.2009.01412.x>.

Eveland Jr., W.P., Morey, A.C. and Hutchens, M.J. (2011) 'Beyond Deliberation: New Directions for the Study of Informal Political Conversation from a Communication Perspective', *Journal of Communication*, 61(6), pp. 1082–1103. Available at: <https://doi.org/10.1111/j.1460-2466.2011.01598.x>.

Fung, A. (2007) 'Minipublics: Deliberative Designs and Their Consequences', in S.W. Rosenberg (ed.) *Deliberation, Participation and Democracy: Can the People Govern?* London:

Palgrave Macmillan UK, pp. 159–183. Available at:
https://doi.org/10.1057/9780230591080_8.

Gil de Zúñiga, H., Valenzuela, S. and Weeks, B. (2016) 'Motivations for Political Discussion: Antecedents and Consequences on Civic Engagement: Motivations for Political Discussion', *Human Communication Research*, 42. Available at: <https://doi.org/10.1111/hcre.12086>.

Graham, T. (2015) 'Everyday political talk in the internet-based public sphere', in, pp. 247–263. Available at: <https://doi.org/10.13140/RG.2.1.1217.5524>.

Graham, T., Jackson, D. and Wright, S. (2015) 'From everyday conversation to political action: Talking austerity in online "third spaces"', *European Journal of Communication*, 30(6), pp. 648–665. Available at: <https://doi.org/10.1177/0267323115595529>.

Graham, T. and Wright, S. (2014) 'Discursive Equality and Everyday Talk Online: The Impact of "Superparticipants"', *Journal of Computer-Mediated Communication*, 19(3), pp. 625–642. Available at: <https://doi.org/10.1111/jcc4.12016>.

Gregson, K. (1998) 'Conversation and Community or Sequential Monologues: An Analysis of Politically Oriented Newsgroups', *Proceedings of the ASIST Annual Meeting*, 35, pp. 531–41.

Hagberg, A.A., Schult, D.A. and Swart, P.J. (2008) 'Exploring Network Structure, Dynamics, and Function using NetworkX', in. *Proceedings of the 7th Python in Science Conference (SciPy2008)*. Available at: https://conference.scipy.org/proceedings/SciPy2008/paper_2/ (Accessed: 11 August 2023).

Hagen, L. *et al.* (2022) 'Rise of the Machines? Examining the Influence of Social Bots on a Political Discussion Network', *Social Science Computer Review*, 40(2), pp. 264–287. Available at: <https://doi.org/10.1177/0894439320908190>.

Hamilton, K. *et al.* (2014) 'A path to understanding the effects of algorithm awareness: 32nd Annual ACM Conference on Human Factors in Computing Systems, CHI EA 2014', *CHI EA 2014: One of a CHIInd - Extended Abstracts, 32nd Annual ACM Conference on Human Factors in Computing Systems*, pp. 631–640. Available at: <https://doi.org/10.1145/2559206.2578883>.

Hampton, K.N., Shin, I. and Lu, W. (2017) 'Social media and political discussion: when online presence silences offline conversation', *Information, Communication & Society*, 20(7), pp. 1090–1107. Available at: <https://doi.org/10.1080/1369118X.2016.1218526>.

Highfield, T. (2016) *Social Media and Everyday Politics* | Wiley. polity. Available at: <https://www.wiley.com/en-gb/Social+Media+and+Everyday+Politics-p-9780745691343> (Accessed: 2 June 2023).

Himmelboim, I. *et al.* (2017) 'Classifying Twitter Topic-Networks Using Social Network Analysis', *Social Media + Society*, 3(1), p. 2056305117691545. Available at: <https://doi.org/10.1177/2056305117691545>.

Hummon, N. and Doreian, P. (2003) 'Some Dynamics of Social Balance Processes: Bringing Heider Back Into Balance Theory', *Social Networks*, 25, pp. 17–49. Available at: [https://doi.org/10.1016/S0378-8733\(02\)00019-9](https://doi.org/10.1016/S0378-8733(02)00019-9).

Hutto, C. and Gilbert, E. (2014) 'VADER: A Parsimonious Rule-Based Model for Sentiment Analysis of Social Media Text', *Proceedings of the International AAAI Conference on Web and Social Media*, 8(1), pp. 216–225. Available at: <https://doi.org/10.1609/icwsm.v8i1.14550>.

Jackson, S.W., Todd Graham, Dan (2015) 'Third Space, Social Media, and Everyday Political Talk', in *The Routledge Companion to Social Media and Politics*. Routledge.

Jenkins, J. and Nielsen, R.K. (2018) 'The digital transition of local news', *Reuters Institute for the Study of Journalism* [Preprint]. Available at: <https://ora.ox.ac.uk/objects/uuid:f1f8876e-a100-4c20-9f87-3f380630fe92> (Accessed: 31 May 2023).

Johnson, R.B. and Onwuegbuzie, A.J. (2004) 'Mixed Methods Research: A Research Paradigm Whose Time Has Come', *Educational Researcher*, 33(7), pp. 14–26. Available at: <https://doi.org/10.3102/0013189X033007014>.

Katz, E. and Lazarsfeld, P.F. (1955) *Personal influence: the part played by people in the flow of mass communications*. New York, NY, US: Free Press (Personal influence: the part played by people in the flow of mass communications), pp. xx, 400.

Kollanyi, B., Howard, P.N. and Woolley, S.C. (2016) *Bots and Automation over Twitter during the First U.S. Presidential Debate*. COMPROM DATA MEMO. Available at: <https://demotech.oii.ox.ac.uk/research/posts/bots-and-automation-over-twitter-during-the-u-s-election/> (Accessed: 1 June 2023).

Kozinets, R. (2020) *Netnography: The Essential Guide to Qualitative Social Media Research*. 3rd edn. Sage.

Leong, C. et al. (2019) 'Social media empowerment in social movements: power activation and power accrual in digital activism', *European Journal of Information Systems*, 28(2), pp. 173–204. Available at: <https://doi.org/10.1080/0960085X.2018.1512944>.

Light, E. by R. and Moody, J. (eds) (2020) *The Oxford Handbook of Social Networks*. Oxford, New York: Oxford University Press (Oxford Handbooks).

Lundgaard, D. and Etter, M. (2023) 'Everyday Talk on Twitter: Informal Deliberation About (Ir-)responsible Business Conduct in Social Media Arenas', *Business & Society*, 62(6), pp. 1201–1247. Available at: <https://doi.org/10.1177/00076503221139838>.

Lupia, A. and Sin, G. (2003) 'Which Public Goods are Endangered?: How Evolving Communication Technologies Affect The Logic of Collective Action', *Public Choice*, 117(3), pp. 315–331. Available at: <https://doi.org/10.1023/B:PUCH.0000003735.07840.c7>.

Mansbridge, J. (1999) 'Should Blacks Represent Blacks and Women Represent Women? A Contingent "Yes"', *The Journal of Politics*, 61(3), pp. 628–657. Available at: <https://doi.org/10.2307/2647821>.

Matters, T. for L. | E.J. (no date b) *Vision Zero for London, Transport for London*. Available at: <https://www.tfl.gov.uk/corporate/safety-and-security/road-safety/vision-zero-for-london> (Accessed: 31 May 2023).

Mendelberg T. (2002) 'The deliberative citizen: theory and evidence.', in MX Delli Carpini, L Huddy, R Shapiro, *Research in Micropolitics: Political Decisionmaking, Deliberation and Participation*. Greenwich, CT: JAI Press, p. 6:151-93.

Mutz, D.C. (2002) 'The Consequences of Cross-Cutting Networks for Political Participation', *American Journal of Political Science*, 46(4), pp. 838–855. Available at: <https://doi.org/10.2307/3088437>.

Mutz, D.C. (2006) *Hearing the Other Side: Deliberative versus Participatory Democracy*. Cambridge: Cambridge University Press. Available at: <https://doi.org/10.1017/CBO9780511617201>.

Norman, D. (1998) *The Design of Everyday Things*. The MIT Press. Available at: <https://mitpress.mit.edu/9780262640374/the-design-of-everyday-things/> (Accessed: 31 May 2023).

Oltmann, S.M., Cooper, T.B. and Proferes, N. (2020) 'How Twitter's affordances empower dissent and information dissemination: An exploratory study of the rogue and alt government agency Twitter accounts', *Government Information Quarterly*, 37(3), p. 101475. Available at: <https://doi.org/10.1016/j.giq.2020.101475>.

Ottovordemgentschenfelde, S. (2017) "'Organizational, professional, personal": An exploratory study of political journalists and their hybrid brand on Twitter', *Journalism*, 18(1), pp. 64–80. Available at: <https://doi.org/10.1177/1464884916657524>.

Perren, R. and Kozinets, R. (2017) 'Lateral Exchange Markets: How Social Platforms Operate in a Networked Economy', *Journal of Marketing*, 82. Available at: <https://doi.org/10.1509/jm.14.0250>.

Rainie, L. and Wellman, B. (2012) *Networked: The New Social Operating System*. The MIT Press. Available at: <https://www.jstor.org/stable/j.ctt5vjg62> (Accessed: 31 May 2023).

Schmitt-Beck, R. and Grill, C. (2020) 'From the Living Room to the Meeting Hall? Citizens' Political Talk in the Deliberative System', *Political Communication*, 37(6), pp. 832–851. Available at: <https://doi.org/10.1080/10584609.2020.1760974>.

Schudson, M. (1997) 'Why conversation is not the soul of democracy', *Critical Studies in Mass Communication*, 14(4), pp. 297–309. Available at: <https://doi.org/10.1080/15295039709367020>.

Shah, D. *et al.* (2005) 'Information and Expression in a Digital Age: Modeling Internet Effects on Civic Participation', *Communication Research - COMMUN RES*, 32, pp. 531–565. Available at: <https://doi.org/10.1177/0093650205279209>.

Smith, M. a *et al.* (2014) 'Mapping Twitter Topic Networks: From Polarized Crowds to Community Clusters', *Pew Research Center: Internet, Science & Tech*, 20 February. Available at: <https://www.pewresearch.org/internet/2014/02/20/mapping-twitter-topic-networks-from-polarized-crowds-to-community-clusters/> (Accessed: 24 May 2023).

Valenzuela, S., Kim, Y. and Gil de Zúñiga, H. (2012) 'Social Networks that Matter: Exploring the Role of Political Discussion for Online Political Participation', *International Journal of Public Opinion Research*, 24(2), pp. 163–184. Available at: <https://doi.org/10.1093/ijpor/edr037>.

Van Dijck, J. and Poell, T. (2013) 'Understanding Social Media Logic', *Media and Communication*, 1, pp. 2–14. Available at: <https://doi.org/10.12924/mac2013.01010002>.

Weeks, B.E., Ardèvol-Abreu, A. and Gil de Zúñiga, H. (2017) 'Online Influence? Social Media Use, Opinion Leadership, and Political Persuasion', *International Journal of Public Opinion Research*, 29(2), pp. 214–239. Available at: <https://doi.org/10.1093/ijpor/edv050>.

Wellman, B. (2002) 'Little Boxes, Glocalization, and Networked Individualism', in M. Tanabe, P. van den Besselaar, and T. Ishida (eds) *Digital Cities II: Computational and Sociological Approaches*. Berlin, Heidelberg: Springer (Lecture Notes in Computer Science), pp. 10–25. Available at: https://doi.org/10.1007/3-540-45636-8_2.

Wittel, A. (2001) 'Toward a Network Sociality', *Theory, Culture & Society*, 18(6), pp. 51–76. Available at: <https://doi.org/10.1177/026327601018006003>.

Wojcieszak, M.E. and Mutz, D.C. (2009) 'Online Groups and Political Discourse: Do Online Discussion Spaces Facilitate Exposure to Political Disagreement?', *Journal of Communication*, 59(1), pp. 40–56. Available at: <https://doi.org/10.1111/j.1460-2466.2008.01403.x>.

Wyatt, R.O., Katz, E. and Kim, J. (2000) 'Bridging the Spheres: Political and Personal Conversation in Public and Private Spaces', *Journal of Communication*, 50(1), pp. 71–92. Available at: <https://doi.org/10.1111/j.1460-2466.2000.tb02834.x>.

Zhang, J.-X. *et al.* (2016) 'Identifying a set of influential spreaders in complex networks', *Scientific Reports*, 6(1), p. 27823. Available at: <https://doi.org/10.1038/srep27823>.

Appendix

Attached as an appendix to this paper is a zip file containing the python code used for analysis as well as the corresponding corpus saved as a JSON file. Included is a README file explaining all items in the file and their use.

Due to the size of the file, it has to be downloaded from [this link](#). Access should be available to anyone in the Birkbeck organisation

A guide to reproduce data and ease code navigation is provided below.

To reproduce the CSV files used;
do the following in `twitter_network_main_code.py`

combined_tweets.csv	run json_to_csv
<code>deg_cent_dir.csv</code>	<code>run get_centrality_data</code>
<code>deg_out_cent.csv</code>	<code>run get_centrality_data</code>
<code>voterank.csv*</code>	<code>run get_centrality_data</code>
<code>links.csv</code>	<code>uncomment lines 769 - 771</code>
<code>keywords.csv</code>	<code>uncomment lines 784 - 786</code>

*Note that for `voterank.csv`, a second column titled “Rank” needs to be manually added for related code to run.

To calculate descriptive statistics in Table 1;
`run get_descriptive_statistics():` in `twitter_network_main_code.py`

To reproduce visualisation in Figure 1;
`run visualize_network(G_undirected):` in `tweet_network_analysis.py`

To calculate layout fit used in visualisation in Figure 1;
`print(layout_fits)` in `tweet_network_analysis.py`

To calculate descriptive statistics for sentiment analysis in Table 2;
`run get_sentiment_scores():` in `twitter_network_main_code.py`

To calculate keyword counts across corpus in Tables 3 and 4;
`run get_keywords_stats():` in `twitter_network_main_code.py`

To calculate communities with sentiment scores and keywords in Table 5;
`run get_community_data():` in `twitter_network_main_code.py`

To calculate degree centrality and out degree centrality with descriptive statistics in 6.2.2.;;
`run degree_desc` and `out_degree_desc` in `Network_Calculations.py`

To reproduce logarithmic frequency distribution charts in Figure 1.2;
uncomment lines 45 and 46 to print graph.

To reproduce scatterplot diagram in Figure 1.3;
run `def scatterplot_vrdc():` in `Network_Calculations.py`

To reproduce boxplot diagram in Figure 1.4;
run `def boxplot_vr_degcen():` in `Network_Calculations.py`

To calculate table of influential nodes in Table 6;
`print(final_table_df)` in `Network_Calculations.py`

The data in Table 7 was manually checked, so no code is available.

Please let me know if the code has broken somewhere.