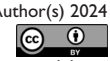
Article

new media & society
1–21



DOI: 10.1177/14614448241274456
journals.sagepub.com/home/nms


Offline connections, online votes: The role of offline ties in an online public election

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Abstract

Building democratic communities and fostering inclusive participation is challenging, especially in participatory organisations where governance and sustained contributions are critical. This study explores the dynamics of election participation within the peer-production project Wikipedia, a prime example of an online collaboration model of democratic organisation where democratically elected administrators wield special rights. While previous research on online governance has predominantly focused on online interactions, this study shifts the spotlight to the influence of offline interactions occurring at various gatherings and meetings. Using fixed effects models and large-scale observational data spanning 20 years of offline and online actions, this study finds significant effects of offline meeting participation on users' voting behaviour. It makes use of novel data sources to emphasise the significance of offline relationships in shaping online (democratic) processes and shows that traditional findings of political science and election research regarding social capital and social networks hold within an online context.

Keywords

Friends-and-neighbours-effect, governance, online community, online election, public election, request for adminship, social capital, social network, voting process, Wikipedia

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Introduction

Voting serves as a fundamental pillar of democratic societies: it enables individuals to express their preferences, shape policy outcomes and hold their representatives accountable. From large-scale anonymous elections to smaller public assemblies like town meetings, voting takes place in various forms. Online communities, a phenomenon facilitated by the advent of new media in recent decades, face significant governance challenges when trying to determine, for example, who should set policies or what content should be permitted (Schneider et al., 2021). To address these challenges, online communities often also use online polls and elections to negotiate and decide on new rules, as well as new platform moderators or administrators.

One example of a virtual community which employs democratic governance structures is the online encyclopaedia Wikipedia. Wikipedia functions as a source of information to the general public, is a participatory organisation and one of the few successful examples of peer-production (Foote et al., 2023). It exemplifies the transformative impact of new media on knowledge production and dissemination and is, as of today, one of the most visited websites worldwide. Wikipedia is not only an encyclopaedia, but the editors surrounding Wikipedia have become a community (e.g. Konieczny, 2009b; Pentzold, 2011). This community operates through a sophisticated democracy among its active volunteers which is a comparatively rare occurrence in online networks (Schneider, 2022) and features so-called *Requests for Adminship* where registered users express their vote in a public space to decide whether nominated others should be granted special rights (see also Rijshouwer et al., 2023). Peer-production communities like Wikipedia have been described as deeply democratic by some (Benkler, 2006; Konieczny, 2009a; Morell, 2012; Wright, 2010), arguing that the employed technologies allow for avoiding top-down bureaucratic control featuring flatter hierarchies and more discursive norms (e.g. Bennett and Segerberg, 2013) with a trend towards emergent, shared leadership (Zhu et al., 2012). However, at the same time, empirical research has shown that extreme hierarchies, social differentiation, bureaucratic processes and deep inequalities exist and suggested that peer-production projects might not fulfil democratic ideals (Forte et al., 2009; Kittur et al., 2007; Matei and Britt, 2017: Chapter 3; Ortega et al., 2008; Panciera et al., 2009; Shaw, 2012; Shaw and Hill, 2014).

In this study, I will take Wikipedia as an example and make use of its detailed records of one direct participatory democratic activity, requests for adminship, to test the extent to which classical findings of political science hold within this context (see for similar contributions, e.g. Brekke et al., 2021; Forestal, 2017; Frey et al., 2019). These records provide a unique opportunity to test and expand established theories in a digital participatory setting where online behaviour is informative and salient. Specifically, the theories underpinning this study are rooted in social capital and network theory and I will test whether a 'friends-and-neighbours-effect' (see, e.g. Campbell et al., 2019; Key and Heard, 1949) exists in a digital context removed from geographical districts. This study explores the role of a person's social network within their voting behaviour, which is one aspect highlighted in continuing research efforts within political science aimed at explaining voting behaviour (see for an overview Campbell, 2013).

Wikipedia is primarily recognised as an online encyclopaedia with online interactions. However, it encompasses a noteworthy offline component: Wikipedia is characterised by regular local offline meetups which give editors the chance to get to know each other. These offline interactions are an understudied facet of online communities generally (Sessions, 2010) albeit they enrich online relationships by providing social contacts and personal exchange (Richter, 2020: 132–136). This study asks to what extent offline engagement can enhance democratic participation, disentangling the role of offline and online interactions. This aspect is crucial because offline relationships can turn mere online encounters into deeper and multiplex relationships. However, an interplay between users' offline meeting attendance and their subsequent online behaviour can lead to concerns regarding the democratic nature of the platform as these meetings are rather selective in their attendees (Schwitter, 2022). In terms of online interactions, previous research has shown that there is a relationship between users' shared online ties – such as having co-edited an article together or having undone each other's edits – and their voting behaviour in later elections (Jankowski-Lorek et al., 2013; Turek et al., 2011); this study will now extend previous research to include users' offline networks.

This interplay of offline and online activities extends beyond Wikipedia: in recent years, many work and participatory organisations have enhanced virtual team working using digital infrastructures like Slack or GitHub, and they use digital media for coordination and engagement (Pazos et al., 2013). Technical characteristics and the changing dynamic of offline and online interaction can enable or limit collective actions in collaborative work (Anders, 2016; Lanubile et al., 2010; Larson and DeChurch, 2020). By understanding the dynamics of offline and online interactions, this work provides valuable lessons for fostering democratic participation and effective community-scale self-governance in a variety of digital and hybrid organisational contexts. Against this background, this study will take Wikipedia as an example and ask how offline social relationships influence democratic voting behaviour, basing the theoretical approach on the rich body of political science literature.

Understanding the role of offline ties in online elections

There is a long history of research on voting behaviour: since the classical, prominent study by Lazarsfeld et al. (1944), researchers have tried to explain the real-world decision to vote. Lazarsfeld et al. (1944) conducted surveys on individual voting in presidential elections and identified the information flow through networks of interpersonal communication as a decisive factor: '[. . .] face-to-face contacts turned out to be the most important influences stimulating opinion change' (p. xiii). Most existing research has since confirmed that social influences play a decisive role in voting: observational and experimental studies have shown how the decisions of if and how to vote can be affected by people in one's social network such as family and household members, friends and co-workers (see, e.g. Bond et al., 2012; Huckfeldt, 2003; Huckfeldt and Sprague, 1991; Kenny, 1992; McClurg, 2004; Nickerson, 2008; Pattie and Johnston, 2000; Santoro and Beck, 2016). Many previous studies have shown that formal – such as memberships in association or religious communities – as well as informal networks

– such as with family, friends and neighbours – play a significant role in explaining and understanding political participation (Fieldhouse and Cutts, 2012; Giles and Dantico, 1982; Huckfeldt, 1979; Lim, 2008; McClurg, 2003; Putnam, 2000; Verba et al., 1995; see for an overview also Campbell, 2013). Presently, voting tends to be considered a social act partly driven by the social context of the voter (Bhatti and Hansen, 2012). Democratic theory also provides a broader framework for understanding collective decision-making and participation within different organisational contexts. Lipset et al. (1956) were among the first to emphasise the role of democratic practices in non-traditional political environments such as unions, workplaces and voluntary organisations (see also Michels, 1911). These contexts reveal how democratic principles can be applied and understood within various organisational structures. This perspective is crucial for analysing participatory democracy within online communities, where governance dynamics can reflect similar patterns.

In contrast to classical elections and democratic structures, governance and voting within online communities are much younger phenomena. Nevertheless, there is considerable research on both the general governance structure as well as elections in particular within Wikipedia. In the following section, I will build upon previous research on real-world elections, apply them to the online context, derive testable hypotheses and discuss previous research on Wikipedia regarding two different explananda: **v**oting in elections (hypotheses V) and voting supportively, that is, voting **p**ro, in elections (hypotheses P).

Voter–candidate relationship

This section will focus on the *voter* and their relationship to the candidate. A direct relationship from a user to the candidate might make the user more likely to vote. This follows from perceived obligations to support friends: trust and obligations are key to social capital (Coleman, 1990; Putnam, 2000). As the voting process on Wikipedia is public, candidates know who voted and who supported them so that it is visible whether their friends and acquaintances have fulfilled their expectations; there thus can be a certain pressure to vote. Beyond Wikipedia, there is a well-documented friends-and-neighbours-effect, which shows candidates in various electoral settings receive more electoral support in and around their hometown area (see, e.g. Campbell et al., 2019; Key and Heard, 1949). Using survey experiments, Campbell et al. (2019) find that local roots allow voters to make inferences about politicians' actions. This argumentation can also hold in the context of Wikipedia: voting for a user one knows reduces the uncertainty as one better knows what to expect. Generally, if two users have met, they have more information about one another and can thus also be more likely to cast an informed vote (without needing to incur extra costs by collecting information via other avenues).

In this study, I will test whether meetup ties lead to an increase in the probability of voting at all, and whether meetup ties influence the probability of voting supportively (assuming positive interactions at offline meetings):

Hypothesis V1: The probability of voting increases if the user knows the candidate, that is, they have attended a meeting together.

Hypothesis P1: The probability of voting supportively increases if the user knows the candidate, that is, they have attended a meeting together.

Turek et al. (2011) and Jankowski-Lorek et al. (2013) model the election process on the Polish-language Wikipedia using a multidimensional social network. They find positive effects of co-editing, while having a shared revert history leads to opposing votes. There is only weak evidence that discussion interactions matters.

When voting, users assess whether a candidate is a good fit for the position. This assessment can, on one hand, be a simple assessment of whether the candidate fulfils certain criteria. On the other hand, it can also be a relative assessment in which the attributes of a candidate are compared to the voters themselves. Whether a positive vote will be cast is then not a function of just the candidate alone, but a function of both the candidate and the voter and their relation to each other (Leskovec et al., 2010). I assume that candidates who fare better on this relative assessment are more likely to be supported as voters search for the most qualified users to become administrators. Attending meetings can be a signal of candidates to highlight their stronger commitment to Wikipedia. Centrality of a user within the offline network can be understood as a signal of commitment and power and might function as an indicator of a candidate's quality. Given this reasoning, I assume, and it has been shown (by Oppong-Tawiah et al., 2016; Picot-Clémenté et al., 2015), that being strongly embedded within other users makes a candidate more probable to be successful in their candidacy. Taken together, I expect that the centrality of users is also assessed in relative terms:

Hypothesis P2: The probability of voting supportively increases the more central the position of a candidate in the offline network in comparison to the position of the user.

Leskovec et al. (2010) analysed the assessment strategies of voters on Wikipedia. Certain forms of relative assessments have shown to matter in their analysis. Positive votes were observed to be more probable when a nominee has a greater number of edits and/or a greater number of awards than the voter.

Voter–voter relationship

Voting is described to be a social experience with people sharing political decisions, discussing them and often voting together (Unt et al., 2017). People discuss their political attitudes within their networks which can shape their individual choices (Pattie and Johnston, 2001). Ties can help diffuse information on how to get involved and the current state of the political sphere (Knoke, 2004; McClurg, 2003). Sinclair (2012) pointed out how basic political acts are subject to social pressures: others in a social network notice and might conform to expressions of political opinion, particularly if conformity is likely to be highly visible. The social network can matter as the group can instil shared attitudes that drive the given behaviour, or a desire to conform to the dominant group behaviour (Bhatti and Hansen, 2012).

The voting process on Wikipedia can be observed by everyone, and it can be argued that observing friends who are voting can highlight one's duty to also vote (Verba et al., 1995); social interactions can have a mobilising effect (Rosenstone and Hansen, 1993). Get-out-the-vote studies have shown how such pressures and interpersonal voter contact can increase turnout (see, e.g. Gerber et al., 2008; Gerber and Green, 2000). These studies have focused on secret ballot voting; when such effects exist in secrecy, it can be assumed that they are even stronger in public (Manin, 2015). In addition, public votes can reduce the cost of information: a potential voter might be able to get information about the election directly from their voting contact or trust their decision altogether without needing additional information. This leads to the following hypotheses:

Hypothesis V2: The more other voters a user knows, the greater will be their probability of voting.

Hypothesis P3: The more other voters who vote supportively a user knows, the greater will be their probability of voting supportively.

Hypothesis P4: The more other voters who vote opposingly a user knows, the smaller will be their probability of voting supportively.

Cabunducan et al. (2011) and Lee et al. (2012) found that voters tend to participate in Wikipedia elections that their contacts have participated in, and they find evidence that an individual's decision-making is influenced by their contacts' actions. Several network characteristics influence the voting decisions, such as degree, betweenness or closeness. In their setup, ties are based on communication on users' talk pages.

Context: requests for adminship in the German-language version of Wikipedia

This research study focuses on the online encyclopaedia Wikipedia; specifically, it will use data from the German-language version. The German-language edition of Wikipedia is the second oldest version, established in March 2001, and one of the most active ones.

Wikipedia is maintained by volunteers, and at the core of Wikipedia's governance structure is its reliance on a decentralised model of administration, where decisions regarding content, policies and community guidelines are largely made through consensus among its contributors and the formal structure and governance are fully participative (Jemielniak, 2016b; for a critical discussion on its organisation see Schneider, 2022). Administrators play a pivotal role in the day-to-day operations and maintenance of Wikipedia. Once granted adminship through the Request for Adminship (RfA) process, administrators gain access to a range of additional tools and permissions that enable them to perform various administrative tasks effectively. One of the primary responsibilities of administrators is to enforce Wikipedia's policies and guidelines, ensuring the integrity and quality of content on the platform. They have the authority to review and address reports of misconduct and are entrusted with the ability to perform technical tasks such as page deletion, page protection and user blocking when necessary; they help to protect pages from vandalism, remove

content that violates Wikipedia's content policies and intervene in disputes to facilitate resolution (see on conflicts on Wikipedia, e.g. Yasseri et al., 2012). Furthermore, administrators also gain social authority (Forte et al., 2009).

The process of becoming an administrator, the RfA, has not been stable throughout the past 20 years but has evolved with Wikipedia. The process was less regulated in the early days of Wikipedia when it was also generally easier to become an administrator. Potential candidates were found through the mailing list of Wikipedia by asking users about their interest in the position and the task. In January 2003, there were seven administrators in the German-language version of Wikipedia. As of May 2003, suggestions for administrators were starting to be centrally collected on a site on Wikipedia, and since 2006, each candidacy is being discussed on its designated subpage. In the beginning, there was no well-defined procedure for elections; candidates needed to be endorsed by other users, but there was substantial leeway. As of March 2004, new guidelines for the promotion process were drafted. Generally, to become an administrator on Wikipedia, an eligible user must be nominated or self-nominate. This is possible at any point in time; there are no calls for application and there is also no fixed number of administrators. During the election, the voting community looks for a variety of factors which allow them to determine the trustworthiness of nominees; successful candidates generally must have shown significant positive contributions to Wikipedia.

During an RfA, the candidate presents their qualifications, experience and rationale for seeking admin privileges to the Wikipedia community. Following the submission of the RfA, community members engage in an evaluation process. The voting phase of the RfA typically lasts for a period of 2 weeks, during which eligible Wikipedia users cast their votes. In addition, users may provide detailed comments explaining their stance, offering constructive feedback, or raising concerns about the candidate's suitability for adminship. For a candidate to be appointed administrator, at least 50 users should have voted supportively within 2 weeks (this number increased over the years), with at least two-thirds of the total votes cast being in favour of the candidate; the German-language Wikipedia thus enforces a supermajority rule. Bureaucrats (a further, small group of special users with extended privileges) implement the decision but have some leeway in deciding whether candidates or voters fulfil the eligibility criteria.

The RfA process exemplifies the principles of transparency, accountability and community involvement that underpin Wikipedia's governance structure. By empowering the community to discuss and vote on administrators, Wikipedia ensures that those entrusted with administrative privileges uphold the platform's values and contribute to its continued success as a collaborative online encyclopaedia. However, RfAs are not without their critique as the tone in the discussions can be extremely harsh (Forte et al., 2009; Jemielniak, 2015). For a deep ethnographic perspective on Wikipedia including on the experiences of becoming an administrator in the Polish-language Wikipedia, see Jemielniak (2014).

Material and methods

This article makes use of publicly available data from Wikipedia to study whether offline networks are linked to whether and how users of Wikipedia vote in RfA. To answer this

question, I scraped the election pages, combined the scraped election data with offline meeting data, and made use of the Wikipedia data dump,[1] which provides information on all actions undertaken on the online platform, to control for online behaviours and activity. This study was approved by the ethical advisor of the Department of Sociology at the University of Warwick in January 2020.

Election data

To become an administrator on Wikipedia, an eligible user must be nominated or self-nominated. Nominations will generally remain active for 2 weeks during which eligible users can cast their vote in the *support*, *oppose* and *neutral* sections of an RfA. All RfAs are archived on Wikipedia.[2] Information on all elections was collected using a web-scraper. To collect the voters and their opinions, the web page was split into separate parts via the section headings. The web-scraper then collected which user signed under which text part. This can lead to errors when users commented in one part of the voting process which was not an expression of a vote. However, as there are designated talk pages dedicated to discussions, it is reasonable to assume that this occurred in only very few instances (if at all). Instances in which users seemingly voted multiple times were checked manually.

Eligibility to vote. To make meaningful comparisons, the pool of potential voters must be known; they are assumed to consist of everyone eligible. Active and passive eligibility criteria are identical on the German-language Wikipedia and currently comprise tenure, total activity and recent activity. Blocked users, sock puppets (fake accounts), bots and additional accounts of the same person are excluded from the election processes. Using the Wikipedia data dump and thus tracing the activity of users across time, a list of all eligible users was created for each election date (on the basis of tenure and activity). Bots and users that were blocked at the time of the election for at least 2 weeks were excluded (information on this was retrieved through Wikipedia log books). Sock puppets are not flagged and it is thus not possible to identify them from the list of eligible users.

Description of election data. Overall, 1213 elections took place in the German-language Wikipedia between its launch in 2001 and the end of March 2020. The first election recorded took place on 9 April 2003, without any recorded voters, and the last one ended on 16 March 2020 after 257 users voted. Both elections led to a new administrator. In total, 60.1% of elections were successful. The number of voters per election varies between 0 (in the early days of Wikipedia) to 533 with a *mean* (*M*) of 168.35 (*standard deviation* (*SD*) 110.91, *median* 165). Users who were not eligible to vote but still voted were excluded from the analysis. Twenty-two elections were excluded completely because it appeared they did not have an eligible candidate. This was especially prevalent with elections which took place around the date when eligibility criteria changed. It might well be the case that these criteria changes were effective a few days later than recorded or that the users were negligent in enforcing the stricter rules immediately.

Data setups

There are two different explananda addressed in this research project: who votes in an election and who votes supportively? For the first question, the data include all eligible users observed at all elections they were eligible (6,791,107 observations belonging to 30,004 different users who were eligible to vote in at least one of the 1191 elections). While some users were only eligible to vote in one of these elections, others were eligible for all 1191 elections taking place (*mean* 226.30, *standard deviation* 232.90, *median* 131). There are 200,852 instances in which users used their right to vote. To answer the second question, the data include all users who have voted in elections. I thus focus on those 200,852 instances in which users voted. Like most previous research, I exclude users who have cast a neutral vote, so that there is a total of 183,263 instances in which users voted (with $n = 135{,}230$ supporting votes). The dataset includes 5022 different users who voted; some once, others up to 807 times (*mean* 36.49, *standard deviation* 74.53, *median* 7).[3]

Variables and data description

Network measures. Several network measures regarding the offline and online networks of Wikipedians are included in my models to test the outlined hypotheses. I include whether a direct tie exists between two users, particularly between candidate and voter. Furthermore, I include measures of *centrality* which describe how central nodes are in a network (see, e.g. Wasserman and Faust, 1994: 169–219). A user's *degree* describes the number of links that a node shares with others and works as a measure of popularity; I work with a relative definition of degree (i.e. a proportion). *Eigenvector centrality* is another popular measure of the importance of a node developed by Bonacich (1987). Eigenvector centrality scores correspond to links connecting a node to other central nodes.

On Wikipedia, different networks can be conceptualised. My main interest lies in the role of ties stemming from *offline* meetings; however, I will simultaneously control for online network ties.

The offline network. This article makes use of the offline meetup data described in Schwitter (2023). Most offline gatherings between Wikipedians are organised on Wikipedia itself on dedicated organisational pages. The dataset collected by Schwitter (2023) covers (almost) all offline meetings between 2001 and 2020; excluded are only those meetings which took place in community hubs and where the same small group of users repeatedly attended very regular meetings (and which lacked a rigorously maintained list of attendees which is typical for other meetings). For all recorded meetings, the dataset contains information on which user signed up to attend which meeting at what point in time. This dataset thus allows me to capture which users met each other within an offline setting. Overall, the dataset contains information on 4418 meetups organised within the German-language Wikipedia. I exclude 10 very large meetings (which have over 50 attendees and which are not primarily social events; this refers, for example, to WikiConventions) from this dataset as I focus on meetings where it is reasonable to assume that attendees of the same meeting had met each other and had the opportunity to create a tie.

I consider the previous 12 months of meetup activity to calculate the network measures for any given point in time, meaning that I consider that meetings happening in the last year are relevant for Wikipedians as many meetings are annual events.

Online networks: collaboration and communication on Wikipedia. Network measures regarding different online networks on Wikipedia are considered to isolate the effect of offline ties: collaboration and talk ties. A collaboration tie is based on the co-editing network (defined as registered users editing the same Wikipedia page directly after one another). Talk ties refer to leaving messages on users' talk pages.[4] The Wikipedia data dump is used to obtain this information. I focus on the previous *2* months of online activity instead of 12 months for several reasons. First, the online space tends to move more rapidly than offline activities with new actions being undertaken every minute. Previous research, which has focused exclusively on online activities, has thus generally focused on these shorter timeframes (see, e.g. a 1-month time span when focusing on collaboration in Piskorski and Gorbatâi, 2017 or when focusing on reverts in Kittur and Kraut, 2010). Second, the past 2 months of activity are particularly relevant in the context of elections, as eligible users must have been registered for at least 2 months to participate in the election. In contrast to this fast-moving online space, offline interactions evolve more slowly. This approach ensures that both online and offline network measures are appropriately tailored to reflect their respective dynamics.

Further variables. The current state of research has identified several additional determinants relevant for predicting election participation. To ensure a comprehensive analysis and to avoid confounding the effects of the offline network, I control for factors in the models which are likely to affect voting and meetup participation. Control variables include the previous total level of activity up to the time of the election as well as the recent activity before the election (logged number of article edits in the past 2 months). Active Wikipedians are generally more engaged with and interested in the platform and are both, more likely to take part in governance activities and meetings. Tenure, measured as years passed since a user's first edit, is included as it reflects a user's experience and long-term commitment to Wikipedia. More experienced users may have different voting behaviours as well as meeting behaviours compared to newer contributors. I also control for features describing the relationship between the voter and the candidate. Using a dummy variable, I capture whether a voter has reverted or has been reverted by the candidate in the past 2 months. A revert, which is the undoing of a user's edit, can signal conflict or disagreement, potentially influencing voting behaviour (Geiger and Ribes, 2010; Halfaker et al., 2011). Finally, I control for the year of the election, differentiating three equally long categories (before 2009, between 2009 and 2014, 2015 and after). This accounts for any temporal changes in voting patterns and platform dynamics over time. Descriptive information on all variables included in the models is shown in Table 1.

Statistical approach: Fixed-effects (FE) models

In the following analyses, the regression framework will be extended to include network statistics as covariates; this is a popular alternative approach to network models. While it

Table 1. Descriptive information on all variables included in the models.

Variable	Voting	Voting supportively
	Setup 1	Setup 2
Number of meetups attended	0.28 (1.45) 0 / 47	1.75 (3.71) 0 / 46
Met candidate	0.24%	3.41%
Proportion of voters met	0.21 (1.29) 0 / 80	1.71 (3.63) 0 / 80
Proportion of pro-voters met	0.22 (1.50) 0 / 100	1.86 (4.13) 0 / 100
Proportion of anti-voters met	0.15 (1.33) 0 / 100	1.10 (3.57) 0 / 100
Eigenvector centrality meetup network	0.012 (0.076) 0 / 1	0.087 (0.21) 0 / 1
Collaborated with candidate (direct collaboration tie, undirected)	4.97%	31.92%
Proportion of voters collaborated with	3.95 (9.29) 0 / 100	21.15 (17.34) 0 / 98.82
Proportion of pro-voters collaborated with	3.86 (9.48) 0 / 100	21.09 (17.73) 0 / 100
Proportion of anti-voters collaborated with	3.54 (9.39) 0 / 100	19.29 (18.42) 0 / 100
Eigenvector centrality collaboration network	0.045 (0.085) 0 / 1	0.20 (0.15) 0 / 1
Talked to candidate (direct talk tie, undirected)	0.45%	6.27%
Proportion of voters talked to	0.38 (1.70) 0 / 100	3.22 (4.46) 0 / 100
Proportion of pro-voters talked to	0.37 (1.93) 0 / 100	3.30 (4.87) 0 / 100
Proportion of anti-voters talked to	0.32 (2.14) 0 / 100	2.90 (6.15) 0 / 100
Eigenvector centrality talk network	0.010 (0.037) 0 / 1	0.072 (0.11) 0 / 1
Difference candidate–voter centrality meetup network	0.093 (0.24) –1 / 1	0.0053 (0.32) –1 / 1
Difference candidate–voter centrality collaboration network	0.22 (0.19) –1 / 1	0.059 (0.20) –0.99 / 0.90
Difference candidate–voter centrality talk network	0.056 (0.12) –1 / 1	0.036 (0.15) –1 / 1
Reverted candidate	0.12%	1.36%
Reverted by candidate	0.15%	1.42%
Mainspace edits, 2 months (log)	2.71 (2.20) 0 / 11.94	5.48 (1.55) 0 / 11.90
Total edits (log)	5.38 (2.10) 0 / 12.40	8.16 (1.46) 0.69 / 12.34
Difference candidate–voter total edits (cube-root)	14.35 (11.35) –62.28 / 45.12	5.71 (19.46) –59.65 / 45.10

(continued)

Table 1. (continued)

Variable	Voting	Voting supportively
	Setup 1	Setup 2
Years since first edit	3.71 (2.80) 0.000004 / 18.73	4.62 (3.46) 0.0014 / 17.85
Year of meetup 03–08	40.38%	31.06%
Year of meetup 09–14	46.17%	45.50%
Year of meetup 15–20	13.45%	23.04%
Observations	6791107	183263
Observations realised (dependent variable = 1)	200852	135230
Number of groups	30004	5022

Given are mean (*standard deviation*), minimum / maximum.

is simpler, it does not allow to model network interdependencies explicitly (Cranmer and Desmarais, 2011). The data further exhibit a multilevel structure as election (non-)participation is nested in users.[5] Fixed effects (FE) models are often used in multilevel contexts, and they concentrate on the within differences of a cluster, excluding all between effects. FE models are employed in this study to control for unobserved heterogeneity and time-invariant factors within the observational data; this limits potential sources of biases in estimating causal effects (Allison, 2009). However, it is important to note that the results do not imply causality and the effects discussed in the result section do not measure causal relationships as this study only uses observational data. I will employ FE generalised linear models with a logit-link, using the R package *fixest* (Berge, 2018) with cluster-robust standard errors over voters and candidates.

Results

This study analysed data from all 1191 elections that took place on the German-language Wikipedia between its launch in 2001 and March 2020 and which featured a candidate who was eligible to be selected. How was the voting behaviour exhibited at these elections associated with the offline network which has developed alongside the online component of Wikipedia? Multivariate model results regarding voting and the direction of voting are shown in Figures 1 and 2, respectively (model results excluding controls can be found in the Supplemental material, see Supplemental Tables S3 and S4). Five different models are run: Models 1–4 include the control variables and different measures of offline meetup participation separately to distinguish their effects; the last model includes all measures simultaneously.

Regarding voting behaviour, I find that users who have met the candidate of an election and who have met a larger proportion of other voters are significantly more likely to take part in an election. Those who have attended more meetings are also more likely to vote at all, but the effect does not remain significant when including other offline network measures. The effect of a voter's centrality within the network of offline meetup attendees is more difficult to understand: when not including other network measures,

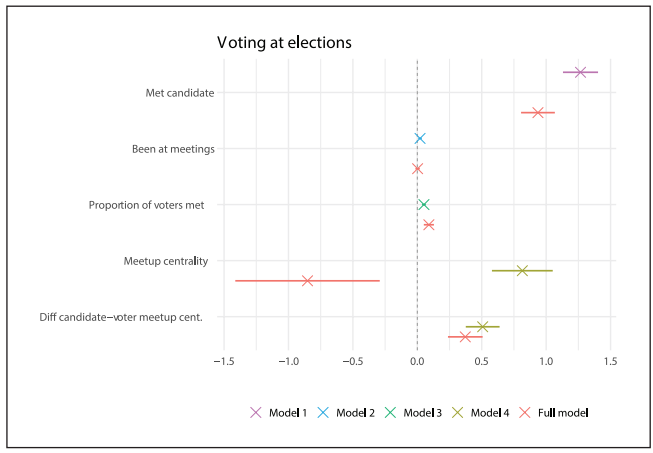

Figure 1. Modelling voting behaviour with a FE generalised linear model, logit-link (based on Supplemental Table S1 in the Supplemental material). Users who have met the candidate, have met a larger proportion of other voters and are more central in the offline network than the candidate are more likely to vote in all model specifications.
Note. Horizontal line reflects 95% confidence interval. Models 1–4 refer to models which include all control variables regarding online behaviour, but only the displayed predictors of the offline network. The full model includes all offline network predictors simultaneously.

there is a significant positive effect of both a voter's own centrality and the difference between the candidate's centrality and the voter's centrality. This means, voters are more likely to vote if they are generally more central in the offline meetup network, but also if the candidate in an election is more central than them. If all other network measures are included, I find a significant negative effect of the within effects of a voter's meetup centrality, suggesting that a user is more likely to vote the less central they are. The positive effect of the relative centrality remains stable.

In the next step, I focus on explaining the direction of votes: when do voters support a candidate in contrast to voting opposingly? When not including any other measures of the offline network, I find significant and positive effects of having met the candidate. While the number of meetings attended does not affect the direction of votes, I find significant and positive effects of the proportion of supporting voters ('pro-voters') met and negative and significant effects of the proportion of opposing voters ('anti-voters') met. Knowing an additional percentage point of pro-voters in an election leads to an increase in the probability of also voting supportively (e.g. knowing 2% instead of 1% of the pro-voters leads to an increase of 4% points) and similarly, knowing an additional percentage point of anti-voters in an election leads to a decrease in the probability to vote supportively (e.g. knowing 2% instead of 1% of the anti-voters leads to a decrease of also 4% points; see Figure 3 for the predicted probabilities). Regarding the centrality of voters, I find positive within effects of both a voter's centrality and the difference between the candidate's and the voter's centrality (Model 4), but only the positive effect of the difference between candidate and voter remains significant in the full model.

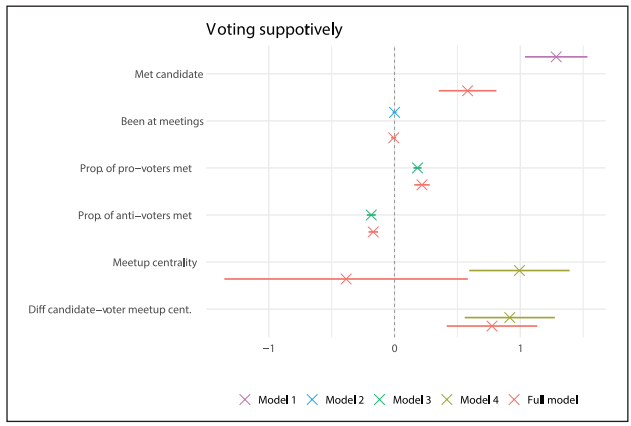

Figure 2. Modelling supportive votes with a FE generalised linear model, logit-link (based on Supplemental Table S2 in the Supplemental material). Users who have met the candidate, a higher proportion of supportive voters, a smaller proportion of opposing voters and who are more central in the offline network than the candidate are more likely to vote supportively in all model specifications.

Note. Horizontal line reflects 95% confidence interval. Models 1–4 refer to models which include all control variables regarding online behaviour, but only the displayed predictors of the offline network. The full model includes all offline network predictors simultaneously.

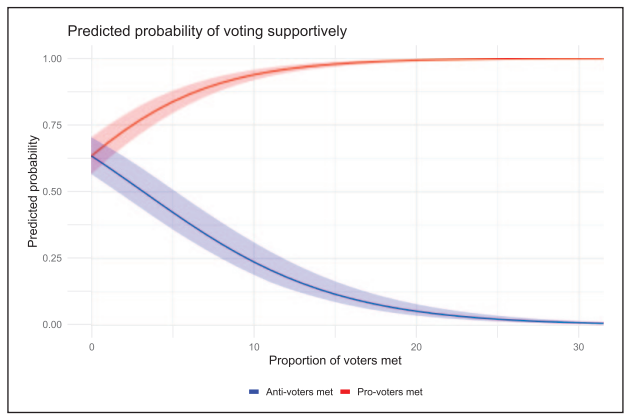

Figure 3. Predicted probabilities of voting supportively. Users who have met a higher proportion of supportive voters and a smaller proportion of opposing voters are more likely to vote supportively. Predicted probabilities are based on the full model including all covariates held at 0.

Note. Shaded areas reflect 95% confidence interval.

Conclusion

This study analysed voting patterns in the online community surrounding Wikipedia, shedding light on the broader relationship between offline and online behaviour as well as social networks and participation in governance activities of a participatory, digital

organisation. Wikipedia is a well-known online encyclopaedia, but it has also grown into a community encompassing both offline and online interactions. I found significant and stable effects of the offline network on voting behaviour and thus support for all hypotheses (V1, V2, P1, P2, P3, P4). Personal voting decisions are influenced by a user's ties to the candidate and to other voters: an eligible user is much more likely to vote if they have met the candidate in the past; they are also more likely to vote if they have met other voters, and offline ties are also linked the direction of the vote. Wikipedia is based on a strongly democratic foundation which fosters inclusivity and diverse perspectives. In contrast to more oligarch online networks, Wikipedia is relatively successful in fostering democracy (Schneider, 2022). However, this study showed that it is important to acknowledge that offline meetings introduce a variable that has the capacity to skew this democratic balance but also increase voter turnout. Put differently, the study also highlights the importance of personal contacts and the significance of fostering robust networks and engagement strategies in (online) elections within participatory organisations. The use of diverse channels – that is, online and offline channels – can help potential leaders to build status and gain support.

This study made use of Wikipedia data but continued in the traditions of Lazarsfeld et al. (1944) and Lipset et al. (1956), underscoring that social contacts matter for voting decisions and extending election research to non-traditional contexts like the cyberspace. The findings are in line with a large body of literature in political science and extend these findings to the online space, highlighting how the underlying principles of social influence and voting behaviour hold relevance across diverse electoral contexts. Albeit the electoral context of Wikipedia is one where online interactions are very salient, face-to-face ties still matter. The present study can be embedded within non-secret public assembly voting where all acts of voting are observable. Manin (2015) has explicitly pointed out the disadvantages of non-secret voting and discussed how open voting allows for pressure and influence, particularly from one's immediate social environment. These (power) dynamics might well affect voting decisions within Wikipedia as this study has shown. They have generally not received much attention in electoral contexts where public votes still take place – in these contexts, public assembly voting usually has a long tradition and forms an almost sacrosanct institution (see on such, e.g. Schaub, 2012). Online elections within virtual communities offer a new lens on voting behaviour and participatory organisations as they make masses of data available: online platforms often allow the unobtrusive extraction of digital trace data on all of a user's actions undertaken within this platform, from first registering to subsequently voting. Web data in this study has shown that social capital matters in explaining voting participation, and future research can study other aspects of political behaviour. In a next step, it is further important to ask why the offline network matters and to improve the understanding of the causal relationships behind the associations uncovered. Are users discussing upcoming or current elections at the meetups they attend and potentially come to a consensus, or are users voting like their friends or even feel pressured to vote in line with them? Are strong ties restricting a flow of information or even restricting what is considered a valid opinion within a group? Are voters selecting themselves into pro-or anti-networks when deciding to vote? These are questions that this study cannot answer but which are important to explore in future work to better understand whether the mechanisms are harming the community (as examples of dark sides of social capital, see Portes, 1998). My

findings provide some evidence for the ideas that voters are fulfilling their obligations towards their friends (one aspect of social capital, see Coleman, 1990; Putnam, 2000), that ties might highlight one's duty to vote (Verba et al., 1995), or also that direct ties provide cheap information to the person voting (see also Sinclair, 2012). This links back to the well-documented friends-and-neighbours effect. Given that users who have met the candidate are more likely to vote as well as to vote supportively, it seems likely to expect that obligations or positive, additional (offline) information are driving the decision.

This study has a number of limitations. Methodologically, I did not model the voting process as a network but assigned network values to users. This has some advantages regarding simplicity and flexibility but does not allow the explicit modelling of network interdependencies like reciprocity across time. Also, other network values could also be included in future work; for example, different centrality measures could be contrasted (e.g. betweenness centrality). Furthermore, the results might be affected by unobserved, time-varying heterogeneity; this would mean that there are time-varying variables which affect both meeting and election participation. Finally, it needs to be acknowledged that it is not possible to grasp all forms of communication and all offline meetings between Wikipedians. The dataset used contains almost all meetings which were organised within Wikipedia; it might well be that users are in contact through other channels of communication and organise private meetings. Such meetings are impossible to collect. The analyses in this study further only controlled for communication and collaboration which took place on Wikipedia itself, focusing on article-level collaboration and user talk page discussions. However, other socialisation channels exist (see on these interactions also Yam, 2015): editors can know each other from WikiProjects, which are topic-related initiatives to improve articles on a specific topic. They serve as central places for topic-specific communication and can create close relationships between editors (see, e.g. Jemielniak et al., 2021). Further channels away from Wikipedia also exist and are even more difficult to capture, for example, on Discord or Facebook or throug Internet Relay Chat (Jemielniak, 2016a). These channels are used for communication and discussion, and this could include discussions on elections. It might well be that activity in WikiProjects or in such external communication channels bias the association between offline meetings and election participation, as those users more active in these channels might also be more likely to attend meetings and vote.

This study focused on Wikipedia as an example of an online community which offers detailed information on online elections. It is unique in employing classical voting theory in the context of an online election. However, it is important for future research to broaden its scope and explore the interplay between online and offline behaviour beyond Wikipedia (and its governance structure). The study highlighted the significant role of offline activities. Despite the challenges of obtaining data about the offline domain, it is essential for understanding the full picture and for gaining deeper insights into the dynamics of digital communities and hybrid, participatory organisations.

Acknowledgements

The author wants to thank Ulf Liebe, Andreas Murr, Wojtek Przepiorka, Richard Lampard, Martina Frnka and two extraordinary anonymous reviewers for helpful feedback to previous

versions of this article, Achim Edelmann for technical advice regarding data preparation and the Scientific Computing Team at the University of Leipzig for computing support.

Availability of data

The data and code that support the findings of this study are available at https://osf.io/8yxph/ (DOI: 10.17605/OSF.IO/8YXPH).

Funding

The author disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by the Wikimedia Foundation [https://meta.wikimedia.org/wiki/Grants:Project/nschwitter/The_Role_of_Offline_Ties_of_Wikipedians].

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Supplemental material

Supplemental material for this article is available online.

Notes

1. Data dumps provided by the Wikimedia Foundation offer well-structured data exports of different facets of Wikipedia. See for the German-language Wikipedia https://dumps.wikimedia.org/dewiki. For this study, the stub history meta data was used which contains information on all articles and on all its revisions without including the actual text data.
2. See https://de.wikipedia.org/wiki/Wikipedia:Adminkandidaturen/Archiv.
3. The sample size in the models is smaller as observations in which the outcomes are constant are dropped.
4. All registered users on Wikipedia have a 'talk page'. These user talk pages are mainly for interpersonal discussion related to Wikipedia. Wikipedia does not have a feature to privately message others on the platform, but there is the 'Wikimail', an opt-in feature to send others emails (see https://de.wikipedia.org/wiki/Hilfe:E-Mail). Such talk pages, neither personal ones nor article talk pages, are to be used for non-project-related small talk (see, e.g. Schneider et al., 2010; Welser et al., 2011).
5. The data are nested further as candidates can run multiple times and current administrators can run for re-elections. The following analyses focus on voter behaviour and include fixed effects for voters. The 1191 elections observed feature 756 distinct candidates; 475 of them ran only once, while one person ran nine times. Candidate-clustering is accounted for by estimating cluster-robust standard errors over voters as well as candidates.

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