Predicting Elections with Twitter: What 140 Characters Reveal about Political Sentiment

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Abstract

Twitter is a microblogging website where users read and write millions of short messages on a variety of topics every day. This study uses the context of the German federal election to investigate whether Twitter is used as a forum for political deliberation and whether online messages on Twitter validly mirror offline political sentiment. Using LIWC text analysis software, we conducted a content analysis of over 100,000 messages containing a reference to either a political party or a politician. Our results show that Twitter is indeed used extensively for political deliberation. We find that the mere number of messages mentioning a party reflects the election result. Moreover, joint mentions of two parties are in line with real world political ties and coalitions. An analysis of the tweets' political sentiment demonstrates close correspondence to the parties' and politicians' political positions indicating that the content of Twitter messages plausibly reflects the offline political landscape. We discuss the use of microblogging message content as a valid indicator of political sentiment and derive suggestions for further research.

Introduction

The successful use of social media in the US presidential campaign of Barack Obama has established Twitter, Facebook, MySpace, and other social media as integral parts of the political campaign toolbox. Some analysts attribute Obama's victory to a large extent to his online strategy. Obama's social-networking website mybarackobama.com, known as MyBO, helped him set records in terms of donations and grassroot mobilization (Williams and Gulati 2008). Shortly after his victory, Obama used Twitter to let the web community know how he felt: "This is history". As this example demonstrates, after the rise of candidate websites in 1996, e-mail in 1998 (the Jesse Ventura campaign), online fund-raising in 2000 (the John McCain campaign), and blogs in 2004 (the Howard Dean campaign; Gueorguieva 2007), Twitter has become a legitimate communication channel in the political arena as a result of the 2008 campaign.

Twitter is a novel microblogging service launched in 2006 with more than 20 million unique monthly visitors. On Twitter, every user can publish short messages with up to 140 characters, so-called "tweets", which are visible on a public message board of the website or through third-party applications. The public timeline conveying the tweets of all users worldwide is an extensive real-time information stream of more than one million messages per hour. The original idea behind microblogging was to provide personal status updates. However, these days, postings cover every imaginable topic, ranging from political news to product information in a variety of formats, e.g., short sentences, links to websites, and direct messages to other users. Especially in the weeks leading up to elections, political issues are clearly on the minds of many users. In addition, politicians are communicating with the electorate and trying to mobilize supporters. While some political analysts are already turning to the "Twittersphere" as an indicator of political opinion (e.g., Skemp 2009), others have suggested that the majority of the messages are "pointless babble" (pearanalytics 2009). As a result, we aim at answering the question whether microblogging messages can actually inform us about the political landscape in the offline world.

The aim of this study is threefold. First, we examine whether Twitter is a vehicle for online political deliberation by looking at how people use microblogging to exchange information about political issues. Second, we evaluate whether Twitter messages reflect the current offline political sentiment in a meaningful way. Third, we analyze whether the activity on Twitter can be used to predict the popularity of parties or coalitions in the real world.

Background on the German election

In our study, we use 104,003 tweets published in the weeks leading up to the federal election of the national parliament in Germany which took place on September 27th, 2009. After 4 years in a grand coalition with the social democrats (SPD), Chancellor Angela Merkel member of the conservatives (CDU) - was running for reelection, but favoring a coalition with the liberals (FDP).

Many commentators have called the parties' campaigns uninspiring due to the unwillingness of the main candidates to attack their then-coalition partners. The left side of the

political spectrum was fragmented by the rise of the socialist party (Die Linke). The SPD candidate for Chancellor, Frank-Walter Steinmeier, publicly rejected Die Linke as a possible coalition partner, thus limiting his options to build a governing coalition. The potential coalition of CDU and FDP was leading by a slight majority in most polls and was ultimately able to form a center-right government after the election.

Related work and research questions

Recently, the exponential growth of Twitter has started to draw the attention of researchers from various disciplines. There are several streams of research investigating the role of Twitter in social media, product marketing, and project management. One stream of research concentrates on understanding microblogging usage and community structures (e.g., Honeycutt and Herring 2009; Huberman, Romero, and Wu 2008; Java et al. 2007). In sum, this research demonstrates that the intensity of Twitter usage varies considerably. Market researchers have reported that in June 2009 (only a couple of weeks before the German federal election) 71% of all 1.8 million German users had visited Twitter only once and 15% of them at least 3 times (Nielsen Media Research 2009). Honeycutt and Herring (2009) showed that Twitter is used not only for one-way communication but often serves as a means of conversation. In their study exploring conversation via Twitter, they find that 31% of a random sample of tweets contain an "@"-sign and that the vast majority (91%) of those were used to direct a tweet to a specific addressee. While these findings have provided us with a general understanding of why and how people use microblogging services, they have not explored the use of this new communication device in specific contexts such as, for instance, corporate public relations or the political debate online.

Another stream of research focuses on corporate applications of microblogging such as the company-internal use for project management (e.g., Böhringer and Richter 2009) or the analysis of Twitter as electronic word of mouth in the area of product marketing (e.g., Jansen et al. 2009). In their study, Jansen et al. (2009) have found that 19% of a random sample of tweets contained mentions of a brand or product and that an automated classification was able to extract statistically significant differences of customer sentiment (i.e., the attitude of a writer towards a brand). While this study provides reason to believe that sentiment may also be embedded in tweets covering other topics besides branding, Twitter sentiment analysis has not yet been applied to the research regarding the political debate online.

Scholars have debated the potential of weblogs as a forum for democratic debate. In a comparison with traditional media, Woodley (2008) highlights the dialogic quality of political blogs, whereas Sunstein (2008) is more pessimistic and questions the ability of blogs to aggregate dispersed bits of information. Alongside these theoretical works, "empirical research on deliberative democracy has lagged significantly behind theory" (Delli Carpini, Cook, and Jacobs 2007, p. 316). A few researchers have empirically examined internet discussion boards as a vehicle for political deliberation[1] (e.g., Jansen and Koop 2005; Schneider 1996). Koop and Jansen (2009) have defined the exchange of substantive issues as an indicator of deliberation and the equality of participation as a measure of the deliberative quality of blog-based discussion. While they have found discussion boards and blogs to be dominated by a relatively small number of users, it is unclear whether their findings also apply to the political debate on Twitter.

Recent scholarly work on political blogs has focused on their effect on real world politics, such as complementing the watchdog function of the mainstream media and mobilizing supporters, but largely ignored the reflection of offline politics in the digitally enhanced public sphere (Drezner and Farrell 2008). However, there are some studies exploring the reflection of the political landscape in "traditional" weblogs and social media sites. For instance, Williams and Gulati (2008) have found that the number of Facebook supporters can be considered a valid indicator of electoral success. Even more simple measures have produced surprising results. For example, Véronis (2007) has shown that the simple count of candidate mentions in the press can be a better predictor of electoral success than election polls. Adamic and Glance (2005) have found that linkage patterns among bloggers reflect the blogosphere along party lines. Albrecht et al. (2007) have examined the use of weblogs during the 2005 federal election in Germany including the distribution of blogs along party preference.

Despite the fact, that previous research provides evidence that "traditional" social media content can be used to validly predict political outcomes, we know very little about the predictive power of Twitter for political debates and outcomes. Previous scholarly examinations of social media may not be easily transferrable to Twitter for the following reasons: First, tweets are much shorter and contain much less content than, for instance, news articles and traditional blogs. Hence, their informational value is less clear-cut. One marketing consultancy has even suggested that up to 40% of all Twitter messages are "pointless babble" (pearanalytics 2009). Second, only part of the information conveyed is found in the words themselves because 19% of all messages contain links to other websites (Zarrella 2009a). Thus, a basic question is whether 140-character-messages can contain differentiated information regarding the electorate's political sentiment.

With respect to the reflection of politics on Twitter, Meckel and Stanoevska-Slabeva (2009) analyzed the interconnections between 577 political Twitter accounts (i.e., official accounts of parties and politicians) prior to the German federal election. They conclude that German politicians have not managed to mobilize the electorate

[1] In line with Delli Carpini, Cook, and Jacobs (2007) we use the words deliberation, debate and discussion interchangeably.

online. The connections between Twitter accounts were by no means a reflection of the political ties along party lines: while there was significant overlap among followers of the Green party and Die Linke, the users of the two leftist parties SPD and Die Linke were less connected. However, this research focused solely on associations between Twitter accounts and did not analyze the content of political Twitter messages.

To summarize, studies analyzing the political debate online have focused on traditional weblogs and social media websites, such as Facebook, MySpace, and YouTube. Previous research has shown that social media is widely used for political deliberation and that this deliberation reflects the political landscape of the offline world.

Although the reference to tweets in some political commentaries (e.g., Skemp 2009) shows that analysts are already turning to the Twittersphere as an indicator of political opinion, to the best of our knowledge, there are no scientific studies systematically investigating the political sentiment in microblogs. As a result, some research has posed the question whether we can even "use the word public opinion and blogging in the same sentence" (Perlmutter 2008, p. 168). Therefore the goal of the present explorative study is to address the following research questions:

- Does Twitter provide a platform for political deliberation online?
- How accurately can Twitter inform us about the electorate's political sentiment?
- Can Twitter serve as a predictor of the election result?

Data set and methodology

We examined 104,003 political tweets, which were published on Twitter's public message board between August 13th and September 19th, 2009, prior to the German national election, with volume increasing as the election drew nearer. We collected all tweets that contained the names of either the 6 parties represented in the German parliament (CDU/CSU, SPD, FDP, B90/Die Grünen, and Die Linke) or selected prominent politicians of these parties who are regularly included in a weekly survey on the popularity of politicians conducted by the research institute "Forschungsgruppe Wahlen". CDU and CSU, often referred to as the "Union", are sister parties which form one faction in the German parliament.

Our query resulted in roughly 70,000 tweets mentioning one of the 6 major parties and 35,000 tweets referring to their politicians.

To extract the sentiment of these tweets automatically, we used LIWC2007 (Linguistic Inquiry and Word Count; Pennebaker, Chung, and Ireland 2007), a text analysis software developed to assess emotional, cognitive, and structural components of text samples using a psychometrically validated internal dictionary. This software calculates the degree to which a text sample contains words belonging to empirically defined psychological and structural categories. Specifically, it determines the rate at which certain cognitions and emotions (e.g., future orientation, positive or negative emotions) are present in the text. For each psychological dimension the software calculates the relative frequency with which words related to that dimension occur in a given text sample (e.g., the words "maybe", "perhaps", or "guess" are counted as representatives of the construct "tentativeness"). LIWC has been used widely in psychology and linguistics (see Tausczik and Pennebaker, 2009). For example, Yu, Kaufmann, and Diermeier (2008) have used LIWC to measure the sentiment levels in US Senatorial speeches.

We focus on 12 dimensions in order to profile political sentiment: Future orientation, past orientation, positive emotions, negative emotions, sadness, anxiety, anger, tentativeness, certainty, work, achievement, and money. Following the methodology used by Yu, Kaufmann, and Diermeier (2008) we concatenated all tweets published over the relevant timeframe into one text sample to be evaluated by LIWC. Tweets were downloaded in German and automatically translated into English to be processed by the LIWC English dictionary.

Results

Twitter as a platform for political deliberation

In this section, we will evaluate our sample along two widely accepted indicators of blog-based deliberation, the exchange of substantive issues and the equality of participation (Koop and Jansen 2009).

Table 1 shows the number of mentions and a random sample of tweets for all parties in our sample. While this is only a small selection of the information stream in our sample, these messages illustrate that tweets can contain a lot of relevant information. So despite their brevity substantive issues can be expressed in 140 characters or less.

Table 1: Tweets by party

Party	Tweets	
	Number of tweets	Examples*
CDU	30,886	CDU wants strict rules for internet
CSU	5,748	CSU continues attacks on partner of choice FPD
SPD	27,356	Only a matter of time until the SPD dissolves
FDP	17,737	Whoever wants civil rights must choose FDP!
LINKE	12,689	Society for Humans Rights recommends: No government participation for LINKE
Grüne	8,250	After the crisis only Green can help HTTP:[…] GREEN +

** Examples shortened for citation (e.g., omission of hyperlinks)*

Next, we analyze the level of addressivity and retweets in the messages as an indication regarding the exchange of

ideas on Twitter. About one third of all tweets in our sample (30.8%) contain an "@"-sign which is in line with previous research that has also suggested that the vast majority of "@"-signs are used to direct a tweet to a specific addressee (Honeycutt and Herring 2009).

However, some users also employ the "@"-sign to label the mere mention of another person. A more conservative measure of direct communication are direct messages to another user starting with an "@"-sign. Roughly 10% of the messages in our sample are direct messages indicating that people are not just using Twitter to post their opinions, but also engage in interactive discussions.

Many users on Twitter forward messages to their followership. These so-called retweets often contain information that the sender finds noteworthy such as links to other websites. While only 19% of all Twitter messages contain a hyperlink, that number is much higher (57%) for retweets (Zarrella 2009b). Consequently, the rate at which messages are retweeted indicates whether information is considered being interesting. According to Zarrella (2009a), only 1.44% of all tweets are retweets. In our sample, however, that share is significantly higher: 19.1% of all messages were retweets with no significant variation across user groups. This relatively high share is in line with McKenna and Pole (2008) who found that 87% of political bloggers provide links to news articles and other blogs. Summarizing, our results indicate that people are finding interesting political information on Twitter which they share with their network of followers.

We now turn to the analysis of the equality of participation. While we find evidence of a lively political debate on Twitter, it is unclear whether this deliberation is lead by a few "political junkies" rather than the wider general public. Jansen and Koop (2005) found less than 3% of all users on the political message board *BC Votes* to be responsible for almost a third of all posted messages. Table 2 shows the share of users and the share of messages across various user groups for our sample according to the frequency with which a user posts messages. We adopted the categorization from Jansen and Koop (2005).
While the distribution of users across user groups is almost identical with the one found by Jansen and Koop (2005), we find even less equality of participation for the political debate on Twitter. There is a high concentration of messages in the groups of heavy (23.1%) and very heavy users (21.2%).

In sum, it becomes clear that, while Twitter is used as a forum for political deliberation, this forum is dominated by a small number of heavy users.

Table 2: Equality of participation

	Twitter			
User group	User		Messages	
	Total	Share	Total	Share
One time (1)	7064	50.3%	7064	10.2%
Light (2 5)	4625	32.9%	13353	19.3%
Medium (6 20)	1820	12.9%	18191	26.2%
Heavy (21 79)	463	3.3%	15990	23.1%
Very heavy (80+)	84	0.6%	14710	21.2%
Total	14056	100.0%	69318	100.0%

Twitter as a reflection of political sentiment

The fact that users are discussing political issues online does not mean that we can necessarily extract meaningful information from this debate. To explore this question we aggregated the information stream about parties and politicians and compared the resulting profiles with anecdotal evidence from election programs and the press. In order to analyze the political sentiment of the tweets, we generated multi-dimensional profiles of the politicians in our sample using the relative frequencies of LIWC category word counts.

Figure 1 shows these profiles for the leading candidates of the 5 main parties: Angela Merkel (CDU), Frank-Walter Steinmeier (SPD), Guido Westerwelle (FDP), Jürgen Trittin (Grüne), and Oskar Lafontaine (Linke). Overall, positive emotions clearly outweigh negative emotions. This is in line with Yu, Kaufmann, and Diermeier (2008) who find that positive emotions outweigh negative emotions by more than 2 to 1 in an LIWC-based analysis of 18 years of congressional debates.

Only liberal party leader Westerwelle and socialist party leader Lafontaine show more distinctive deviations from this profile on some dimensions. The dimension of perceived anger, for example, is most prominent in the case of these two politicians who, as free-market advocate and socialist leader, represent two contrasting political programs in the political spectrum. Messages regarding Steinmeier, who at the time of our recording was sending mixed signals regarding potential coalition partners for his party after the election, reflect more tentativeness than those of other politicians.

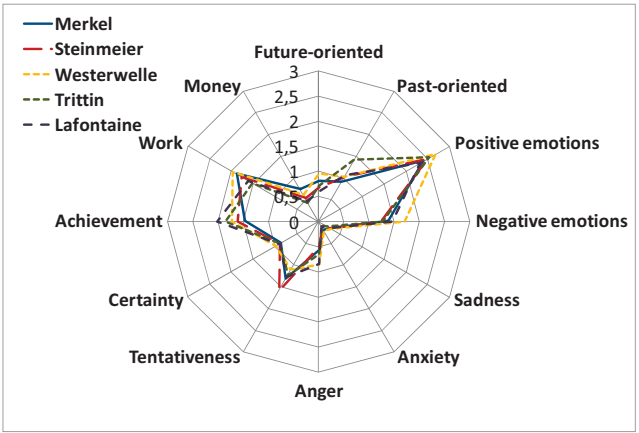

Figure 1: Profiles of leading candidates

Figure 2 shows the profiles of other prominent politicians: Karl-Theodor zu Guttenberg (CSU, economics minister), Horst Seehofer (CSU chairman), Peer Steinbrück (SPD, finance minister), and Gregor Gysi (leader of Die Linke in the German parliament). Their profiles show some distinct differences from those of the leading candidates. Again, positive outweigh negative emotions with the exception of Seehofer who in addition is most frequently associated with anger. This might reflect the fact that Seehofer irritated many voters and party members by attacking the

coalition partner desired by sister party CDU for much of the election campaign. Especially for Steinbrück and zu Guttenberg, the issues money and work are probably reflecting their roles as finance and economics ministers. As can be seen, while small in absolute terms, the sentiment embedded in tweets does reflect nuanced differences between the politicians in our sample.

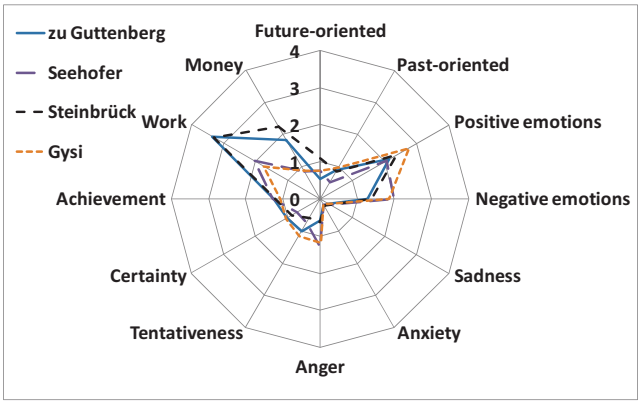

Figure 2: Profiles of other candidates

Since it is not easy to spot differences in the profiles from the radar charts, we computed a distance measure for various combinations of politicians and parties (Table 3). If $d_{i,p}$ is the value of the i-th dimension for politician p, then the following equation represents the average distance from the mean profile per category of all politicians across the 12 dimensions:

$$(1) \qquad d = \sum_{d=1}^{n_d} \frac{\left| d_{i,p} - \left(\sum_{p=1}^{n_p} d_{i,p} \right) / n_p \right|}{n_d} / 12$$

The lower the values of d, the more similar are the profiles. As can be seen in Table 3, the differences between politicians are generally higher than those between political parties.

The distance measures confirm the high convergence of the leading candidates from all parties (d = 0.1) and particularly for the two candidates running for chancellor (d = 0.02). There is more divergence among politicians of the governing grand coalition (d = 0.23) than among those of a potential right-wing coalition (d = 0.16).

Apart from Merkel and Steinmeier, the highest fit emerges between politicians of a potential left-wing coalition.

With respect to the parties, the fit of a potential right-wing coalition is almost as good as the fit in the governing coalition (d = 0.08), but much higher than the similarity of parties on the left side of the political spectrum (d = 0.14). The similarity measure confirms the tight fit between the Union faction of sister parties CDU and CSU (d = 0.01).

Overall, the similarity of profiles is a plausible reflection of the political proximity between the parties in the weeks before the federal election.

Twitter as a predictor of the election result

In order to understand whether the activity on Twitter can serve as a predictor of the election outcome we examine two aspects. First, we compare the share of attention the political parties receive on Twitter with the election result. Second, we analyze whether tweets can inform us about the ideological ties between parties and potential political coalitions after the election.

Table 4 shows the number of tweets mentioning a particular party. As can be seen, the ranking by tweet volume (i.e., the number of tweets) and the ranking by share of vote in the election results are identical. In fact, the relative volume of tweets mirrors the results of the federal election closely. If we consider the number of tweets to be a predictor of the election result, the mean absolute error (MAE) of this prediction is 1.65%. The MAE is a measure of forecast accuracy and has been widely used to compare the accuracy of political information markets relative to election polls (see Huber and Hauser 2005).

To understand how the above-mentioned prediction based on message volume compares with traditional methods to collect this data, we compared Twitter with a number of election polls. Table 5 shows the MAE for Twitter and the last poll prior to the election for 6 research institutes which published election polls in our sample period. As can be seen, Twitter comes close to these accepted benchmarks. This is in line with the findings reported by Véronis (2007) who has shown that, in the case of the 2007 French presidential election, the simple count of candidate mentions in the press was a better predictor of electoral success than many election polls.

Table 3: Distance of profiles

Politicians		Distance*	Parties		Distance*
All politicians	*Merkel, Steinmeier, Westerwelle, Trittin, Lafontaine, zu Guttenberg, Seehofer, Steinbrück, Gysi*	**0.21**	**All parties**	*CDU, CSU, SPD, FDP, Linke, Grüne*	**0.09**
Governing coalition	*Merkel, Steinmeier, zu Guttenberg, Seehofer, Steinbrück*	**0.23**	**Governing coalition**	*CDU, CSU, SPD*	**0.07**
Right coalition	*Merkel, Westerwelle, zu Guttenberg, Seehofer*	**0.16**	**Right coalition**	*CDU, CSU, FDP*	**0.08**
Left coalition	*Steinmeier, Trittin, Lafontaine, Steinbrück, Gysi*	**0.10**	**Left coalition**	*SPD, Linke, Grüne*	**0.10**
Candidates for chancellor	*Merkel, Steinmeier*	**0.02**	**Union**	*CDU, CSU*	**0.01**
Leading candidates	*Merkel, Steinmeier, Westerwelle, Trittin, Lafontaine*	**0.10**			
Other candidates	*zu Guttenberg, Seehofer, Steinbrück, Gysi*	**0.24**			

** Average distance from the mean profile per category across all 12 dimensions (in percentage points)*

Table 4: Share of tweets and election results

Party	All mentions		Election	
	Number of tweets	Share of Twitter traffic	Election result*	Prediction error
CDU	30,886	30.1%	29.0%	1.0%
CSU	5,748	5.6%	6.9%	1.3%
SPD	27,356	26.6%	24.5%	2.2%
FDP	17,737	17.3%	15.5%	1.7%
LINKE	12,689	12.4%	12.7%	0.3%
Grüne	8,250	8.0%	11.4%	3.3%
			MAE:	1.65%

** Adjusted to reflect only the 6 main parties in our sample*

In conclusion, the mere number of tweets mentioning a political party can be considered a plausible reflection of the vote share and its predictive power even comes close to traditional election polls.

Table 5: Forecast accuracy of various election polls

Source	MAE (last poll)
Twitter	*1.65%*
Forsa	0.84%
Allensbach	0.80%
Emnid	1.04%
Forschungsgruppe Wahlen	1.48%
GMS	1.40%
Infratest/dimap	1.28%

After extracting the absolute strength of each party from the message volume, we now turn to the relationships between parties. This is all the more relevant, as all parties were far from an absolute majority in the weeks preceding the federal election and a coalition government was on the horizon.

As many tweets mention more than one political party, we investigate whether joint mentions reflect prevailing or even upcoming political ties. To make the comparison easier, we focus on tweets mentioning only two parties. Based on the overall probability that any one party is mentioned in these tweets, a conditional probability that two parties are mentioned together can be computed. If all combinations were equally likely, this conditional probability should equal the observed share of tweets mentioning these two parties. Due to different base rates, we divide the observed share of joint mentions by the conditional probability to derive a comparative measure. If *share*(*CDU*, *CSU*) represents the share of observed joint mentions of these two parties, the relative frequency (*f*), is calculated as follows:

$$(2) \qquad f = \frac{share(CDU, CSU)}{\left[P(CDU|CSU) + P(CSU|CDU)\right]/2}$$

The relative frequency illustrates how often two parties are mentioned together relative to the random probability based on the overall "share of voice" of the individual parties. If f equals 1.5 the share of observed joint mentions is 50% higher than pure chance would suggest.

Table 6 shows the relative frequency for all combinations of two parties based on all tweets mentioning more than on party (n = 61.700). Not surprisingly, the combined mentioning of sister parties CDU and CSU was the most frequent (f = 1.25), whereas CSU and the left-of-center parties (SPD, Green party, and Linke) were mentioned together the least.

While the governing coalition of CDU and SPD are naturally mentioned jointly quite frequently, the Union parties (CDU and CSU) are associated most closely with its desired coalition partner at that time, the FDP. The parties of the left side of the political spectrum are associated with each other more often than with the right-of-center parties (CDU, CSU, and FDP). In sum, the joint mentions of political parties accurately reflect the political ties between the parties.

We conclude that despite the fact that the Twittersphere is no representative sample of the German electorate, the activity prior to the election seems to validly reflect the election outcome.

Table 6: Relative frequency of joint mentions

	CDU	CSU	SPD	FDP	LINKE
CDU					
CSU	1.25*				
SPD	1.23*	0.71*			
FDP	1.04*	1.01	0.90*		
LINKE	0.81*	0.79*	1.04*	0.97	
Grüne	0.84*	0.79*	0.98	1.06*	1.18*

** Significant at the .05 level*

Conclusion and further research

We analyzed over 100,000 Twitter messages mentioning parties or politicians prior to the German federal election 2009. Overall, we found that Twitter is indeed used as a platform for political deliberation. The mere number of tweets reflects voter preferences and comes close to traditional election polls, while the sentiment of Twitter messages closely corresponds to political programs, candidate profiles, and evidence from the media coverage of the campaign trail.

With respect to our first research question, we found more than one third of all messages to be part of a conversation indicating that Twitter is not just used to spread political opinions, but also to discuss these opinions with other users. While we find evidence of a lively political debate on Twitter, this discussion is still dominated by a small number of users: only 4% of all users accounted for more than 40% of the messages.

With respect to our second research question, we found the sentiment profiles of politicians and parties to plausibly reflect many nuances of the election campaign. For example, the similar profiles of Angela Merkel und Frank-Walter Steinmeier, mirror the consensus-oriented political

style of their grand coalition before this election. Messages regarding Steinmeier, who at that time was sending mixed signals regarding potential coalition partners after the election, reflect more tentativeness than those of other politicians. More polarizing political characters, such as liberal party leader Westerwelle and socialist party leader Lafontaine, show deviations from this profile which correspond to their roles as politicians of the parliamentary opposition. We also found that politicians evoke a more diverse set of profiles than parties. Overall, the similarity of the profiles is indicative of the parties' proximity with respect to political issues, the great similarity of the Union factions CDU and CSU only being the most prominent example.

With respect to our third research question, we found that the mere number of messages reflects the election result and even comes close to traditional election polls. This finding is in contrast to previous studies of political deliberation online. The share of campaign weblogs prior to the 2005 federal election in Germany was by no means representative of the relative strength of the parties showing an overrepresentation of the small parties in the blogosphere (Albrecht et al. 2007). In a study on internet message boards by Jansen and Koop (2005) even the positions of the two largest parties were reversed and the party winning an absolute majority attributed only 27.2% of the party mentions. The authors attributed this phenomenon to the dominance of a few users who "determined the overall ideological 'feel' of the discussion board" (Jansen and Koop 2005, p. 624) Given that there was even less equality of participation in our sample, it is all the more surprising that heavy users were unable to impose their political sentiment on the discussion. This may be a result of the large number of participants on Twitter who make the information stream as a whole more representative of the electorate. Our results suggest that Twitter may complement traditional methods of political forecasting (e.g., polls or surveys).

In sum, our results demonstrate that Twitter can be considered a valid indicator of political opinion.

This study has several limitations. First, research on political bloggers (McKenna and Pole 2008) and similar demographics of Twitter users (pearanalytics 2009) suggest that our sample may not have been representative of the German electorate. However, the fact that these well-educated users "influence important actors within mainstream media who in turn frame issues for a wider public" (Farrel and Drezner 2008, p. 29) warrants special attention to Twitter as a source of opinion leadership.

Second, our data were limited to the tweets containing the names of parties and politicians that we defined as search terms. Therefore, we may have missed some replies belonging to a discussion thread because respondents do not necessarily repeat these names in every message. In their study of political discussion boards, Jansen and Koop (2005) have found that only 60% of all messages mentioned a political party by name. However, since Twitter users are aware of the unstructured nature of microblogging communication and therefore include searchable keywords, so-called hashtags, in many messages (e.g., "#CDU"), we believe the share of relevant replies to be small. In addition, parts of the information relayed through Twitter are embedded in links. Including these missing pieces of information may change our results regarding sentiment and equality of participation. Therefore, future research should try to capture the context of a particular statement more comprehensively either by following embedded links or by searching for replies to an author.

Third, our investigation was based on one particular text analysis software and used an existing dictionary not specifically tailored to classify such short messages as tweets. There are many specifics of communication through microblogging services, including the use of a special syntax and conventions (e.g., the use of emoticons) which are not reflected in our default LIWC dictionary. Since we translated the German language messages into English some meaning may have been lost in the translation. However, we believe this effect to be negligible since LIWC is based on word count only and therefore should not be affected by grammatical errors. Fourth, we treated all messages published in a given time frame as one document. Further research should refine the text analysis to the political discussion and investigate sentiment one tweet at a time.

Finally, while we have examined overall political sentiment, voters' attitudes and opinions may vary depending on specific political issues. Future sentiment analysis could address this issue by conducting a more detailed classification of content.

Summarizing, our results demonstrate that Twitter can be seen as a valid real-time indicator of political sentiment. Little research has yet been conducted in this area leaving many questions unresolved. Further research should test whether text analysis procedures which are more closely tailored to the political debate reflecting both the specifics of microblogging and the political issues can produce even more meaningful results. Researchers should also try to capture the context of a particular statement in a more comprehensive manner including threads of conversation and links to information beyond the tweet.

In contrast to Sunstein (2008), who argues that the blogosphere cannot serve as a marketplace for information because it lacks a pricing system, we find that information on Twitter can be aggregated in a meaningful way. The size of the followership and the rate of retweets may represent the Twittersphere's "currency" and provide it with its own kind of a pricing mechanism. The fact, that even the fairly simple methodology used in our study was able to generate plausible results is encouraging and points to additional possibilities to leverage Twitter as an information market.

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