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Individual users' participation on political Facebook pages

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Social media platforms such as Facebook enable citizens to participate in politics by engaging with content from parties and politicians. Most research has described these activites by means of survey self-reports, smaller sample studies which combined surveys and digital trace data, or larger-scale aggregate digital trace data. The current literature lacks a large-scale descriptive account of individual users' interactions with political content. We analyze a large-scale collection of individual-level Facebook user data from the German federal election year 2017. The data contain millions of interactions by over 2.5 million unique users on 320 Facebook pages of major parties in Germany. They include almost all possible ways to publicly interact with content on these pages and as such cannot be collected today due to newer access restrictions. A large share of users participated only once, especially on the top politicians' pages, or interacted only with a single page. However, we also found a sizeable group of users who were active on many different pages even across party boundaries, and that these users were responsible for a majority of comments and reactions

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on almost all pages. In addition, there were substantial differences in user participation on the main national party pages and the ones of top politicians on the one hand, and the less prominent pages on the other hand. Our large-scale quantitative description provides context for previous and future smaller-scale in-depth analyses.

Keywords: social media, Facebook, individual user behavior, political participation, digital traces, computational methods

The rise of social media has opened up new ways for citizens to engage with parties, politicians, and politics by means of comments, recommendations, references, and other forms of online expression. Recent work has emphasized that most of these expressive social media-enabled activities constitute a form of political participation (Gibson & Cantijoch, 2013; Theocharis, Moor, & van Deth, 2021; Theocharis & van Deth, 2018). Moreover, a vast body of literature has examined how social media use relates to other means of participation. A meta-analysis by Boulianne (2019) focusing on cross-sectional survey designs found that social media use —and especially expressive acts such commenting on a political post— is conducive to offline political engagement (e.g., voting, protesting). Notable exceptions are panel and experimental studies, which tend to produce diverging results (Boulianne, 2015, 2019). With respect to platforms, Facebook tended to be the focus of survey-based research, if a specific social networking site was mentioned (Boulianne, 2019). Since most studies have relied on respondents' self-reported Facebook activities, researchers have started to examine the accuracy of these measures by combining survey and digital trace data (Guess, Munger, Nagler, & Tucker, 2019; Haenschen, 2020). Overall, individuals' assessments tended to match their actual behavior. Moreover, both studies found low levels of political activity on Facebook such as liking politicians' pages or sharing news links, which is in line with previous survey studies (e.g., Theocharis & van Deth, 2018; Wells & Thorson, 2017). Still, these findings are based on samples of a few hundred individuals, making it hard to accurately capture infrequent activities (Guess, Aslett, Tucker, Bonneau, & Nagler, 2021). Digital trace data, on the other hand, allow for a more fine-grained analysis of user behavior

on a large scale (Stier, Breuer, Siegers, & Thorson, 2020). Studies using such data mainly focused on Twitter (Jungherr, 2016). The service provides easier data access, but has a very specific user base compared to the general electorate (Hölig, 2018). Facebook, on the contrary, is much more popular among mainstream Internet users (Koch & Frees, 2017), but its data were always harder to collect at the level of individual users. Most of the existing studies on Facebook user behavior have therefore looked at the audience in aggregate numbers (e.g., Blassnig, Udris, Staender, & Vogler, 2021; Magin, Podschuweit, Haßler, & Russmann, 2017; Muraoka, Montgomery, Lucas, & Tavits, 2021; Nielsen & Vaccari, 2013). The few analyses of larger data sets on individual user behavior focused only on specific types of users (Bossetta, Dutceac Segesten, & Trenz, 2017; Papakyriakopoulos, Serrano, & Hegelich, 2020) or on more general questions on information flows (e.g., Bakshy, Messing, & Adamic, 2015; Del Vicario et al., 2016). Despite these important contributions, we still lack a clear-cut description of individuals' activity patterns and thus how online political participation on Facebook typically looks like.

In this article, we aim at filling this gap by using a large-scale collection of individual-level Facebook user data from the German federal election year 2017. The present data encompass *public* communication activities on 320 Facebook pages of the major parties in Germany (CDU, CSU, SPD, GRÜNE, LINKE, FDP, AFD) and their politicians over six months, which allows for individual-level analyses of all contributions (not only comments and replies but also one-click reactions),[1] as they were available via Facebook's Graph API. We argue that a thorough description of user behavior is helpful for assessing the overall relevance of Facebook interactions as forms of political participation or facilitators thereof, but also provides a solid foundation for discussions about cross-party interactions.

Literature overview and research questions

In the 1970s, Verba and Nie (1972) defined political participation as "activities by private citizens that are more or less directly aimed at influencing the selection of governmental personnel and/or the actions they take" (p. 2). Their conceptualization encompassed four broad types: voting, campaign activity, cooperative activity, and citizen-initiated contact.

[1]Under one-click reactions, we subsume likes and emoticon reactions to posts as well as likes to comments.

The Internet and especially social media have added to this repertoire. Some online activities can be characterized as digital versions of traditional acts such as signing an online petition, whereas more expressive actions on social media have been conceptualized as a distinct form of political participation (Gibson & Cantijoch, 2013; Theocharis, Moor, & van Deth, 2021; Theocharis & van Deth, 2018). Using the set of decision rules developed by van Deth (2014) as a starting point, Theocharis (2015) argues that many common forms of expressive social media-enabled acts (e.g., sharing links or commenting) conform to narrow as well as expansive definitions of political participation. One notable exception is liking, something, which, according to Theocharis (2015), displays an attitude, and therefore misses the prerequisite of being an action. Others, however, have referred to liking as a form of low-effort participation (Heiss & Matthes, 2019; Knoll, Matthes, & Heiss, 2020) or easy political behavior (Bode, 2017). One-click reactions to political social media content may be understood as a communicative action toward its sender. It can also be assumed that at least some users are aware of the influence of likes on the algorithms which control the distribution of content on social media. A like is then another, less direct form of sharing the content. Since the aim of our study is to give a broad overview over users' Facebook activities, which have been studied with respect to political participation, we included all one-click reactions (e.g., likes) alongside commenting in our analysis.

Regarding political Facebook pages, a study by Guess, Munger, Nagler, and Tucker (2019) that linked survey and digital trace data found that a large proportion of users liked no or only a few of those pages. Studies using aggregate audience metrics corroborate this finding. For example, Nielsen and Vaccari (2013) revealed that only a few candidates in the 2010 U.S. congressional election received a significant amount of likes for their public Facebook profiles. In the German context, Stier et al. (2018) showed that leading candidates and main party accounts amassed the most Facebook page likes. Moving beyond the profile level, other scholars observed that comments were strongly concentrated on a few candidate pages (Sørensen, 2016). We extend this research by investigating how users distributed comments and reactions across different page types, i.e. party main pages, pages belonging to the top politicians, and all other pages, including state-level and regional party chapters as well as candidates. Therefore, our first research question is:

RQ1 Did users predominantly interact with content created by main party

pages and leading politicians compared to other political Facebook pages?

User-focused studies have mostly used digital trace data in order to analyze information diffusion or network structures. In this context, much of the current research revolves around the extent to which users interact with politically like-minded individuals, i.e. exhibit homophilic tendencies (e.g. Bakshy, Messing, & Adamic, 2015; Barberá, Jost, Nagler, Tucker, & Bonneau, 2015; Colleoni, Rozza, & Arvidsson, 2014). Without exposure to others who hold diverging political viewpoints, this might contribute to echo chambers, whereby individuals become entrenched in "a bounded, enclosed media space that has the potential to both magnify the messages delivered within it and insulate them from rebuttal" (Jamieson & Cappella, 2008, p. 76).[2] However, due to the networked nature of social media platforms, users also encounter information that they did not actively seek out. Existing survey research tends find to a positive relationship between incidental exposure to political content on social media and online and offline participation (Heiss & Matthes, 2019; Kim, Chen, & Gil de Zúñiga, 2013; Valeriani & Vaccari, 2016; notable exception: Lee, Nanz, & Heiss, 2022). Encountering opposing viewpoints (i.e. cross-cutting exposure) is considered to have consequences for political engagement, although the magnitude and even the direction of such effects, as well as the conditions under which they may occur, remain disputed in the literature (for an overview see Matthes, Knoll, Valenzuela, Hopmann, & Von Sikorski, 2019). Descriptive evidence on how common opportunities for engagement with cross-party political content are on social media provides important context to think about the broader relevance of its potential effects. Within the specific realm of political Facebook pages, the studies by Papakyriakopoulos, Serrano, and Hegelich (2020) and Batorski and Grzywińska (2018) provided insights into cross-ideological user interactions and user activities more broadly. Focusing on Polish users' activity in 2013 and 2015, Batorski and

[2]Our empirical study of passively collected digital trace data does not contain information about individuals' political leaning, media diet, or social media activities beyond the surveyed political pages. The analysis aims to shed light on opportunity structures for cross-party talk, i.e., the engagement with content on the pages of different parties, rather than interactions with users of different political leaning. Therefore, we cannot address the concepts of homophily and echo chambers directly. Instead, we will use the terms cross-party interactions and co-presence of users who were active on pages of different parties. Such observable interaction patterns make ideologically cross-cutting exposure more likely (and, consequently, homophily and echo chambers less likely), but they are not direct measures of these concepts.

Grzywińska (2018) found that a majority of individuals rarely interacted with Facebook pages of political parties and their politicians. More than two thirds of users in 2013 and 2015 were active on only one page (Batorski & Grzywińska, 2018, p. 364). In similar vein, Papakyriakopoulos, Serrano, and Hegelich (2020) report that 74% of all commenters left only one comment on the main Facebook pages of the major German political parties. On the other hand, a small group of hyperactive users was responsible for roughly 25% of all likes and comments. Similarly, Bossetta, Dutceac Segesten, and Trenz (2017) found that 70% of users only commented once on British media or Brexit campaign pages. Focusing on user-generated posts on the Facebook page of the German AFD party, Arzheimer (2015) found further evidence for a highly uneven distribution of activities across users. These findings form the basis of two research questions:

RQ2 How active have individual users been overall and on different pages?

RQ3 On how many different political Facebook pages were individual users active, and how many interactions came from one-time and page-exclusive users?

With regards to user interactions across the political spectrum, Batorski and Grzywińska (2018) found evidence for users being clustered along party lines in 2013 (less so in 2015). Papakyriakopoulos, Serrano, and Hegelich (2020) only looked at the cross-party interactions of hyperactive users.[3] A fairly large proportion either liked (29%) or commented (54%) on more than one page. However, this group is very small in absolute terms. These diverging results may be due to the selected sample of professional political communicators and their audiences. Papakyriakopoulos, Serrano, and Hegelich (2020) collected public communication activities only for seven party main pages, whereas Batorski and Grzywińska (2018) also included candidate profiles resulting in larger sample sizes of 70 pages for 2013 and 133 for 2015. Thus, we want to further investigate the interaction patterns of users with the content on a larger and more diverse set of political pages, which also includes party and politician pages on the subnational level. This leads to the research question:

[3]Hyperactive users were identified separately for likes and comments. In both cases, users were defined as hyperactive if they repeated the respective activity three or more times. 5.3% of all commenters and 4.3% of all people who liked content were characterized as hyperactive.

RQ4 How prevalent were users' interactions with pages of different parties?

In the political participation literature, comments and one-click reactions (e.g., likes) have been characterized as easy political behavior (Bode, 2017), lower-threshold (Vaccari et al., 2015) or low-effort activities (Heiss & Matthes, 2019). Despite being commonly grouped together, the interaction types we focus on in this article, reactions and comments, differ in terms of motivations behind them and the required effort. A study by Macafee (2013) linked commenting to social and informational motivations, whereas clicking the like button was more strongly connected to self-presentation motivations. Furthermore, reactions only consume a small amount of time and energy. Commenting, in contrast, requires at least some elaboration on the content of the post (Bode, 2017). Regarding political Facebook pages, Batorski and Grzywińska (2018) found that users mostly liked content, whereas more time- and energy-consuming activities were less common. Unfortunately, the authors only reported the aggregate number of likes and comments, thereby missing out on individual level variation. Thus, we ask:

RQ5 How were users' individual activities distributed across comments and reactions?

The different motives and required effort behind commenting (social/informational motivations) and liking (expressive motivations) might also play a role for the type of users' cross-party interactions. A study based on the major German parties' Facebook pages by Stier, Posch, Bleier, and Strohmaier (2017) found that liking followed ideological lines, whereas comments were more evenly spread across all party pages. We want to build on these findings by broadly looking into the way users distributed comments and one-click reactions across parties. A key reason for this investigation is that Facebook added more reaction features (e.g., an angry emoticon) in 2016, thereby giving individual users more and easier ways to interact with content. We therefore pose the following question:

RQ6 How did users distribute comments and one-click reactions across parties?

Finally, the temporal dimension of user behavior on political Facebook pages has mostly been studied in aggregate numbers (e.g., Gerodimos & Justinussen, 2015; Koc-Michalska, Lilleker, Michalski, Gibson, & Zajac, 2021). In the German context, Stier et al. (2018) investigated the aggregate temporal dynamics over the course of the 2017 election campaign. They found that the activities from both the audience and professional communicators increased in the run up to election day. We want to expand this research by investigating individual users' activities before and after the election. Therefore, our final research question asks:

RQ7 What were the temporal dynamics of users' interactions before and after the election?

Methods

The vast majority of research on social media and political participation has been carried out in the USA (Boulianne, 2020). By focusing on German Facebook profiles, this study provides an empirical account of online political participation under proportional representation in a multi-party system. The different political context likely impacts the level of users' engagement. For example, the level of campaign spending is much higher in the USA, which should result in differences between the proportion of users that actually come into contact with content from political party pages, e.g., via paid advertising. Additionally, in comparison to other European states, Germany has an above average proportion of citizens that reported posting or sharing political content online in the last twelve months (European Social Survey, 2020). This makes it more likely to encounter online forms of participation. The German social media landscape in 2017 also makes for an excellent case study for investigating political participation on social media. Facebook was then still the single predominant social media platform for the German general public: 33% of the German population reported to use the platform at least weekly (Koch & Frees, 2017), roughly matching Facebook's own reports of 31 million monthly active German users (Facebook, 2017). The use of other platforms, such as Instagram (9% weekly users) or Twitter (1% weekly users) (Koch & Frees, 2017), was negligible in the general population. Facebook in Germany 2017 was therefore a reasonable proxy for social media in general. A valid

description of the online activities of similarly large population segments in later election years would require cross-platform data, which is hard, if not impossible, to collect at such scale.

2017 was also the last year in which the Facebook Graph API allowed for the collection of data on individual user behavior (Freelon, 2018). We collected the digital traces of all user interactions on a variety of political Facebook pages of the major German political parties. The data were collected continuously from July to December 2017. They cover a time frame of six months, including the pre-campaign, campaign, and post-election periods. We have an almost complete recording of users activities on these pages, covering comments to posts, replies to these comments, reactions to posts, and likes to comments. Each user has a unique alphanumeric identifier, which allowed us to trace every user's contributions across all Facebook pages in our sample. The data retrieval process was initialized every six hours, and each new post or comment was surveyed over three days after its initial publication. The six-hour time window added approximate time stamps for reactions, for which the API did not provide a date attribute. Additionally, the close tracking of Facebook offers a more complete picture of user behavior compared to data collection after the study period, because considerable parts of user-created content disappear from the platform rather quickly (Bachl, 2019).

We initially collected data from about 400 political Facebook pages, but oversampled the pages of the right-wing AFD (n = 121). We collected data from a comparable number of pages for each of the other parties, which resulted in the following frequency distribution: CDU (n = 44), CSU (n = 38), FDP (n = 47), GRÜNE (n = 53), LINKE (n = 48), SPD (n = 50). The pages were selected by a network sampling approach based on page likes to include the pages which were most liked by other pages of the same party. To allow for a more balanced comparison of user behavior across party pages in the present analyses, we reduced the number of AFD pages to 40 by drawing a stratified subsample from all AFD pages. The strata were based on the characteristics of the pages, specifically, whether it was a page of a politician or belonged to either a federal, state or regional party chapter. We then randomly sampled from each level according to the average number of cases in each stratum for all parties except the AFD.[4] Since this study focuses on individual user

[4]The only exception are politician pages where we took a complete sample. This is due to the small

behavior, we also removed all activities of professional page administrators, regardless of whether they were found on their own or on other pages. Table 3 in the Appendix lists the pages in the sample.

We split our analyses according to two factors: page type and political party. We distinguished three page types: Party main pages, pages belonging to the top politicians, and all other pages. This allows for a comparison between the findings in this study and existing research on individual user behavior, which has focused on the Facebook main pages of the major German parties (Papakyriakopoulos, Serrano, & Hegelich, 2020). Furthermore, Haller (2019) found that some major candidates for the 2017 German federal election received far more attention than the main pages belonging to their respective party in terms of aggregate number of likes. The division into three page types aims at capturing these inter-page differences. The top politician pages for each party were selected based on the overall popularity of the pages on Facebook and on the status of the politicians within their parties. For CDU, SPD, and FDP, the selection was straightforward: Angela Merkel (CDU), Martin Schulz (SPD), and Christian Lindner (FDP) were the top candidates of their parties and also had the most popular pages. GRÜNE and LINKE fielded two top candidates, but only one candidate of each party had a page which stood out from the other pages of their party. The pages of Cem Özdemir (GRÜNE) and Dietmar Bartsch (LINKE) were therefore included in the top politicians category. For the CSU, we selected Markus Söder, who had the most prominent page of a CSU politician in our sample and soon after the election became Minister-President of the Free State of Bavaria, instead of the rather unknown Joachim Herrmann, who was the parties' official top candidate. Finally, several AFD politicians in top party positions had similarly popular pages. We included the pages of the chairs of the federal party, Jörg Meuthen and Frauke Petry, as well as the page of one of the two top candidates, Alice Weidel, in the top politician category. The second top candidate, Alexander Gauland, had no Facebook page. In sum, the top politicians group encompassed 9 pages and the main party category 7 pages (one for each of the seven parties), leaving 304 pages in the "other" category.[5]

number of politician pages associated with the AFD.

[5]The pages in the "other" category were additionally split into two groups: pages of politicians and pages of federal, state or regional party organisations. However, as shown in Table 4 in the Appendix, both groups only exhibited small differences. Therefore, only the aggregated "other"

Prior research points to substantial inter-party differences. Compared to the other six major German parties, the AFD has consistently attracted a much larger and more active audience on Facebook (Serrano, Shahrezaye, Papakyriakopoulos, & Hegelich, 2019; Stier et al., 2018). Magin, Podschuweit, Haßler, and Russmann (2017) found that small parties in Germany and Austria were more inclined to reach out to voters via Facebook. This relates to the question whether social media levels the playing field for smaller parties (equalization hypothesis) or replicates the dominance of major parties (normalization hypothesis) (Gibson & McAllister, 2015). Therefore, and because such a split is interesting descriptively, we also present most of our results for each party separately.

We used *R* (version 4.1.0) (R Core Team, 2021) for data analysis. Packages from the *tidyverse* (Wickham et al., 2019) were used for data management, manipulation, and plotting. We investigated how users distributed their comments and one-click reactions across parties (RQ 6) by calculating the number of effective parties with a function provided by the *vegan* package (Oksanen et al., 2020). The manuscript was generated with *papaja* (Aust & Barth, 2020). Replication material can be found on the Open Science Framework.[6] It contains a data set of 200.000 randomly sampled unique users. To avoid re-identification of individual users, the data set does not contain the exact page name. Only the information on the three page types is retained. In addition, the publication dates were rounded to weeks. The OSF repository contains an *R* script, which allows to reproduce our analyses based on the provided data set.

Results

Over the six month time frame covered by this study, we observed 2,617,353 Facebook users on 320 pages belonging to seven parties. Taking into account the approximately 31 million monthly active users in Germany, our analysis shows that less than one-tenth of the all Facebook users interacted with the pages in our sample. Still, those users accounted for an overall of n=30,360,980 interactions.

The first step in understanding individuals' participation activities on political Face-

category is presented in the main text.
[6]The link is https://osf.io/wmf6q/.

book pages is inspecting on what type of pages users were active. Our first research question (RQ1) asked whether we could observe differences in users and interactions between the main party pages, top politician pages, and other party pages. The most frequented (in terms of interactions) page was the national party page of the AFD with an average of 169,342 weekly interactions, more than twice as many as any other page in our sample. The next most popular pages were those of the top candidates for the AFD (Alice Weidel), SPD (Martin Schulz), and CDU (Angela Merkel). The 10 most frequented pages included seven top politicians pages and three party main pages. Despite accounting for only 5% of all pages in our sample, both the top politician (n = 1,703,679) and main party pages (n = 1,048,657) attracted more unique users than all the remaining pages combined (n = 942,651), and accounted for more than 72% of all interactions. Our findings therefore corroborate earlier research that found a strong concentration of users' attention towards a small number of pages, specifically top politician and national party pages. It is noteworthy, however, that even within these groups of popular politician and party pages, there was considerable variation in the number of users and interactions.

Since we tracked individual users across pages and over time, we can address research questions RQ2 and RQ3 by summarizing their activities across pages and parties. Out of all Facebook users who interacted with a page in our sample, 45% appeared only once, and an additional 21% interacted only with a single page (Table 1). The one-time users appeared mostly on the major pages. The top politician pages alone accounted for 54% of all one-time users and 57% of all one-page users. Given this uneven distribution, the average proportion of one-time and one-page users was highest for the pages in the top politician category (Table 1). Additionally, we found substantial heterogeneity when looking at different parties within these groups. As displayed in the upper panel of Figure 1, candidates for chancellor Martin Schulz (SPD) and Angela Merkel (CDU) disproportionately attracted one-time users. From the main party pages subset, the accounts of GRÜNE and AFD were those with highest proportion of one-time users. Still, the proportion of users who interacted with multiple parties across all page types was quite high, ranging from 23% for the page of Angela Merkel to 69% for the main party page of the CSU. Moreover, large majorities of comments and reactions were from users who interacted with multiple parties (Figure 1). Most notably, the pages of Martin Schulz and Angela Merkel had significantly more one-time and page-exclusive users compared to other pages in our sample, and therefore also fewer cross-

Table 1: Overview of sample and user behavior by page types

	Main party pages	Top politicians	Other	Overall
Sample sizes				
Pages	7	9	304	320
Interactions	8,903,879	13,058,026	8,399,075	30,360,980
Comments	1,366,738	1,838,465	1,058,224	4,263,427
Reactions	7,537,141	11,219,561	7,340,851	26,097,553
Unique users	1,048,657	1,703,679	942,651	2,617,353
Proportions of users / interactions (in percent)				
One time	27 / 3	37 / 5	27 / 3	45 / 4
One page	39 / 10	58 / 18	36 / 7	66 / 13
One party	62 / 30	73 / 36	58 / 26	78 / 31
Multiple parties	38 / 70	27 / 64	42 / 74	22 / 69
Cross-Cutting (gov.-opp.)	29 / 61	20 / 55	31 / 64	15 / 59
Cross-Cutting (left-right)	24 / 51	18 / 49	26 / 54	13 / 51
Per user averages (SD) / median				
No. of interactions	23.9 (115) / 4	16.1 (92) / 2	25.6 (121) / 4	11.6 (74) / 2
No. of pages	3.1 (3) / 2	2.4 (3) / 1	3.4 (4) / 2	2 (2) / 1
No. of parties	1.7 (1) / 1	1.4 (0.9) / 1	1.7 (1) / 1	1.3 (0.8) / 1
Comment share	13.7 (27) / 0	11.3 (25) / 0	13 (26) / 0	11.8 (27) / 0

Notes. The top third of the table shows some aggregate statistics for the three page types as well as the full sample. Note that users could interact with more than one page type. Thus, the number of unique users on each of the three page types does not sum to the number of unique users displayed in the overall column. The next two sections contain proportions and averages of individual-level characteristics for users that interacted with the given page type. The variable *cross-cutting left-right* shows the proportion of users who were active on the pages of parties on the left side (GRÜNE, LINKE, SPD) and right side (CDU, CSU, FDP, AFD) of the ideological spectrum. Similarly, *cross-cutting government-opposition* displays the proportion of users who were active on the pages of both opposition (GRÜNE, LINKE, AFD, FDP) and government (CDU, CSU, SPD) parties. Lastly, *comment share* measures the share of comments among all interactions (averaged over all users who interacted with the given page type).

partisan users. But they were the exceptions rather than the norm, at least in our sample of German political Facebook pages. While Table 1 shows that the average user in all three groups was at least active on two distinct pages, Figure 2 gives a graphical overview of this distribution for both the number of unique pages and parties users interacted with. In each of the subcategories, a small but substantial minority of individuals left their digital traces behind on four or more pages. Taken together, our analysis indicates that users were quite frequently active (RQ2) and interacted with a rather diverse set of pages (RQ3) — with the exception of users' activities on top politician pages, which slightly deviated from these findings. However, it is important to keep in mind that only about 2.5 million accounts out of the 31 million monthly active Facebook users interacted with the pages in our sample. If we additionally take into account that 45% were active only once, it becomes clear that the group of frequent users was rather small in relative terms.

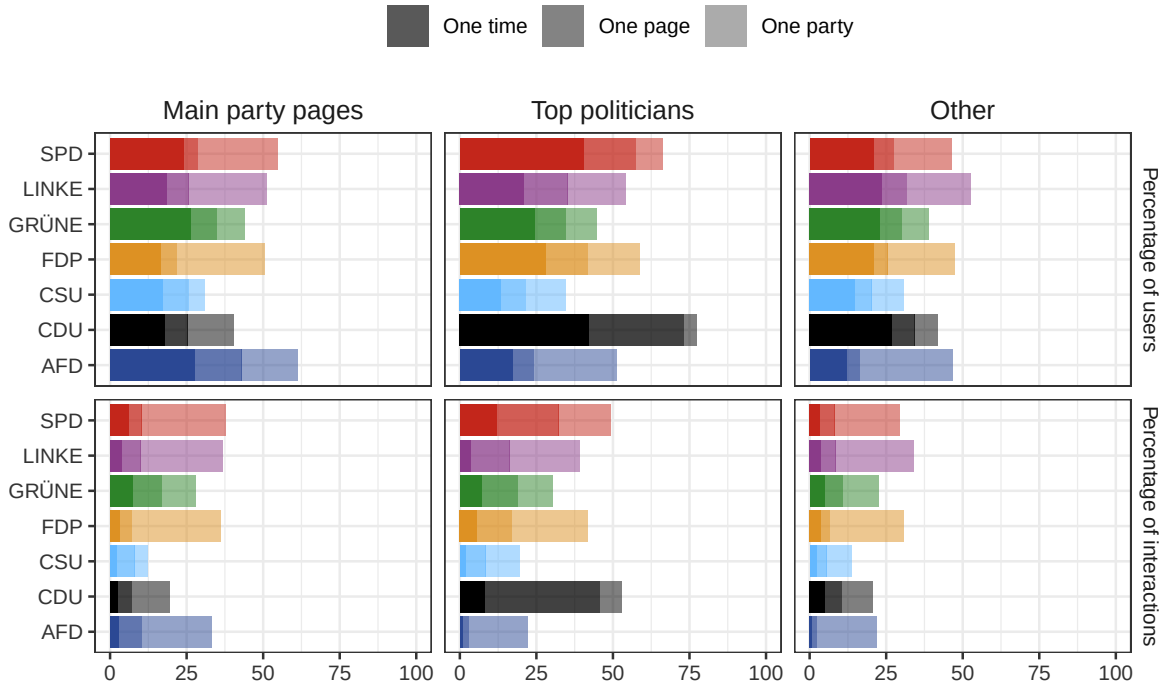

Figure 1. User types per party and page type (in percent)
Notes. The top row shows the proportions of users with only one interaction, users with interactions on one page, and users with interactions on multiple pages of the same party for each party. The bottom row shows the proportions of interactions per party which originated from the users in each category.

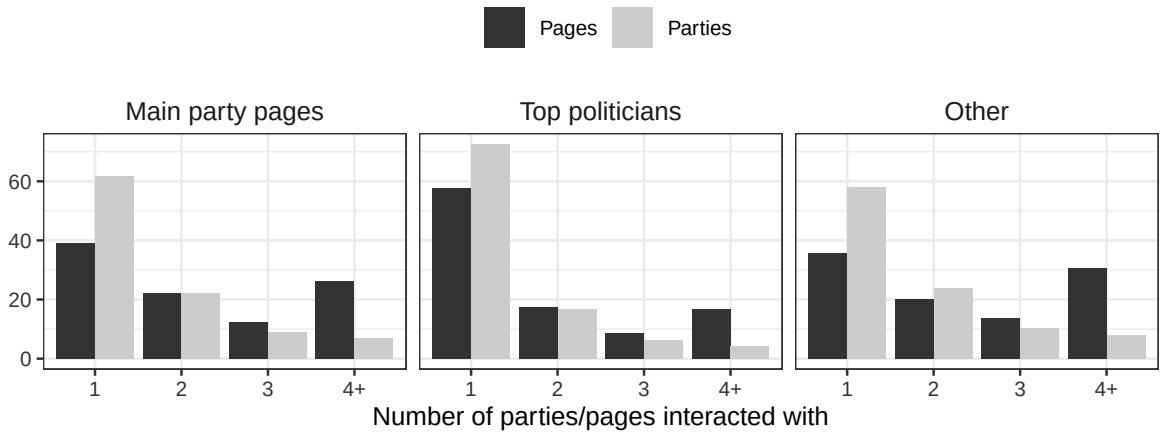

Figure 2. Frequency of cross-party users (in percent)

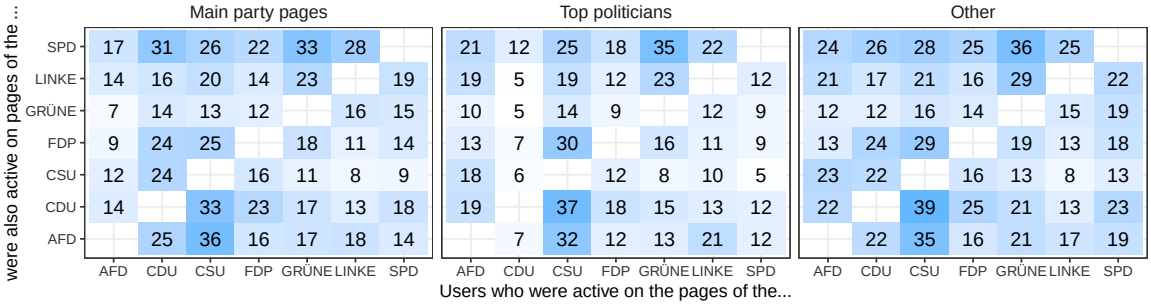

Figure 3. User overlap between all parties (in percent)
Notes. The numbers are read as follows (using the top-left cell as an example): 17% of the users who engaged with the main AFD party page also engaged with any page of the SPD.

Figure 2 moreover shows that a relatively small group (n = 77,648, 3%) of users engaged with four or more different parties in our sample of Facebook pages. Crossing party lines was typically confined to interacting with two or three different parties, but not altogether rare. In order to further explore the underlying patterns, we adopted an approach by Stier, Posch, Bleier, and Strohmaier (2017) for calculating the overlap between users of each party. The results are presented in Figure 3. While some overlap between parties can be expected, especially for the CSU (with its larger sister party CDU), the emerging picture is that almost all political pages provided opportunities for cross-party interactions as Figure 3 shows significant shared user bases for almost all party pairs. Again, the only exception from this pattern were the pages of Angela Merkel (CDU) and Martin Schulz (SPD) in the top politician category, which shared only a small proportion of their users with other parties. This is hardly surprising, given the high percentage of one-time users associated with both politicians' pages. One finding is especially noteworthy: Despite forming a parliamentary union, the CDU and CSU did not share the highest user overlap in the main party pages group. Instead, 36% of users who were active on the main page of the CSU also interacted with content on one of the pages belonging to the AFD, making it the pair with the largest shared user groups in this group. Apart from this, parties of the left political spectrum (LINKE, GRÜNE, SPD) and right political spectrum (AFD, CSU, CDU, FDP) tended to have higher levels of user overlap with each other, thereby indicating some degree of ideological left-right sorting.

From the perspective of ideological polarization, we further analyzed these patterns

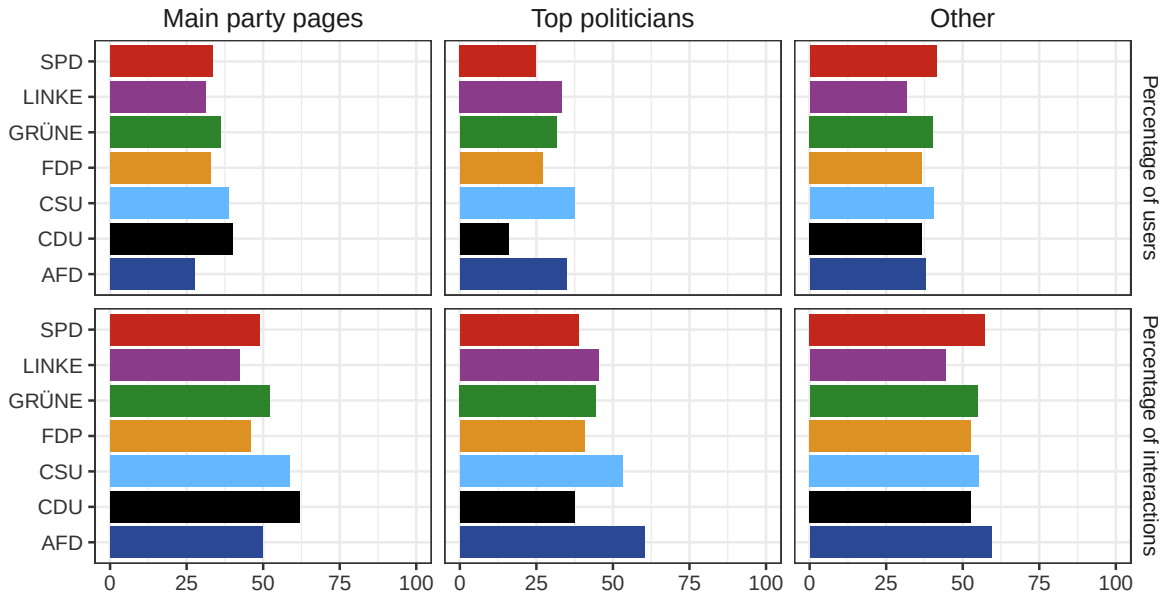

Figure 4. Cross-cutting (left-right) users per party and page type (in percent)

by counting how many users were active (a) on both left and right party pages (62% of all multi-party users) as well as (b) on both government (CDU, CSU, SPD) and opposition (LINKE, GRÜNE, FDP, AFD) parties' pages (72% of all multi-party users). Again, details for different page types can be found in Table 1. The relatively more common case of government-opposition party interactions could be explained by the fact that the governing SPD/CDU/CSU coalition covered a broad ideological spectrum, and partly overlaps with positions from left and right opposition parties. Interestingly, the binary measure of user overlap (i.e. whether or not a user interacted with a party pair) seems to mask that a large proportion and often times even a majority of comments and reactions stemmed from users who were active on the pages of parties from the left and right political spectrum (Figure 4). Overall, our finding suggest that crossing party lines by participating on different Facebook pages was a rather common behavior (RQ 4). Figure 4 also illustrates that co-presence and even cross-party interactions were the norm, with the exception of the user bases for the top politicians of SPD and CDU as well as the AFD main party page.

Turning to the types of users' individual activities (RQ 5), Table 1 and Figure 5 show the share of comments among all interactions for the average user of each page group (i.e. number of comments divided by number of comments and reactions per user). Several

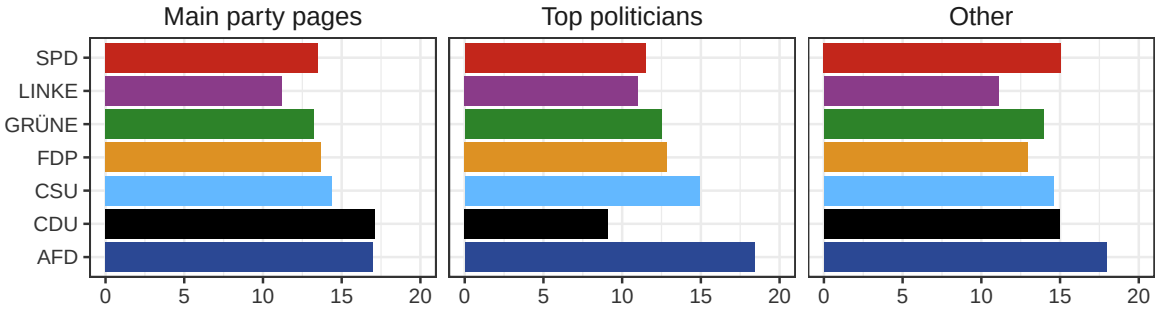

Figure 5. Average comment share of all interactions per user (in percent)

interesting patterns can be observed. First, comments only made up a small percentage of all user interactions. In fact, on average, less than 15% of an individual's activities were comments in each of the pages subsets (Table 1). Accordingly, there exists only a moderate correlation between the number of reactions and comments for each subset (upper row of Table 2). Secondly, users who engaged with content on the page of Angela Merkel (CDU) predominantly did so by using one-click reactions (e.g., likes). Thirdly, only on the AFD pages comments made up more than one sixth of an average individual's interactions in each subcategory. This is potentially due to the controversial positions of the party which could attract highly engaged users who are more open to commenting. Overall, our findings are in line with previous research which found that users typically refrain from engaging in more time- and energy-consuming means of online participation such as commenting.

Table 2: Correlation between reactions and comments (Pearson's r)

	Main party pages	Top politicians	Other
Count	0.38	0.38	0.38
Effective Parties	0.43	0.43	0.41

The next research question (RQ 6) is concerned with the interplay between the type of activity and the prevalence of cross-party interactions. In order to explore this relationship, we separately calculated the effective number of parties for both types of activities (one-click reactions and comments) at the individual level. Instead of equally considering all parties an individual interacted with, this approach weights the number of parties based on how concentrated the activities were. In case of an even distribution of comments and one-click reactions, the effective number of parties will equal the number of

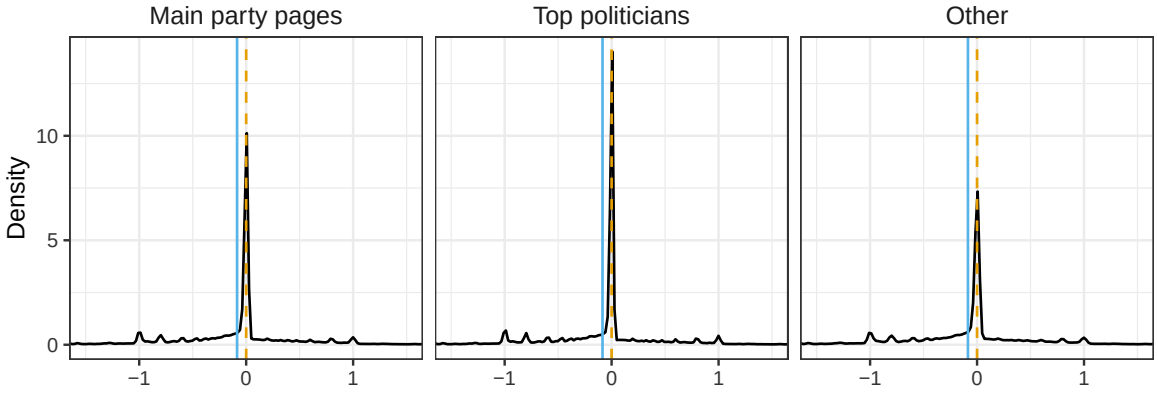

Figure 6. Individual-level difference in the number of effective parties for reactions and comments

Notes. The figure only displays the interval from -1.5 to 1.5, which removes the long but uninformative tail of the distribution. 94 to 95% of the individuals for whom the measure was definded were included in the presented interval. Negative values indicate that individuals used one-click reactions on a larger number of effective parties than comments. Positive numbers represent the opposite. The dotted vertical line shows the median, the solid line shows the mean.

parties. If all activities are concentrated on the Facebook pages of one party, the index will equal one. A user who interacted once with several parties and very often with only one party has an effective number of parties of only somewhat above one. Figure 6 displays the difference between the numbers of effective parties with which the users engaged by commenting and one-click reactions. Positive values indicate that users commented on a larger number of parties compared with the number of parties on whose pages they left one-click reactions.[7] In all three groups, we observe a slightly left-skewed distribution, which means that individuals tended to spread their one-click reactions across a larger number of parties than comments. However, most users effectively only interacted with the same number of parties as indicated by the median value of 0 in each subset. Moreover, the majority of observations fall into the interval ranging from -1 to 1. Thus, even if users distributed their one-click reactions and comments differently, they did this in a very confined way. This is supported by the moderate positive correlation between the effective number of parties for both types of participating in the exchanges on political Facebook pages (bottom row of Table 2).

[7]This measure is only defined for the subset users who used both types of interactions, which obviously excludes the large group of users who engaged only once (see Table 1). Overall, we are left with 1,019,313 unique users out of our initial sample of 2,617,353 individuals.

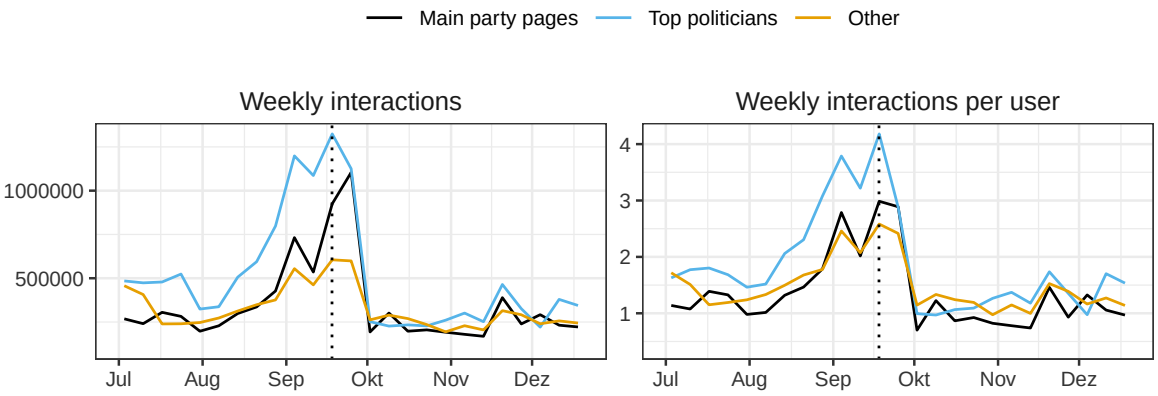

Figure 7. Weekly interactions (aggregated and per user)
Notes. The right-hand side graph only includes users that were active at least once in each month throughout the study's timeframe. The dotted vertical line shows the election week.

Finally, we asked about the temporal dynamics of users' activities (RQ 7). The left panel of Figure 7 shows the development in the aggregate, the right panel at the individual level. This is an important distinction, because increased overall numbers during a period could be result of either more (new) users interacting with the pages or regular users ramping up their activities. In both panels of Figure 7, we see an increase of user engagement in the run-up to the 2017 German federal election. The right panel in Figure 7 clearly shows an increased activity for the average user in our sample. On the top politician and party pages, the number of recorded activities doubled in the hot campaign phase, which in Germany typically starts four to six weeks prior to an election, and nearly tripled around election week, only to drop soon after the election. Interestingly, in the week immediately after the election, users continued to be very active. Qualitative inspection of these activities showed that they were primarily reactions to and comments on statements on the outcome of the campaign. The temporal dynamics were less pronounced for the other, less prominent pages. Interactions on these pages seem to have been less event-driven and more steady across the 6 months.

Discussion

In this study, we aimed at describing user behavior on Facebook that has commonly been studied in the political participation literature. Our large-scale analysis of digital trace data from user activities on German political Facebook pages in 2017 replicated earlier

findings in some respects, but also allowed many interesting observations that would have been impossible without user-level data. As others have reported, activities are very unevenly distributed between the top politician and main party pages compared to many other partisan Facebook pages. Overall, we also observed a large proportion of one-time and one-page users, which are most concentrated on the pages of Angela Merkel and Martin Schulz, the top candidates for chancellor. In fact, our overall estimate of one page users is almost identical to the proportion reported by Batorski and Grzywińska (2018) for Polish Facebook pages. However, outside the extremely popular politician pages, the proportion of regular and multi-page users was substantially higher. It is therefore necessary to qualify previous findings on top pages. They are unlikely to be representative of the broader political landscape on Facebook in Germany. Similarly, while there were many occasional users overall, most interactions could be attributed to users who were active on more than one page, and even on pages of multiple parties. Additionally, the co-presence of users who were active on different parties was rather common. Our overlap analyses showed that all parties shared a significant amount of their audience with each other. We also investigated whether comments and one-click reactions were used at different rates. In line with previous research, individuals typically used one-click reactions as opposed to the more time- and energy-consuming activity of writing a comment. Furthermore, reactions were distributed across a larger number of parties than comments. Finally, our longitudinal analyses revealed some unsurprising temporal dynamics, but also highlighted that outside the spotlight of top politician pages, the volume of political communication activities were less volatile. In addition, the individual-level analysis revealed that —in addition to more new users participating— regular users became more active. This distinction would not have been possible with previously published analyses of aggregate-level data.

Taken together, our study highlights several important points. First, page characteristics seem to matter for the types of political participation as well as the amount of cross-party interactions. Especially, the profiles of the candidates for chancellor Angela Merkel (CDU) and Martin Schulz (SPD) stood out. Individuals on these pages tended to interact with content by using one-click reactions. Additionally, both profiles were disproportionately visited by one-time and one-page users. In contrast, most of the other pages in our sample attracted a large share of users who interacted with pages of different parties. This finding suggests that most political Facebook pages provide individual users with

opportunities for encountering opposing viewpoints.

Secondly, there are differences in how individuals use the affordances of the platform to politically express themselves. Even though one-click reactions and comments are frequently bundled together as forms of political participation that require little effort (Heiss & Matthes, 2019; e.g., Vaccari et al., 2015), our findings suggest that individuals used them at different rates. Moreover, users, on average, distributed their one-click reactions across a slightly larger number of parties than comments. As pointed out by Bode (2017), comments require at least some elaboration on the content. Especially in the context of unfamiliar opposing viewpoints, this may lead some individuals to resort to one-click reactions instead of comments (e.g., simply leaving an angry emoticon instead of writing a counterargument), resulting in a lower number of parties commented on. An avenue for future research could be to also consider the content of a post and its impact on different kinds of low-effort online participation, extending work like Blassnig, Udris, Staender, and Vogler (2021) to the individual level. Further studies could also take the structural characteristics of posts into account as previous research indicates a relationship between users' reactions and the embedded media type (e.g., photos, videos) (e.g., Gerodimos & Justinussen, 2015; Heiss, Schmuck, & Matthes, 2019).

Similarly, a systematic linkage of the parties' campaign strategies and resource allocation with individual user participation data would be able to shed more light on social media's equalizing potential in favor of smaller parties (Gibson & McAllister, 2015). The findings with regard to the higher activity levels and cross-party interactions of individual users on the AFD pages can be interpreted through this lens. One way by which less established parties make up for their overall smaller base of supporters might be to encourage their participation on social media. Further studies on both the supply- and the demand-side, which take the individual users into account, might contribute to this literature.

Lastly, our results suggest that political participation on partisan Facebook pages was not a ubiquitous phenomenon. Even though Facebook was by far the dominant social media platform in 2017, with about one third of Germans visiting the platform at least weekly, our sample of 320 pages contained only somewhat more than 2.5 million unique accounts. Additionally, 45% of those users appeared only once in six months. The vast

majority of Facebook users did not or only barely engage with pages run by the major political parties. However, one should keep in mind that not all Facebook users are equally likely to become politically involved on the platform. For example, higher education has been linked to increased political participation on social media (Theocharis & van Deth, 2018). Additionally, political engagement on the platform is not confined to pages belonging to political parties or candidates. Thus, our data covered only a specific subset of political engagement on the platform and does not allow for a general estimate of overall political participation on Facebook.

Overall, we are confident that the present description of individual user activities on political Facebook pages in the context of the German general election 2017 provides some value also beyond the time frame, platform, and context under study. By leveraging that the platform under study a) was by far the predominant social media platform for the general population, b) allowed to collect data on public activities at the individual level, and c) organized the parties' communication activities in a clearly identifiable form on their pages, we could describe a major part of individual citizens' public interactions with political parties on social media. In the meantime, the social media landscape has changed considerably. Individual users and political communicators have diversified their social media activities and distributed them across various platforms. Each platform comes with different affordances and is more or less suitable for different kinds of online participation. Studies on single platforms today, even if they allowed for access of individual-level data, would likely only show a specific part of all activities. Cross-platform studies are clearly needed, but they are currently impossible to conduct at scale. Therefore, we believe that this description of general patterns is currently the best available empirical information on individual users' political participation on social media accounts run by parties. Since the study by Batorski and Grzywińska (2018) in the Polish context produced comparable results in terms of activity patterns, our findings may also apply to other European countries with a multi-party systemand they add descriptive knowledge beyond the literature's focus on the USA (Boulianne, 2020).

Even though our data offered a very nuanced picture of user activity on Facebook, they still have some blind spots: the six hour time interval as well as private pages and groups. The timely data collection provides a more fine-grained picture of the communica-

tion activities compared to ex post retrieval of the data. However, the changing nature of online content makes it reasonable to assume that even our data collection procedure missed out on a small portion of users' activities. Secondly, the Facebook Graph API only allowed data to be collected on public pages. Therefore, user activity on private accounts and in groups are out of the scope of this study, as are user-to-user interactions in chats or other non-public spaces on Facebook. We acknowledge that we relied mostly on relatively superficial information such as counts of comments and interactions, without closer inspection of the content and context of these interactions. Further research, e.g. using content analyses, are certainly necessary to explain some of our findings and even uncover previously unseen results.

Acknowledgments

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Online Appendix

Table 3: Facebook pages in the sample

Page name	Party
AfD - Alternative für Deutschland / Baden-Württemberg	AFD
AfD Bamberg	AFD
AfD Bayern	AFD
AfD Fraktion Sachsen	AFD
AfD Kreisverband Anhalt-Bitterfeld	AFD
AfD Saarland	AFD
AfD Sachsen-Anhalt	AFD
AfD Schleswig-Holstein	AFD
AfD Südthüringen	AFD
AfD Thüringen	AFD
AfD-Fraktion Hamburg	AFD
AfD-Fraktion im Thüringer Landtag	AFD
AidA - Arbeitnehmer in der AfD	AFD
Alice Weidel	AFD
Alternative für Deutschland - Koblenz	AFD
Alternative für Deutschland / AfD Sachsen	AFD
Alternative für Deutschland AfD	AFD
Alternative für Deutschland Bezirksverband Münster	AFD
Alternative für Deutschland Mecklenburg-Vorpommern - AfD MV	AFD
Alternative für Deutschland NRW · AfD NRW	AFD
Beatrix von Storch	AFD
Björn Höcke	AFD
Der Flügel	AFD
Dr. Frauke Petry	AFD
Julian Flak	AFD
Junge Alternative Bayern	AFD
Junge Alternative Berlin	AFD
Junge Alternative Brandenburg	AFD
Junge Alternative für Deutschland	AFD
Junge Alternative Hessen	AFD
Junge Alternative Niedersachsen	AFD
Junge Alternative Saarland	AFD
Junge Alternative Sachsen	AFD
Junge Alternative Sachsen-Anhalt	AFD
Junge Alternative Thüringen	AFD
Marcus Pretzell	AFD
Markus Frohnmaier - AfD	AFD
Mittelstand der Alternative für Deutschland	AFD
Prof. Dr. Jörg Meuthen	AFD

Table 3: Facebook pages in the sample *(continued)*

Page name	Party
Wiebke Muhsal	AFD
Angela Merkel	CDU
Annegret Kramp-Karrenbauer	CDU
Annette Widmann-Mauz	CDU
Armin Laschet	CDU
CDA	CDU
CDU	CDU
CDU Baden-Württemberg	CDU
CDU Berlin	CDU
CDU Brandenburg	CDU
CDU Fraktion Hessen	CDU
CDU Hamburg	CDU
CDU Hessen	CDU
CDU in Niedersachsen	CDU
CDU Nordrhein-Westfalen	CDU
CDU Rheinland-Pfalz	CDU
CDU Saar	CDU
CDU Schleswig-Holstein	CDU
CDU Thüringen	CDU
CDU-Fraktion Berlin	CDU
CDU-Landtagsfraktion Baden-Württemberg	CDU
CDU-Landtagsfraktion NRW	CDU
CDU/CSU-Bundestagsfraktion	CDU
David McAllister	CDU
Frauen Union der CDU Deutschlands	CDU
Hermann Gröhe	CDU
Jens Spahn	CDU
Julia Klöckner	CDU
Junge Union Baden-Württemberg	CDU
Junge Union Deutschlands	CDU
Junge Union NRW	CDU
Kristina Schröder	CDU
Maria Böhmer	CDU
Michael Fuchs	CDU
Michael Grosse-Brömer	CDU
Mittelstands- und Wirtschaftsvereinigung der CDU / CSU	CDU
Nadine Schön	CDU
Norbert Röttgen	CDU
Peter Altmaier	CDU
Peter Tauber	CDU
RCDS [Ring Christlich-Demokratischer Studenten]	CDU

Table 3: Facebook pages in the sample *(continued)*

Page name	Party
Schüler Union Deutschlands	CDU
teAM Deutschland	CDU
Thomas Strobl	CDU
Volker Bouffier	CDU
Alexander Dobrindt,MdB	CSU
Andrea Lindholz	CSU
Andreas Scheuer	CSU
Angelika Niebler	CSU
Anja Weisgerber	CSU
Außen- und Sicherheitspolitischer Arbeitskreis (ASP) in der CSU	CSU
Auszubildenden & Schüler Union in Bayern e.V.	CSU
CSU (Christlich-Soziale Union)	CSU
CSU Bezirksverband München	CSU
CSU Nürnberg-Fürth-Schwabach	CSU
CSU Oberbayern	CSU
CSU-Fraktion im Bayerischen Landtag	CSU
CSU-Kreisverband Würzburg-Stadt	CSU
CSUnet	CSU
Dorothee Bär, MdB	CSU
Edmund Stoiber	CSU
FU Bayern (Frauen-Union Bayern)	CSU
Hans-Peter Friedrich, CSU	CSU
Horst Seehofer	CSU
Ilse Aigner	CSU
Joachim Herrmann	CSU
Josef Schmid	CSU
Junge Union Bayern	CSU
Junge Union München	CSU
Junge Union München-Land	CSU
Junge Union Niederbayern	CSU
Junge Union Oberbayern	CSU
Junge Union Oberfranken	CSU
Junge Union Oberpfalz	CSU
Junge Union Schweinfurt-Stadt	CSU
Katrin Albsteiger	CSU
Manfred Weber	CSU
Markus Ferber	CSU
Markus Söder	CSU
Mittelstands-Union Bayern	CSU
Peter Ramsauer	CSU
RCDS in Bayern e.V.	CSU

Table 3: Facebook pages in the sample *(continued)*

Page name	Party
Thomas Kreuzer	CSU
Alexander Graf Lambsdorff	FDP
Bundesverband Liberaler Hochschulgruppen (LHG)	FDP
Christian Lindner	FDP
FDP	FDP
FDP Baden-Württemberg	FDP
FDP Bayern	FDP
FDP Berlin	FDP
FDP Brandenburg	FDP
FDP Bremen	FDP
FDP Frankfurt am Main	FDP
FDP Hamburg	FDP
FDP Hamburg-Nord	FDP
FDP Hessen	FDP
FDP Liberté	FDP
FDP MV	FDP
FDP Niedersachsen	FDP
FDP NRW	FDP
FDP Rheinland-Pfalz	FDP
FDP Saar - SaarLiberale	FDP
FDP Sachsen	FDP
FDP Sachsen-Anhalt	FDP
FDP Schleswig-Holstein	FDP
FDP Thüringen	FDP
FDP-Fraktion Bremen	FDP
FDP-Fraktion Hessen	FDP
FDP-Fraktion im Niedersächsischen Landtag	FDP
FDP-Fraktion in der Hamburgischen Bürgerschaft	FDP
FDP-Landtagsfraktion NRW	FDP
FDP/DVP-Fraktion im Landtag Baden-Württemberg	FDP
Frank Sitta	FDP
Gesine Meißner	FDP
Hauke Hilz	FDP
Junge Liberale Brandenburg	FDP
Junge Liberale JuLis	FDP
Junge Liberale JuLis Bayern	FDP
Junge Liberale JuLis Berlin	FDP
Junge Liberale Niedersachsen	FDP
Junge Liberale NRW	FDP
Junge Liberale Schleswig-Holstein	FDP
Katja Suding	FDP

Table 3: Facebook pages in the sample *(continued)*

Page name	Party
Lencke Steiner	FDP
Marie-Agnes Strack-Zimmermann	FDP
Nicola Beer	FDP
Sabine Leutheusser-Schnarrenberger	FDP
Stefan Birkner	FDP
Volker Wissing	FDP
Wolfgang Kubicki	FDP
Agnieszka Brugger	GRÜNE
Anton Hofreiter	GRÜNE
Barbara Lochbihler	GRÜNE
Bündnis 90 / Die Grünen Thüringen	GRÜNE
BÜNDNIS 90/DIE GRÜNEN	GRÜNE
BÜNDNIS 90/DIE GRÜNEN Baden-Württemberg	GRÜNE
Bündnis 90/Die Grünen Bayern	GRÜNE
Bündnis 90/Die Grünen Berlin	GRÜNE
Bündnis 90/Die Grünen Brandenburg	GRÜNE
Bündnis 90/Die Grünen Bundestagsfraktion	GRÜNE
BÜNDNIS 90/DIE GRÜNEN Hessen	GRÜNE
Bündnis 90/Die Grünen Mecklenburg-Vorpommern	GRÜNE
BÜNDNIS 90/DIE GRÜNEN NRW	GRÜNE
BÜNDNIS 90/DIE GRÜNEN Rheinland-Pfalz	GRÜNE
Bündnis 90/Die Grünen Saarland	GRÜNE
BÜNDNIS 90/DIE GRÜNEN Sachsen	GRÜNE
BÜNDNIS 90/DIE GRÜNEN Sachsen-Anhalt	GRÜNE
Cem Özdemir	GRÜNE
Claudia Roth	GRÜNE
Ekin Deligöz	GRÜNE
Fraktion Bündnis 90/Die Grünen im Brandenburger Landtag	GRÜNE
Gerhard Schick	GRÜNE
Grüne Bremen	GRÜNE
Grüne Fraktion Baden-Württemberg	GRÜNE
Grüne Fraktion Bayern	GRÜNE
Grüne Fraktion NRW	GRÜNE
GRÜNE Hamburg	GRÜNE
Grüne Jugend	GRÜNE
Grüne Landtagsfraktion Niedersachsen	GRÜNE
Grüne Landtagsfraktion Thüringen	GRÜNE
GRÜNE Niedersachsen	GRÜNE
Grüne Stuttgart	GRÜNE
Hans Christian Ströbele	GRÜNE
HelgaTrüpel	GRÜNE

Table 3: Facebook pages in the sample *(continued)*

Page name	Party
Jan Philipp Albrecht	GRÜNE
Jürgen Trittin	GRÜNE
Katrin Göring-Eckardt	GRÜNE
Kerstin Andreae	GRÜNE
Kordula Schulz-Asche	GRÜNE
Marieluise Beck	GRÜNE
Oliver Krischer	GRÜNE
Peter Meiwald, Bündnis 90/Die Grünen	GRÜNE
Rebecca Harms	GRÜNE
Reinhard Bütikofer	GRÜNE
Renate Künast	GRÜNE
Simone Peter	GRÜNE
Ska Keller	GRÜNE
Sven Giegold	GRÜNE
Sven-Christian Kindler	GRÜNE
Tarek Al-Wazir	GRÜNE
Ulle Schauws	GRÜNE
Volker Beck	GRÜNE
Winfried Kretschmann	GRÜNE
Bernd Riexinger	LINKE
Bodo Ramelow	LINKE
DIE LINKE	LINKE
DIE LINKE Hamburg	LINKE
DIE LINKE Land Bremen	LINKE
DIE LINKE Mecklenburg-Vorpommern	LINKE
DIE LINKE Thüringen	LINKE
DIE LINKE. Baden-Württemberg	LINKE
DIE LINKE. Bayern	LINKE
DIE LINKE. Berlin	LINKE
DIE LINKE. Brandenburg	LINKE
DIE LINKE. Hessen	LINKE
DIE LINKE. im Saarland	LINKE
DIE LINKE. Niedersachsen	LINKE
DIE LINKE. NRW	LINKE
DIE LINKE. Rheinland-Pfalz	LINKE
DIE LINKE. Sachsen	LINKE
DIE LINKE. Sachsen-Anhalt	LINKE
DIE LINKE. Schleswig-Holstein	LINKE
DIE LINKE.Potsdam	LINKE
Die Linke.SDS	LINKE
Die Linke.SDS Berlin	LINKE

Table 3: Facebook pages in the sample *(continued)*

Page name	Party
Dietmar Bartsch	LINKE
Dr. Gesine Lötzsch	LINKE
Fraktion Die Linke im Landtag des Saarlandes	LINKE
Fraktion DIE LINKE im Landtag Mecklenburg-Vorpommern	LINKE
Fraktion DIE LINKE im Sächsischen Landtag	LINKE
Fraktion DIE LINKE. im Bundestag	LINKE
Gregor Gysi	LINKE
Halina Wawzyniak	LINKE
Katja Kipping	LINKE
Klaus Ernst	LINKE
Klaus Lederer	LINKE
Linksfraktion Berlin	LINKE
Linksfraktion Hamburg	LINKE
Linksjugend ['solid]	LINKE
Linksjugend ['solid] - nrw	LINKE
Linksjugend ['solid] Baden-Württemberg	LINKE
Linksjugend ['solid] Bayern	LINKE
linksjugend ['solid] Sachsen	LINKE
Linksjugend ['solid] Sachsen-Anhalt	LINKE
Linksjugend Dresden	LINKE
Linksjugend Leipzig	LINKE
Linksjugend['solid]Thüringen	LINKE
Matthias Höhn	LINKE
Oskar Lafontaine	LINKE
Sahra Wagenknecht	LINKE
Sds Linksjugend Magdeburg	LINKE
Andrea Nahles	SPD
Aydan Özoguz	SPD
Barbara Hendricks	SPD
BayernSPD	SPD
BayernSPD Landtagsfraktion	SPD
Brigitte Zypries	SPD
Christian Ude	SPD
Elke Ferner	SPD
Erwin Sellering	SPD
Florian Pronold	SPD
Heiko Maas	SPD
Hubertus Heil	SPD
Juso-Hochschulgruppen	SPD
Jusos Bayern	SPD
Jusos in der SPD	SPD

Table 3: Facebook pages in the sample *(continued)*

Page name	Party
Jusos Mecklenburg-Vorpommern	SPD
Jusos Niedersachsen	SPD
Jusos Sachsen	SPD
Jusos Schleswig-Holstein	SPD
Lars Klingbeil	SPD
Malu Dreyer	SPD
Manuela Schwesig	SPD
Martin Schulz	SPD
Nils Schmid	SPD
NRW Jusos	SPD
NRWSPD	SPD
Olaf Scholz	SPD
Peer Steinbrück	SPD
Ralf Stegner	SPD
Sigmar Gabriel	SPD
Sozialistische Jugend Deutschlands - Die Falken	SPD
SPD	SPD
SPD Baden-Württemberg	SPD
SPD Berlin	SPD
SPD für Europa	SPD
SPD Hamburg	SPD
SPD Hessen	SPD
SPD Niedersachsen	SPD
SPD Rheinland-Pfalz	SPD
SPD Saar	SPD
SPD Sachsen	SPD
SPD Sachsen-Anhalt	SPD
SPD Thüringen	SPD
SPD-Bundestagsfraktion	SPD
SPD-Landesverband Mecklenburg-Vorpommern	SPD
SPD-Landtagsfraktion Baden-Württemberg	SPD
Stephan Weil	SPD
Thorsten Schäfer-Gümbel	SPD
Ulrich Kelber	SPD
Yasmin Fahimi	SPD

Table 4: Extended overview of sample and user behavior

	Main party pages	Top politicians	Other politicians	Party organisations
Sample sizes				
Pages	7	9	112	192
Interactions	8,903,879	13,058,026	4,337,421	4,061,654
Comments	1,366,738	1,838,465	590,949	467,275
Reactions	7,537,141	11,219,561	3,746,472	3,594,379
Unique users	1,048,657	1,703,679	642,300	514,867
Proportions of users / interactions (in percent)				
One time	27 / 3	37 / 5	24 / 4	20 / 2
One page	39 / 10	58 / 18	33 / 9	25 / 5
One party	62 / 30	73 / 36	53 / 25	52 / 26
Multiple parties	38 / 70	27 / 64	47 / 75	48 / 74
Cross-Cutting (gov.-opp.)	29 / 61	20 / 55	36 / 64	37 / 63
Cross-Cutting (left-right)	24 / 51	18 / 49	30 / 54	31 / 53
Per user averages (SD) / median				
No. of interactions	23.9 (115) / 4	16.1 (92) / 2	32.5 (144) / 5	39.3 (158) / 7
No. of pages	3.1 (3) / 2	2.4 (3) / 1	3.9 (4) / 2	4.4 (4) / 3
No. of parties	1.7 (1) / 1	1.4 (0.9) / 1	1.9 (1) / 1	1.9 (1) / 1
Comment share	13.7 (27) / 0	11.3 (25) / 0	13.1 (25) / 0	13 (25) / 0

Notes. In this table, the other category in Table 1 of the manuscript has been further split into other politicians and party organisations.