COVID-19’s (mis)information ecosystem on Twitter

How partisanship boosts the spread of conspiracy narratives on German speaking Twitter

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ABSTRACT

In late 2019, the gravest pandemic in a century began spreading across the world. A state of uncertainty related to what has become known as SARS-CoV-2 has since fueled conspiracy narratives on social media about the origin, transmission and medical treatment of and vaccination against the resulting disease, COVID-19. Using social media intelligence to monitor and understand the proliferation of conspiracy narratives is one way to analyze the distribution of misinformation on the pandemic. We analyzed more than 9.5M German language tweets about COVID-19. The results show that only about 0.6% of all those tweets deal with conspiracy theory narratives. We also found that the political orientation of users correlates with the volume of content users contribute to the dissemination of conspiracy narratives, implying that partisan communicators have a higher motivation to take part in conspiratorial discussions on Twitter. Finally, we showed that contrary to other studies, automated accounts do not significantly influence the spread of misinformation in the German speaking Twitter sphere. They only represent about 1.31% of all conspiracy-related activities in our database.

Keywords: social networks · misinformation · conspiracy theory · political polarization

1 Introduction

In November 2019, a febrile respiratory illness caused by SARS-CoV-2 infected people in the city of Wuhan, China. On January 30th 2020, the World Health Organization (WHO) declared the spread of the virus a worldwide pandemic [BBC 2020]. Shortly after, the WHO reported multiple COVID-19-related knowledge gaps relating to its origin, transmission, vaccinations, clinical considerations, and concerns regarding the safety of healthcare workers [WHO 2020a]. The organization warned of an “infodemic”, defined by “an overabundance of information and the rapid spread of misleading or fabricated news, images, and videos” [WHO 2020b]. By August 2020, more than 22 million people worldwide had contracted the virus [WHO 2020c]. The Organization for Economic Co-operation and Development (OECD) put forward estimates of negative GDP growth for all member countries in 2020 due to the crisis [OECD 2020].

COVID-19’s indomitable dissemination around the globe combined with a lack of effective medical remedies [Guo et al. 2020; Xie et al. 2020] and its psychological and economic side effects [OECD 2020; Ho et al. 2020; Rajkumar 2020]...
Frank et al. have left many people to uncertainty and fear of further developments. Previous research has shown that lack of certainty and control often results in the emergence and circulation of conspiracy theory narratives [Whitson and Galinsky, 2008]. Popper defined conspiracy mentality as the “mistaken theory that, whatever happens in society – especially happenings such as war, unemployment, poverty, shortages, which people as a rule dislike – is the result of direct design by some powerful individuals and groups” [Popper, 2002]. This one-sided or even pathological method of reasoning regularly facilitates coping with uncertainty and fear by making the world more understandable and providing individuals with an illusion of control [Kruglanski et al., 2006].

There are two main conditions conducive to the emergence of conspiracy narratives: individuals’ psychological traits and socio-political factors. Regarding psychological traits, numerous laboratory studies demonstrate the correlation between conspiracy beliefs and psychological features like negative attitude toward authorities [Imhoff and Bruder, 2014], self-esteem [Abalakina-Paa et al., 1999], paranoia and threat [Mancosu et al., 2017], powerlessness [Abalakina-Paa et al., 1999], education, gender and age [van Prooijen, 2017], level of agreeableness [Swami et al., 2011], and death-related anxiety [Newheiser et al., 2011]. Another part of reasoning sees conspiracy mentality as a generalized political attitude [Imhoff and Bruder, 2014] and correlates conspiracy beliefs to socio-political factors like political orientation. Enders et al. showed that conspiracy beliefs can be a product of partisanship [Enders et al., 2020]. Several other studies show a quadratic correlation between partisanship and the belief in certain conspiracy theories [van Prooijen et al., 2015]. These insights imply that extremists on both sides of the political spectrum are more prone to believe in and to discuss conspiracy narratives.

We define conspiracy narratives as part of the overall phenomenon of misinformation on the internet. We use misinformation as the broader concept of fake or inaccurate information that is not necessarily intentionally produced (distinguished from disinformation which is regularly based on the intention to mislead the recipients). Among all the conspiracy narratives, we are interested in those propagated in times of pandemic crises. The spread of health-related conspiracy theories is not a new phenomenon [Geissler and Sprinkle, 2013; Bogart et al., 2010; Klofstad et al., 2019] but seems to be even accelerated in world connected via social media.

The COVID-19 pandemic’s unknown features, its psychological and economical side effects, the ubiquitous availability of Online Social Networks (OSNs) [Pew, 2019], and high levels of political polarization in many countries [Fletcher et al., 2020; Yang et al., 2016] make this pandemic a potential breeding ground for the spread of conspiracy narratives. From the outset of the crisis, “misleading rumors and conspiracy theories about the origin circulated the globe paired with fear-mongering, racism, and the mass purchase of face masks[...]. The social media panic travelled faster than the COVID-19 spread” [Depoux et al., 2020]. Such conspiracy narratives can obstruct the efforts to properly inform the general public via medical and scientific findings [Grimes, 2016]. Therefore, investigating the origins and circulation of conspiracy narratives as well as the potential political motives supporting their spread on OSNs is of vital public relevance. With this objective, we analyzed more than 9.5M German language tweets about COVID-19 to answer the following research questions:

**Research Question 1**: What volume of German speaking Twitter activities comprises COVID-19 conspiracy discussions and how much of this content is removed from Twitter?

**Research Question 2**: Does the engagement with COVID-19 conspiracy narratives on Twitter correlate with political orientation of users?

**Research Question 3**: To what degree do automated accounts contribute to the circulation of conspiracy narratives in the German speaking Twitter sphere?

## 2 Data

We collected the data for this study during the early phase of the crisis, namely, between March 11th, the day on which the WHO declared the spread of the SARS-CoV-2 virus a pandemic [BBC, 2020] and May 31st, 2020. The data was downloaded using the Twitter’s Streaming API by looking for the following keywords: “COVID”, “COVID-19”, “corona”, and “coronavirus”. Only Tweets posted by German speaking users or with German language were included. The final dataset comprises more than 9.5M tweets from which two categories of conspiracy narratives were selected: conspiracy narratives about the origin of the COVID-19 illness (Table 1) and those about its potential treatments (Table 2). The conspiracy narratives about the origin of the COVID-19 illness were selected based on Shahsavari et al., who automatically detected the significant circulation of the underlying conspiracy theories on Twitter using machine learning methods [Shahsavari et al., 2020]. The second group of conspiracy narratives were chosen based on the fact that they were in the center of attention in German media [Tagesschau, 2020] and thus a considerable number of tweets discussed them [Netzpolitik, 2020].
Table 1: Conspiracy narratives about the origin of COVID-19

| case               | description                                                                 |
|--------------------|-----------------------------------------------------------------------------|
| 5G                 | conspiracy narrative suggesting that the 5G network activates the virus     |
| Bill Gates         | conspiracy narrative suggesting that Bill Gates aims to use COVID-19 to initiate a global surveillance regime |
| Wuhan laboratory   | conspiracy theory narrative suggesting that the virus originates from a laboratory in Wuhan, China |

Table 2: Conspiracy narratives about potential treatments of COVID-19

| case         | description                                                                 |
|--------------|-----------------------------------------------------------------------------|
| Ibuprofen    | conspiracy narrative suggesting that Ibuprofen reduces COVID-19 symptoms    |
| Homoeopathy  | conspiracy narrative suggesting that homeopathy medicines reduce COVID-19 symptoms |
| Malaria      | conspiracy narrative suggesting that a malaria drug is an antiviral against SARS-CoV-2 virus |

Table 3 indicates the number of tweets belonging to each conspiracy narrative and the keywords that are used to filter them out. There were 68,466 tweets in total discussing the underlying conspiracy narratives. Figure shows the timeline of the tweets.

Table 3: Number of tweets for each conspiracy narrative

| case               | number of tweets | keywords                                      |
|--------------------|------------------|-----------------------------------------------|
| 5G                 | 5,762            | 5G, #5g                                       |
| Bill Gates         | 24,653           | Bill Gates, #billgates                        |
| Wuhan laboratory   | 9,366            | #wuhanlab Wuhan Lab                           |
| Ibuprofen          | 7,016            | Ibuprofen, #ibuprofen                        |
| Homeopathy         | 4,714            | Homöopath, #Homöopath                        |
| Malaria            | 7,955            | Malaria, #malaria                             |
| Control group      | 9,000            |                                               |

In addition to the six conspiracy narratives, 9000 tweets were randomly extracted from the dataset and served as a control group.

To answer research question 2, a list was extracted from official party websites; this list contains members of parliament (MPs) who are active on Twitter and belong to one of the six political parties in Germany’s federal legislature. Each party runs several official Twitter pages that were added to the list of Twitter pages of each political party; for example, the official Twitter page of the Social Democratic Party (SPD) in the federal state of Bavaria, called “BayernSPD”, was added to the SPD list. For each twitter account in the extracted list a maximum of 4000 tweet handles were downloaded from the Twitter API. Table shows the relevant statistics on the political tweets.

Table 4: Number of political tweets extracted from politicians’ twitter pages

| political party     | number of MPs on Twitter | number of extra official Twitter pages | total number of tweet handles |
|---------------------|--------------------------|---------------------------------------|------------------------------|
| AfD                 | 27                       | 14                                    | 68,789                       |
| CDU/CSU             | 131                      | 18                                    | 220,768                      |
| FDP                 | 56                       | 7                                     | 96,046                       |
| Bündnis 90/Die Grünen | 56                      | 11                                    | 169,864                      |
| Linke               | 50                       | 12                                    | 155,794                      |
| SPD                 | 110                      | 17                                    | 221,029                      |

In the next step, for each of the 68,466 users spreading conspiracy narratives (Table), the lists of their tweet handles were downloaded (Table). Finally, for each of them we counted the number of times they retweeted one of the political tweets in Table. Based on Boyd et al. retweets are mainly a form of endorsement. Therefore, we

\footnote{1We used “homöopath” in order to match both German words “homöopathie” and “homöopathisch”}
assume if a user collects a discernible number of retweets from members of a certain political party, this user will most likely share the corresponding political orientation. This method of inference about the political orientation of users has been applied in similar studies [Garimella et al., 2017].

Table 5: Number of tweets extracted from users spreading conspiracy narrative tweets

| case              | number of tweets | number of downloaded tweets from the contributing users |
|-------------------|------------------|--------------------------------------------------------|
| 5G                | 5762             | 10,967,158                                             |
| Bill Gates        | 24653            | 35,144,536                                             |
| Wuhan laboratory  | 9366             | 14,332,403                                             |
| Ibuprofen         | 7016             | 14,855,267                                             |
| Homoeopathy       | 4714             | 7,746,555                                              |
| Malaria           | 7955             | 16,258,164                                             |
| Control group     | 9000             | 12,217,082                                             |

3 Results

There are multiple studies showing that exposure to misinformation can lead to persistent negative effects on citizens. The respondents in a study adjusted their judgment proportional to their cognitive ability after they realized that their initial evaluation was based on inaccurate information. In other words, respondents with lower levels of cognitive ability tend to keep biased judgments even after exposure to the truth [Keersmaecker and Roets, 2017]. In another study, Tangherlini et al. found that conspiracy narratives stabilize based on the alignment of various narratives, domains, people, and places such that the removal of one or some of these entities would cause the conspiracy narrative to quickly fall apart [Tangherlini et al., 2020]. Imhoff and Lamberty have shown that believing COVID-19 to be a hoax negatively correlated with compliance with self-reported, infection-reducing, containment-related behavior [Imhoff and Lamberty, 2020].

On that account, to assess a democratic information ecosystem that is balanced rather towards reliable information than misinformation we need to monitor and estimate if COVID-19 conspiracy theory narratives circulate significantly on Twitter. Based on a survey in mid-March 2020, about 48% of respondents stated that they have seen some pieces of likely misinformation about COVID-19 [Pew, 2020]. Shahsavari et al. used automated machine learning methods to automatically detect COVID-19 conspiracy narratives on Reddit, 4Chan, and news data [Shahsavari et al., 2020].

![Image: Number of Tweets per day](image_url)
Multiple other studies found evidence of COVID-19 misinformation spread on different OSNs [Boberg et al., 2020; Ahmed et al., 2020; Serrano et al., 2020].

To address the public concerns many of the service providers claimed that they will remove or tag this sort of content on their platforms. On March 16th 2020, Facebook, Microsoft, Google, Twitter and Reddit said they are teaming up to combat COVID-19 misinformation on their platforms [Bloomberg, 2020]. On April 22nd, Twitter stated that they have removed over 2230 tweets containing misleading and potentially harmful COVID-19-related content [Twitter, 2020]. On June 7th 2020, we examined how many of the German conspiracy-related tweets still exist on Twitter in order to understand if conspiracy-related tweets tend to exist on Twitter for a longer period of time compared to non conspiracy-related tweets. Table 6 shows the results.

| case          | number of tweets | share (among all 9.5M COVID-19 tweets) | share deleted on 7th June 2020 |
|---------------|------------------|----------------------------------------|--------------------------------|
| 5G            | 5762             | 0.06%                                  | 6%                             |
| Bill Gates    | 24653            | 0.25%                                  | 7%                             |
| Wuhan laboratory | 9306          | 0.098%                                 | 9%                             |
| Ibuprofen     | 7016             | 0.073%                                 | 14%                            |
| Homoeopathy   | 4714             | 0.049%                                 | 3%                             |
| Malaria       | 7955             | 0.083%                                 | 5%                             |
| Control group | 9000             | 0.094%                                 | 6%                             |

3.1 Research Question 1

Based on Table 6, only about 0.61% of all COVID-19 German tweets are about one of the conspiracy narratives under consideration. These German tweets are posted by more than 36,000 unique Twitter users. While 0.61% is small in magnitude, it still comprises a relevant number of citizens. It is important to note though that this finding does not imply that only about 36,000 Twitter users believe in conspiracy theories. While our data shows the spread of conspiracy narratives, they do not reveal a user’s stance towards the respective content. In terms of content moderation by Twitter, on average 7.3% of conspiracy narrative tweets are deleted after a certain period of time which is significantly higher than 6% of tweets in the control group. We speculate that more of the conspiracy-related tweets are deleted because of Twitter’s content moderation efforts that have been enforced due to recent public debates about misinformation on OSNs.

3.2 Research Question 2

There is a long list of laboratory studies that show a correlation between conspiracy mentality and extreme political orientation [Enders et al., 2020; van Prooijen et al., 2015]. In this study we answer the slightly different question if the partisanship of Twitter users correlates with their contribution to conspiracy theory narrative discussions. Table 7 shows the distribution of the political orientations of users who discuss each of the underlying conspiracy narratives.

| case          | AfD   | CDU/CSU | FDP  | Bündnis 90/Die Grünen | Linke  | SPD   | Unknown |
|---------------|-------|---------|------|------------------------|--------|-------|---------|
| 5G            | 11%   | 3%      | 3%   | 8%                     | 10%    | 14%   | 51%     |
| Bill Gates    | 16%   | 3%      | 3%   | 8%                     | 12%    | 14%   | 44%     |
| Wuhan laboratory | 27% | 3%      | 15%  | 7%                     | 5%     | 8%    | 35%     |
| Ibuprofen     | 9%    | 3%      | 3%   | 8%                     | 9%     | 16%   | 52%     |
| Homoeopathy   | 5%    | 4%      | 6%   | 13%                    | 15%    | 24%   | 33%     |
| Malaria       | 10%   | 2%      | 2%   | 5%                     | 6%     | 11%   | 64%     |
| Control group | 10%   | 2%      | 2%   | 4%                     | 6%     | 10%   | 66%     |

Table 7 demonstrates that users who are likely to be supporters of AfD and SPD most actively discuss and spread COVID-related conspiracy narratives on Twitter. To check if contributions to conspiracy narratives are correlated with
the political orientation of users, we ran a saturated Poisson log-linear model on the contingency Table 7. The model defines the counts as independent observations of a Poisson random variable and includes the linear combination and the interaction between conspiracy narratives and the political orientation of users [Agresti, 2003].

\[
\log(\mu_{ij}) = \lambda + \lambda_i^N + \lambda_j^P + \lambda_{ij}^{NP}
\]

where \(\mu_{ij} = E(n_{ij})\) represents the expected counts, \(\lambda\)s are parameters to be estimated and \(N\) and \(P\) stand for Narrative and Political Orientation. \(\lambda_{ij}^{NP}\)'s corresponds to the interaction and association between conspiracy narratives and also reflects the departure from independence [Agresti, 2003]. Since we suspect that beliefs in certain mutually contradictory conspiracy theories can be positively correlated [Wood et al., 2012], we aggregated the six conspiracy theory cases to two based on to which category they belong and formed Table 8 to remove any possible correlation.

### Table 8: Political orientation of users who discuss two conspiracy narratives (absolute counts)

| case                                    | AID | CDU/CSU | FDP | Bündnis 90/Die Grünen | Linke  | SPD  | Unknown |
|-----------------------------------------|-----|---------|-----|------------------------|--------|------|---------|
| Origins of COVID-19                     | 4133| 694     | 1396| 1873                   | 2449   | 3028 | 10296   |
| Possible treatments of COVID-19         | 1263| 432     | 497 | 1149                   | 1347   | 2330 | 7841    |

Table 9 shows the ANOVA analysis of the underlying saturated Poisson log-linear model applied on Table 8. The last line of resulting p-values in Table 9 shows that in interaction parameter, \(\mu_{ij} = E(n_{ij})\), is statistically significant. Therefore, we can reject the hypothesis that the contribution to conspiracy narratives is independent of the political orientation of users. The fact that there is evidence of a correlation between the contribution to conspiracy narratives and the political orientation of users, however, does not imply any causality.

### Table 9: ANOVA of Poisson log-linear model on the contingency Table 7

|             | Df | Deviance | Resid. Df | Resid. Dev | Pr(>Chi) |
|-------------|----|----------|-----------|------------|----------|
| NULL        | 13 | 31332.82 |           |            |          |
| narrative   | 1  | 2115.49  | 12        | 29217.32   | 0.0000   |
| party       | 6  | 28294.31 | 6         | 923.02     | 0.0000   |
| narrative:party | 6 | 923.02 | 0         | 0.00       | 0.0000   |

To further estimate the relative effect of political orientation on the contribution to conspiracy narratives on Twitter, we applied six Chi-Square goodness of fit tests on the control group and each of the other six conspiracy narratives. For all of the six tests the p-values were significantly less than 0.05, which suggests that the distributions of the contribution to the six different conspiracy narratives are statistically different compared to the control group. Figure 2 shows the distribution of the tests’ residuals. The last column of Figure 2 shows that the Twitter users without a certain political orientation contributed relatively less to conspiracy narratives in comparison to the control group. In other words, compared to the control group, users with certain political orientations contributed more to the circulation of conspiracy narratives.

### 3.3 Research Question 3

Automated accounts, or users who post programmatically, make up a significant amount of between 9% and 15% of Twitter users worldwide [Davis et al., 2016]. Multiple studies hold automated accounts responsible for political manipulation and undue influence on the political agenda [Shao et al., 2017; Ferrara et al., 2016]. However, more recent studies shed light on these previous results and showed that the influence of automated accounts is overestimated. Ferrara finds that automated accounts comprise less than 10% of users who post generally about COVID-19 [Ferrara, 2020].

There are multiple methods to automatically detect automated accounts on OSNs [Alothali et al., 2018]. For this study, we used the method developed by Davis et al. [Davis et al., 2016]. They applied random forest classification trees on more than a thousand public meta-data available using the Twitter API and on other human engineered features.
Figure 2: Distribution of residuals of Chi-Square goodness of fit tests

Table 10: Ratio of tweets posted by automated and verified users

| case            | share of tweets posted by verified users | share of tweets posted by automated accounts | Ratio of automated accounts to verified users |
|-----------------|-----------------------------------------|---------------------------------------------|---------------------------------------------|
| 5G              | 3.141%                                  | 1.578%                                     | 0.5                                        |
| Bill Gates      | 1.85%                                   | 1.358%                                     | 0.73                                       |
| Wuhan Laboratory| 9.065%                                  | 1.3%                                       | 0.14                                       |
| Ibuprofen       | 3.349%                                  | 1.386%                                     | 0.41                                       |
| Homoeopathy     | 1.039%                                  | 0.921%                                     | 0.89                                       |
| Malaria         | 4.626%                                  | 1.343%                                     | 0.29                                       |
| Control group   | 4.644%                                  | 0.89%                                      | 0.19                                       |

Based on this analysis, 1.31% of COVID-19 conspiracy narrative tweets are suspected to be posted by automated accounts. This number is significantly lower than many other studies on bot activities on Twitter. We speculate that this occurs due to three reasons. First, the importance of the topic might have captured a lot of public attention, so that significantly more users discuss COVID-19-related topics compared to usual Twitter discussions. Second, many service providers, including Twitter, have started to combat COVID-19 misinformation because of widespread warnings. Finally, we have concentrated on German tweets while the past estimates apply to tweets in English.

4 Discussions and limitations

In this study we analyzed more than 9.5M German language tweets and showed that the volume of tweets that discuss one of the six considered conspiracy narratives represents about 0.6% of all COVID-19 tweets. This translates to more
than 36,000 unique German speaking Twitter users. Imhoff and Lamberty found that “believing that COVID-19 was a hoax was a strong negative prediction of containment-related behaviors like hand washing and keeping physical distance”. To provide the public with accurate information about the importance of such measures, social media intelligence can help elevate potential pitfalls of the Twitter information ecosystem.

Using more than 38,000 tweets and 36,000 unique Twitter users, we formed the contingency table of political orientation and of contribution to COVID-19 conspiracy narratives (Table 8). We then applied a saturated Poisson log-linear regression and showed that we cannot statistically reject independence among the underlying variables. This implies partisans have a higher motivation for taking part in COVID-19-related conspiracy discussions. This shows that politically polarized citizens increase the spread of health misinformation on Twitter.

Finally, we employed an automated accounts detection tool and showed that on average about 1.31% of the users who discuss COVID-19 conspiracy narratives are potentially automated accounts or bots. This number is much lower than estimations on general bot activity on Twitter, which is assumed to be up to 15% [Davis et al., 2016].

This study holds new insights as well as some limitations:

- Our results shed light on the problem of misinformation on Twitter in times of crises for a certain cultural and language context: Germany. We showed that the political orientation of politically polarized users translates to higher circulation of health-related conspiracy narratives on Twitter. Further research could compare the results of this study with other countries and language realms on Twitter.

- We also offer indications between political or ideological partisanship and engagement in the dissemination of misinformation on Twitter. In this study we examined if political partisanship motivates individuals to take part in conspiracy discussions. In other words, we did not distinguish between tweets promoting the conspiracy narratives and those rejecting them. One could extend the analysis and study the effect of partisanship on promoting conspiracy theories. Further research will also need to combine quantitative data analysis and qualitative content analysis to better understand the underlying motivations for engaging in conspiracy communication on OSNs.

- Finally, we offer a more nuanced view on the role of automated tweets regarding a highly emotionally-charged topic. There are numerous studies showing contradictory estimates of bot activity on OSNs. We found only about 1.31% of users who spread COVID-19 conspiracy tweets are potentially bots. This number is much lower than many of those put forward by other researchers. Further research could investigate this result in order to understand the reasons why this estimation is lower than other case studies.

References

BBC. https://www.bbc.com/news/world-51839944, 2020. last accessed 2020/09/02.

WHO. https://www.who.int/who-documents-detail/a-coordinated-global-research-roadmap, 2020a. last accessed 2020/09/02.

WHO. https://www.who.int/news-room/feature-stories/detail/immunizing-the-public-against-misinformation, 2020b. last accessed 2020/09/02.

WHO. https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200601-covid-19-sitrep-133.pdf, 2020c. last accessed 2020/09/02.

OECD. OECD Economic Outlook, Interim Report March 2020, 2020. doi:https://doi.org/10.1787/7969896b-en URL https://www.oecd-ilibrary.org/content/publication/7969896b-en

Yan-Rong Guo, Qing-Dong Cao, Zhong-Si Hong, Yuan-Yang Tan, Shou-Deng Chen, Hong-Jun Jin, Kai-Sen Tan, De-Yun Wang, and Yan Yan. The origin, transmission and clinical therapies on coronavirus disease 2019 (covid-19) outbreak—an update on the status. Military Medical Research, 7(1):1–10, 2020.

Peng Xie, Wanyu Ma, Hongbo Tang, and Daishun Liu. Severe covid-19: A review of recent progress with a look toward the future. Frontiers in Public Health, 8:189, 2020. ISSN 2296-2565. doi:10.3389/fpubh.2020.00189 URL https://www.frontiersin.org/article/10.3389/fpubh.2020.00189

Cyrus SH Ho, Cornelia Yi Chee, and Roger Cm Ho. Mental health strategies to combat the psychological impact of covid-19 beyond paranoia and panic. Ann Acad Med Singapore, 49(1):1–3, 2020.

Ravi Philip Rajkumar. Covid-19 and mental health: A review of the existing literature. Asian journal of psychiatry, page 102066, 2020.
Andreas Frank, Sophia Hörmann, Julia Krombach, Bastian Fatke, Fabian Holzhüter, Wolfgang Frank, Rebecca Sondergeld, Hans Förstl, and Patricia Hölzle. Covid-19 concerns and worries in patients with mental illness. *Psychiatrische Praxis*. 

Jennifer A. Whitson and Adam D. Galinsky. Lacking control increases illusory pattern perception. *Science*. 322(5898):115–117, 2008. ISSN 0036-8075. doi:10.1126/science.1159845 URL https://science.sciencemag.org/content/322/5898/115

Karl Popper. *The Open Society and its Enemies: Hegel and Marx*. Routledge, 2002.

Arie W Kruglanski, Antonio Pierro, Lucia Mannetti, and Eraldo De Grada. Groups as epistemic providers: need for closure and the unfolding of group-centrism. *Psychological review*, 113(1):84, 2006.

Roland Imhoff and Martin Bruder. Speaking (un-)truth to power: Conspiracy mentality as a generalised political attitude. *European Journal of Personality*, 28(1):25–43, 2014. doi:10.1002/per.1930 URL https://onlinelibrary.wiley.com/doi/abs/10.1002/per.1930

Marina Abalakina-Paap, Walter G. Stephan, Traci Craig, and W. Larry Gregory. Beliefs in conspiracies. *Political Psychology*, 20(3):637–647, 1999. doi:10.1111/0162-895X.00160 URL https://onlinelibrary.wiley.com/doi/abs/10.1111/0162-895X.00160

Moreno Mancosu, Salvatore Vassallo, and Cristiano Vezzoni. Believing in conspiracy theories: Evidence from an exploratory analysis of Italian survey data. *South European Society and Politics*, 22(3):327–344, 2017. doi:10.1080/13608746.2017.1359894 URL https://doi.org/10.1080/13608746.2017.1359894

Jan-Willem van Prooijen. Why education predicts decreased belief in conspiracy theories. *Applied Cognitive Psychology*, 31(1):50–58, 2017. doi:10.1002/acp.3301 URL https://onlinelibrary.wiley.com/doi/abs/10.1002/acp.3301

Viren Swami, Rebecca Coles, Stefan Steiger, Jakob Pletschnig, Adrian Furnham, Sherry Rehm, and Martin Voracek. Conspiracist ideation in Britain and Austria: Evidence of a monological belief system and associations between individual psychological differences and real-world and fictitious conspiracy theories. *British Journal of Psychology*, 102(3):443–463, 2011. doi:10.1111/j.2044-8295.2010.02004.x URL https://onlinelibrary.wiley.com/doi/abs/10.1111/j.2044-8295.2010.02004.x

Anna-Kaisa Newheiser, Miguel Farias, and Nicole Tausch. The functional nature of conspiracy beliefs: Examining the underpinnings of belief in the da vinci code conspiracy. *Personality and Individual Differences*, 51(8):1007 – 1011, 2011. ISSN 0191-8869. doi:https://doi.org/10.1016/j.paid.2011.08.011 URL http://www.sciencedirect.com/science/article/pii/S0191886911003849

Adam M. Enders, Steven M. Smallpage, and Robert N. Lupton. Are all ‘birthers’ conspiracy theorists? on the relationship between conspiratorial thinking and political orientations. *British Journal of Political Science*, 50(3):849–866, 2020. doi:10.1017/S0007123417000837

Jan-Willem van Prooijen, André P. M. Krouwel, and Thomas V. Pollet. Political extremism predicts belief in conspiracy theories. *Psychological and Personality Science*, 6(5):570–578, 2015. doi:10.1177/1948550614567356 URL https://doi.org/10.1177/1948550614567356

Erhard Geissler and Robert Hunt Sprinkle. Disinformation squared: Was the hiv-from-fort-detrick myth a stasi success? *Politics and the Life Sciences*, 32(2):2–99, 2013. ISSN 07309384, 14715457. URL http://www.jstor.org/stable/43287281

Laura M Bogart, Glenn Wagner, Frank H Galvan, and Denedria Banks. Conspiracy beliefs about hiv are related to antiretroviral treatment nonadherence among african american men with hiv. *Journal of acquired immune deficiency syndromes (1999)*, 53(5):648, 2010.

Casey A Klofstad, Joseph E Uscinski, Jennifer M Connolly, and Jonathan P West. What drives people to believe in zika conspiracy theories? *Palgrave Communications*. 5(1):1–8, 2019.

Pew. https://www.pewresearch.org/fact-tank/2019/04/10/share-of-u-s-adults-using-social-media-including-facebook-is-mostly-unchanged-since-2018/, 2019. last accessed 2020/09/02.

Richard Fletcher, Alessio Cornia, and Rasmus Kleis Nielsen. How polarized are online and offline news audiences? a comparative analysis of twelve countries. *The International Journal of Press/Politics*, 25(2):169–195, 2020. doi:10.1177/1940161219892768 URL https://doi.org/10.1177/1940161219892768

JungHwan Yang, Hernando Rojas, Magdalena Wojcieszak, Toril Aalberg, Sharon Coen, James Curran, Kaori Hayashi, Shanto Iyengar, Paul K. Jones, Gianpietro Mazzoleni, Stylianos Papathanassopoulos, June Woong Rhee, David Rowe, Stuart Soroka, and Rodney Tiffen. Why Are “Others” So Polarized? Perceived Political Polarization and Media Use in 10 Countries. *Journal of Computer-Mediated Communication*, 21(5):349–367, 09 2016. ISSN 1083-6101. doi:10.1111/jcc4.12166 URL https://doi.org/10.1111/jcc4.12166
Anneliese Depoux, Sam Martin, Emilie Karafillakis, Raman Preet, Annelies Wilder-Smith, and Heidi Larson. The pandemic of social media panic travels faster than the COVID-19 outbreak. *Journal of Travel Medicine*, 27(3), 03 2020. ISSN 1708-8305. doi:10.1093/jtm/taaa031 URL https://doi.org/10.1093/jtm/taaa031

David Robert Grimes. On the viability of conspiratorial beliefs. *PLOS ONE*, 11(1):1–17, 01 2016. doi:10.1371/journal.pone.0147905 URL https://doi.org/10.1371/journal.pone.0147905

Shadi Shahsavari, Pavan Holur, Timothy R Tangherlini, and Vwani Roychowdhury. Conspiracy in the time of corona: Automatic detection of covid-19 conspiracy theories in social media and the news. *arXiv preprint arXiv:2004.13783*, 2020.

Tagesschau. https://www.tagesschau.de/faktenfinder/corona-ibuprofen-101.html, 2020. last accessed 2020/09/02.

Netzpolitik. https://netzpolitik.org/2020/wenn-die-eltern-ploetzlich-an-verschwoerungstheorien-glauben-corona-pandemie/, 2020. last accessed 2020/09/02.

Danah Boyd, Scott Golder, and Gilad Lotan. Tweet, tweet, retweet: Conversational aspects of retweeting on twitter. In *2010 43rd Hawaii international conference on system sciences*, pages 1–10. IEEE, 2010.

Kiran Garimella, Gianmarco De Francisct Morales, Aristides Gionis, and Michael Mathioudakis. Mary, mary, quite contrary: Exposing twitter users to contrarian news. In *Proceedings of the 26th International Conference on World Wide Web Companion*, pages 201–205, 2017.

Jonas De Keersmaecker and Arne Roets. ‘fake news’: Incorrect, but hard to correct. the role of cognitive ability on the impact of false information on social impressions. *Intelligence*, 65:107 – 110, 2017. ISSN 0160-2896. doi:https://doi.org/10.1016/j.intell.2017.10.005 URL http://www.sciencedirect.com/science/article/pii/S0160289617301617

Timothy R. Tangherlini, Shadi Shahsavari, Behnam Shabbazi, Ehsan Ebrahimzadeh, and Vwani Roychowdhury. An automated pipeline for the discovery of conspiracy and conspiracy theory narrative frameworks: Bridgegate, pizzagate and storytelling on the web. *PLOS ONE*, 15(6):1–39, 06 2020. doi:10.1371/journal.pone.0233879 URL https://doi.org/10.1371/journal.pone.0233879

Roland Imhoff and Pia Lamberty. A bioweapon or a hoax? the link between distinct conspiracy beliefs about the coronavirus disease (covid-19) outbreak and pandemic behavior. 2020.

Pew. https://www.journalism.org/2020/03/18/americans-immersed-in-covid-19-news-most-think-media-are-doing-fairly-well-covering-it/, 2020. last accessed 2020/09/02.

Svenja Boberg, Thorsten Quandt, Tim Schatto-Eckrodt, and Lena Frischlich. Pandemic populism: Facebook pages of alternative news media and the corona crisis–a computational content analysis. *arXiv preprint arXiv:2004.02566*, 2020.

Wasim Ahmed, Josep Vidal-Alaball, Joseph Downing, and Francesc López Seguí. Covid-19 and the 5g conspiracy theory: social network analysis of twitter data. *Journal of Medical Internet Research*, 22(5):e19458, 2020.

Juan Carlos Medina Serrano, Orestis Papakyriakopoulos, and Simon Hegelich. Nlp-based feature extraction for the detection of covid-19 misinformation videos on youtube. 2020.

Bloomberg. https://www.bloomberg.com/news/articles/2020-03-17/facebook-microsoft-google-team-up-against-virus-misinformation, 2020. last accessed 2020/09/02.

Twitter. https://twitter.com/TwitterSafety/status/1253044734416711680, 2020. last accessed 2020/09/02.

Alan Agresti. *Categorical data analysis*, volume 482. John Wiley & Sons, 2003.

Michael J Wood, Karen M Douglas, and Robbie M Sutton. Dead and alive: Beliefs in contradictory conspiracy theories. *Social psychological and personality science*, 3(6):767–773, 2012.

Clayton Allen Davis, Onur Varol, Emilio Ferrara, Alessandro Flammini, and Filippo Menczer. Botornot: A system to evaluate social bots. In *Proceedings of the 25th international conference companion on world wide web*, pages 273–274, 2016.

Chengcheng Shao, Giovanni Luca Ciampaglia, Onur Varol, Alessandro Flammini, and Filippo Menczer. The spread of fake news by social bots. *arXiv preprint arXiv:1707.07592*, 96:104, 2017.

Emilio Ferrara, Onur Varol, Clayton Davis, Filippo Menczer, and Alessandro Flammini. The rise of social bots. *Communications of the ACM*, 59(7):96–104, 2016.

Emilio Ferrara. What types of covid-19 conspiracies are populated by twitter bots? *First Monday*, May 2020. ISSN 1396-0466. doi:10.5210/fm.v25i6.10633 URL http://dx.doi.org/10.5210/fm.v25i6.10633
Eiman Alothali, Nazar Zaki, Elfadil A Mohamed, and Hany Alashwal. Detecting social bots on twitter: A literature review. In *2018 International Conference on Innovations in Information Technology (IIT)*, pages 175–180. IEEE, 2018.

Onur Varol, Emilio Ferrara, Clayton A Davis, Filippo Menczer, and Alessandro Flammini. Online human-bot interactions: Detection, estimation, and characterization. In *Eleventh international AAAI conference on web and social media*, 2017.