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Social networks between the US presidential candidates regarding COVID-19

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Abstract: This study explores social networks between the US presidential candidates regarding COVID-19 by employing social network analysis for Twitter. This study employs NodeXL to visualise social networks of the US presidential candidates for COVID-19 on 6 November 2020 right after the US 2020 US presidential election date. This study finds that Donald Trump has strong social networks with his family, while Joe Biden reveals those with news media. Secondly, Donald Trump has strong connections with his political supporters, whereas Joe Biden has many political opponents in the networks. Thirdly, while Donald Trump has only his party in his networks, Joe Biden has not only his political party but also the rival party in his networks. This study contributes to our understanding of how US presidential candidates utilise distinct social networks to address the challenges posed by the COVID-19 pandemic.

Keywords: US presidential candidate; Donald Trump; Joe Biden; COVID-19; social network.

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1 Introduction

Coronavirus (COVID-19) has been one of the most important issues for governments and politicians. As of 7 November 2020, about 50 million patients have been reported, and more than 1.2 million deaths are attributed to COVID-19. Therefore, controlling COVID-19 has been a significant political issue among policymakers and people (see e.g., Druckman et al., 2021; Merkley et al., 2020; Tisdell, 2020).

Governments adopt different COVID-19 policies to deal with the pandemic across countries and regions (see e.g., Cheng et al., 2020; Greer et al., 2020; Lyu and Wehby, 2020). For example, Sabat et al. (2020) highlight that the government's response in the European Union is differentiated by policy measures and countries, such as trust in the information from the national government economic concerns and mobile data use for

movement tracking. Capano et al. (2020) show that there are some variations in national-level state responses, such as immunisation and treatment, support for the vulnerable, and school and university closure, by analysing a variety of datasets, such as the CoronaNet dataset.

Prior studies also suggest that people respond differently to COVID-19 according to their political stance (see e.g., Barrios and Hochberg, 2020; Shao and Hao, 2020). For example, Shao and Hao (2020) highlight that liberals and moderates reveal perceptions of COVID-19 higher than conservatives based on the Pew Research Center's Election News Pathways Survey between 10 March to 16 March 2020 on the American Trends Panel. Barrios and Hochberg (2020) report that people in counties with a higher proportion of Trump supporters are less apt to search for news related to COVID-19 and engage in social distancing behaviours.

However, previous studies have rarely highlighted how politicians build different social networks to deal with the COVID-19 pandemic according to their political position (see e.g., Cairney and Wellstead, 2021; Luengo and García-Marín, 2020; Murdoch et al., 2020). Understanding social networks could give insights into how US politicians have their relationships with other politicians, institutes, organisations, news media, and so on, and their positions to cope with the COVID-19 issues. Also, the COVID-19 issue has been one of the most important issues for people to support the politicians and party. Therefore, this study highlights how the US presidential candidates have their social networks for COVID-19 on social network services (SNS) to respond to the COVID-19 issue.

Table 1 COVID-19 in the world as of 6 November 2020

<i>Location</i>	<i>Total cases</i>	<i>New cases</i>	<i>Cases per 1M people</i>	<i>Deaths</i>
1 The US	9,761,320	121,504	29,620	235,909
2 India	8,411,724	47,638	6,183	124,985
3 Brazil	5,590,025	-	26,451	161,106
4 Russia	1,699,695	19,116	11,583	29,285
5 France	1,605,171	57,340	23,931	38,730
6 Spain	1,306,316	21,908	27,735	38,486
7 Argentina	1,217,028	11,100	27,082	32,766
8 UK	1,123,197	24,138	16,907	48,120
9 Colombia	1,117,977	9,891	22,633	32,209
10 Mexico	949,197	5,567	7,499	93,772
:	:	:	:	:
Worldwide	49,114,225	-	6,316	1,239,757

Source: Google News

This study explores the Twitter account of Donald Trump and Joe Biden who are the candidates for the 2020 US presidential election by employing social network analysis (SNA) for Twitter since the US has experienced the most severe COVID-19 pandemic across the world (see Table 1). To the best of my knowledge, this study is the first article exploring the social networks of US presidential candidates to understand the different COVID-19 responses according to the political position by employing SNA for SNS.

2 Literature review

COVID-19 is a new illness caused by a virus that can spread from person to person. COVID-19 is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and first identified in December 2019 in Wuhan, China. COVID-19 symptoms can range from mild (or no symptoms) to severe illness (CDC, 2020).

The US Government has made concerted efforts to mitigate the impact of the COVID-19 pandemic, diligently formulating and implementing a multitude of comprehensive disease policies (see e.g., COVID et al., 2020; Parodi and Liu, 2020; Tenforde et al., 2020). For instance, the US Government declares three national emergencies in response to the COVID-19 pandemic. Health and Human Services (HHS) declares a public health emergency under the Public Health Service Act (PHSA), authorising funds and rapid development of antiviral drugs, diagnostic tests, and vaccines on 31 January. President Trump announces a national emergency under the National Emergencies Act, which waives federal rules to increase hospital capacity and facilitate telemedicine on 13 March. The US President also announces an emergency under the Stafford Disaster Relief and Emergency Assistance Act, which is the preeminent responsibility of the federal government to take action to stem a nationwide pandemic (Gostin et al., 2020).

Prior studies have highlighted how President Trump responds to the COVID-19 pandemic (Bowling et al., 2020; Dyer, 2020; Yamey and Gonsalves, 2020). Some scholars have criticised President Trump's responses since the US has the highest number of COVID-19 patients and deaths across the world. For instance, Bowling et al. (2020) argue that the Trump administration's response to the COVID-19 Pandemic has brought chaotic, disjointed, and confusing statements and actions to the US. Yamey and Gonsalves (2020) criticise that Trump's response leads the US to become the current epicentre of the global COVID-19 pandemic, with almost one third of the world's cases and a still rising number of new daily cases. Shao and Hao (2020) show that during the public health crisis of COVID-19, President Trump has been inconsistent in his concern about this disease and his messages to the public. He has mostly downplayed the risk of this disease.

Other scholars have also explored how Joe Biden responds to the ongoing pandemic (see e.g., Kirzinger and Brodie, 2020; McInturff and Lewis, 2020; Silberner, 2020). For example, after Joe Biden is selected as the new US President, he immediately announces a step change in the country's response to COVID-19, promising compassion, empathy, and concern (Silberner, 2020). McInturff and Lewis (2020) report that Joe Biden would generally handle the health care issue better than President Trump (49% vs. 34%). For the COVID-19 pandemic issue, believe that Biden would handle it better than Trump (48% vs. 37%).

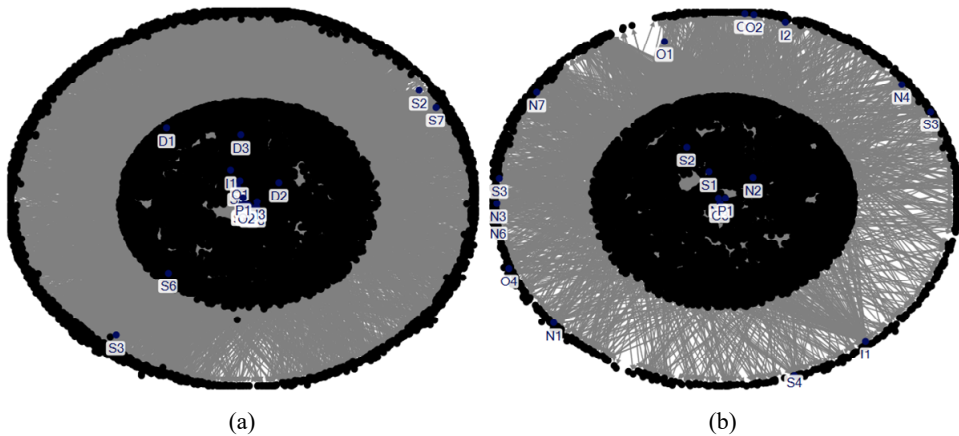
Some authors have highlighted how the US Government has social networks to cope with the COVID-19 pandemic (see e.g., Alagoz et al., 2021; Kuchler et al., 2020; Yum, 2020). For example, Yum (2020) shows that President Trump plays the most essential role in social networks for both in-degree centrality and content in tweets. Alagoz et al. (2021) report that the timing of and adherence to social distancing have a significant effect on COVID-19 occurrence based on agent-based model applied to Dane County, Wisconsin; the Milwaukee metropolitan (metro) area; and New York City (NYC). However, they have not highlighted how US candidates have their social networks for

COVID-19 by employing SNA. Therefore, this study employs SNA for the US candidates based on Twitter in the next section.

3 Research methodology

This study employs SNA for Twitter to explore social networks between the US presidential candidates regarding COVID-19 (see Figure 1). SNA is a methodology to visualise human relationships by means of graph theory (see e.g., Tsvetovat and Kouznetsov, 2011). SNA characterises networked structures among nodes (individual players, people, or things in the network) and the ties, edges, or links (relationships or interactions) that connect them. SNA allows the author to examine these relationships for COVID-19 to describe individuals and groups as parts of a social structure. Individuals interact with each other, and these interaction patterns among groups provide insight into COVID-19 networks. This study utilises Twitter data to highlight government networks for COVID-19 across public key players, such as presidents, politicians, government agencies, and news media. Twitter has been widely used for big data analyses (see e.g., Chow-White et al., 2018; Nambisan et al., 2015; Singh and Kumari, 2016).

Figure 1 Betweenness centrality, (a) Trump (b) Biden (see online version for colours)



This study employs NodeXL on 6 November 2020 right after the 2020 US presidential election date based on the keywords COVID-19 and the US President candidate accounts to collect Twitter data (see Table 2 for descriptive statistics). NodeXL is a network data analysis and visualisation program that allows scholars to explore big data for social networks (see e.g., Sharma et al., 2010). NodeXL enables researchers to undertake social network analysis work metrics, such as centrality, degree, and clustering as well as monitor SNS data and visualise the overall relational network structure. To be specific, NodeXL provides flexible measurement system and parameter selection to confirm the influential nodes in the network, such as in-degree, out-degree centrality, and betweenness centrality. This study collects 17,641 Twitter accounts and 47,236 networks for Trump and 16,749 Twitter accounts and 24,141 networks for Biden from December 2019 to 6 November 2020 by employing NodeXL.

Table 2 The top 20 key players in the Donald Trump networks

	<i>L</i>	<i>BC</i>	<i>Name</i>	<i>Description</i>
1	P1	297,310,592	Donald J. Trump	The US President
2	D1	935,133	Jessica Williams, MD	Family medicine specialist in Phoenix, AZ
3	O1	893,935	Ted Lieu	American politician
4	O2	831,004	Joe Biden	The US President candidate
5	D2	150,270	Cleavon Gilman	Emergency medicine physician in Arizona
6	I1	131,482	The White House	The official workplace of the President of the US
7	S1	97,395	GOP	The Republican Party
8	S2	64,468	Donald Trump Jr.	The eldest child of US President Donald Trump
9	S3	60,197	President Trump	45th President of the USA
10	S4	45,061	Team Trump	The official Twitter account for the Trump Campaign
11	S5	24,408	Ivanka Trump	The daughter and second child of President Trump
12	S6	24,296	Mike Pence	The Vice President
13	N1	23,368	Fox News	American multinational conservative cable news television channel
14	N2	22,768	Breitbart News	American far-right syndicated news, opinion and commentary website
15	N3	17,638	The Spectator US	The conservative American online magazine covering news and politics
16	D3	15,771	Howard Green, MD	The dermatologist in West Palm Beach, FL
17	S6	15,696	Melania Trump	The First Lady of the USA
18	S7	14,991	Ronna McDaniel	Chair of the Republican National Committee
19	S8	14,410	Kristi Noem	Governor of South Dakota
20	S9	10,757	Kayleigh McEnany	White House Press Secretary

Notes: L: label, BC: betweenness centrality, P: Donald Trump or Joe Biden, S: supporter, O: opponent, D: doctor, I: institute, and N: news media.

This study employs betweenness centrality to capture public key players for Twitter users. Betweenness centrality is a global centrality metric, which is calculated by the fraction of shortest paths passing through a node (Jia et al., 2012). Betweenness centrality is a widely utilised method that captures a person's role in allowing information to pass from one part of the network to the other. Technically, betweenness centrality measures the percentage of shortest paths that must go through the specific node (Golbeck, 2013). For example, the more people depend on a person to make connections with other people, the higher that a person's betweenness centrality becomes (Hansen et al., 2010). Therefore, key players with high betweenness centrality have remarkable impacts on the social networks for COVID-19 by virtue of their control over information passing between others. This study chooses the top 20 key players among all Twitter users based on the magnitude of the betweenness centrality.

This study also shows eigenvector centrality and PageRank for social networks of COVID-19 according to the US presidential candidates. Eigenvector centrality calculates a node's importance while giving consideration to the importance of its neighbours (see e.g., Golbeck, 2013). Eigenvector centrality allows for connections to have a variable value, so that connecting to some users has more benefit than connecting to other users (Hansen et al., 2010). For example, A high eigenvector key player means that the key player is connected to many people who themselves have high scores.

PageRank is an algorithm created by Google to rank the importance of nodes based on a number of different factors, including standard information retrieval measures, proximity, and anchor text (see e.g., Bianchini et al., 2005). PageRank works by counting the number and quality of links to a user to determine a rough estimate of how important the user is. PageRank considers that more important users are likely to receive more links from other users. For example, if a key player receives more high-quality links of COVID-19 networks, the key player is considered as more important.

Next, this study employs cluster analysis by utilising the Clauset-Newman-Moore cluster algorithm. Cluster analysis is a methodology for the task of assigning a set of objects into groups so that the objects in the same cluster are more similar to each other than those in other clusters. Cluster analysis is based on distance measures between users. Cluster analysis is to minimise intracluster variance while maximising intercluster variance (Nadif, 2022). The Clauset-Newman-Moore is a clustering technique, which is extensively used in finding community structure among large social networks (Sharon Moses and Babu, 2016). The Clauset-Newman-Moore allows researchers to analyse larger networks with millions of vertices and tens of millions of edges using current computing resources (Clauset et al., 2004).

4 Results

Figure 1 highlights the betweenness centrality according to the US presidential candidates. In the Donald Trump networks, most key players are concentrated in the inner circle, whereas some key players, such as Donald Trump Jr. (S2), President Trump (S3), and Ronna McDaniel (S7), are located in the outer circle. In contrast, in the Joe Biden networks, some key players, such as CBS News (N2), Kamala Harris (S1), and Barack Obama (S2), are located in the inner circle, while most key players are placed in the outer circle and highly dispersed around the circle. Donald Trump and Joe Biden also show different social networks according to eigenvector centrality and PageRank (see Figures 1 and 2).

Table 2 and 3 show the top 20 key players in the Donald Trump and Joe Biden networks, respectively. In the Donald Trump networks, he shows some unique characteristics of social networks. First, he has strong social networks with his family. For instance, Donald Trump Jr. who is the eldest child of Donald Trump ranks eighth, and Ivanka Trump who is the daughter and second child places 11th. Melania Trump who is the first lady takes 17th. Second, he has strong connections with his political supporters. Nine out of the top 20 players are political supporters. For example, the Republican Party ranks seventh, and Team Trump, which is the official Twitter account for the Trump Campaign, places tenth. Third, he has social networks with many doctors, whereas Joe Biden has no doctors in his networks. For example, Jessica Williams who is

the family medicine specialist ranks second, and Cleavon Gilman who is the emergency medicine physician places fifth. Howard Green who is the dermatologist ranks 16th. Fourth, he shows many conservative and far-right news in his networks. For example, Fox News, which is the American multinational conservative cable news television channel, ranks 13th, and Breitbart News, which is the American far-right syndicated news, opinion and commentary website, places 14th. The Spectator US, which is the conservative American online magazine covering news and politics, takes 15th. Fifth, While Donald Trump and Joe Biden have each other in their networks, Joe Biden plays a less important role in Donald Trump networks (Joe Biden: fourth in the Donald Trump networks and Donald Trump: second in the Joe Biden networks).

Table 3 The top 20 key players in the Joe Biden networks

	<i>L</i>	<i>BC</i>	<i>Name</i>	<i>Description</i>
1	P1	279,251,516	Joe Biden	The US President candidate
2	O1	801,900	Donald J. Trump	The US President
3	S1	231,372	Kamala Harris	US Vice President-elect
4	S2	6,212	Barack Obama	The former US President
5	I1	3,368	CDC	The Centers for Disease Control and Prevention
6	N1	2,827	Fox News	American multinational conservative cable news television channel
7	N2	2,294	CBS News	American commercial broadcast television and radio network
8	N3	2,128	CNN	Cable News Network
9	O2	1,943	GOP	The Republican Party
10	O3	1,647	President Trump	45th President of the USA
11	I2	1,481	The White House	The official workplace of the President of the US
12	S3	1,216	Hillary Clinton	Former USA Secretary of State
13	N4	1,100	MSNBC	American news-based pay television cable channel
14	S3	711	Nancy Pelosi	Speaker of the US House of Representatives
15	O4	568	Ivanka Trump	The daughter and second child of President Trump
16	O5	555	Melania Trump	The First Lady of the USA
17	N5	430	The New York Times	American newspaper based in New York City with worldwide influence and leadership
18	N6	420	The Washington Post	American daily newspaper published in Washington, DC
19	N7	394	NBC News	The National Broadcasting Company News
20	S4	257	The Democrats	The Democratic Party

In the Joe Biden networks, he shows many different characteristics from the Donald Trump networks. First, he has news media as the important key players in his networks. For instance, seven out of the top 20 key players are news media. Second, he has strong connections with the prior president and prior president candidate. For

example, Barack Obama who is the former US President places fourth, and Hillary Clinton who is the former US President candidate takes 12th. Third, he has many political opponents in the networks. For instance, Ivanka Trump and Melania Trump rank 15th and 16th, respectively. Fourth, Joe Biden has not only his political party but also the rival party in his networks. For instance, the Republican Party and the Democrats takes ninth and twentieth, respectively. Fifth, he has a strong connection with the CDC (Centers for Disease Control and Prevention), which is one of the most important institutes for COVID-19 and places fifth, whereas it does not rank in the Donald Trump networks.

Figure 2 Eigenvector centrality, (a) Trump (b) Biden (see online version for colours)

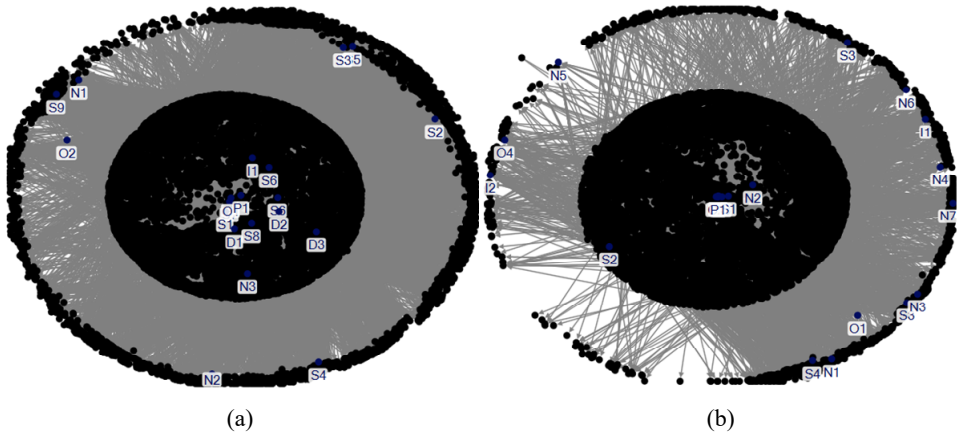


Figure 3 PageRank, (a) Trump (b) Biden (see online version for colours)

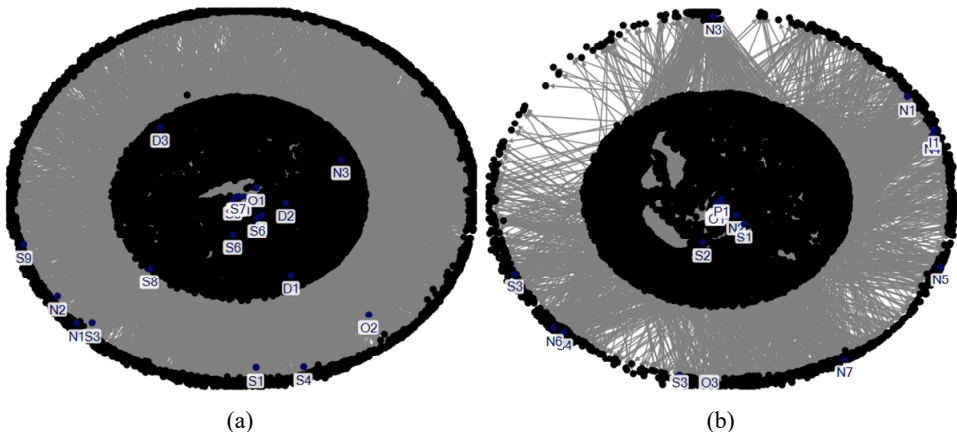


Figure 3 and 4 show the cluster analysis based on the Clauset-Newman-Moore cluster algorithm for the typical case and groups. In the Donald Trump networks, four key players play an important role in the largest group (group 1) (see Figure 5). For instance, Donald Trump (P1) and Ted Lieu (O1) is placed in the central part of the whole networks (O1 is right behind P1 in the Figure), and Kristi Noem (S8) and Breitbart News (N2) are placed in group 1. There are no key players in the second largest group, inconsistent with Joe Biden networks. In contrast, most key players are located in the third largest group.

For example, 14 out of the top 20 key players are placed in group 3, and all his family members are concentrated in the group.

Figure 4 Social networks for the typical case, (a) Trump (b) Biden (see online version for colours)

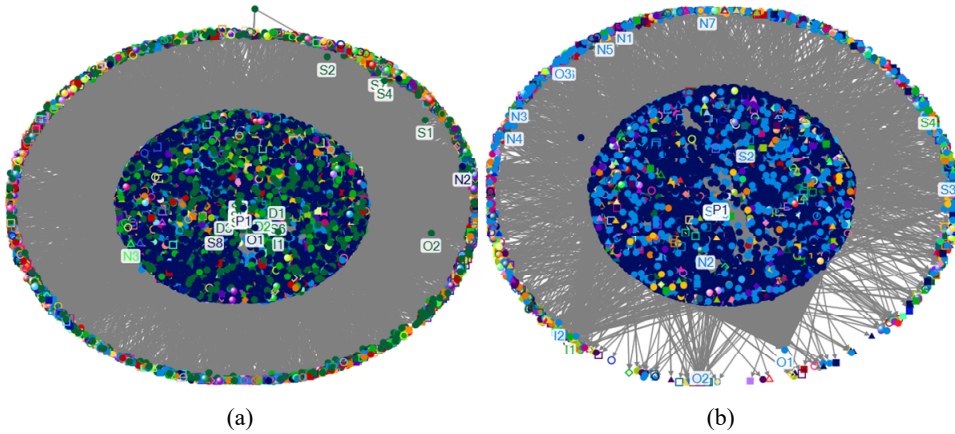
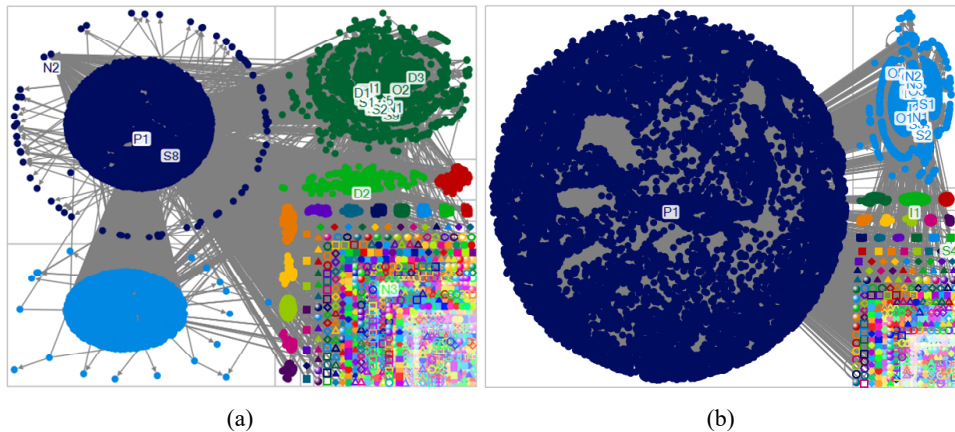


Figure 5 Social networks according to groups, (a) Trump (b) Biden (see online version for colours)



In the Joe Biden networks, Joe Biden (P1) is only placed in the largest group and exerts a significant impact on the whole network. Also, individuals are highly concentrated in group1. They show a huge circle, inconsistent with the Donald Trump networks. All other key players are clustered in the second largest group except for the CDC (group 4) and the Democrats (group 16), whereas key players in Donald Trump are highly located in group 3. Group 3 has a small proportion of the social networks, inconsistent with the Donald Trump networks.

5 Discussion

COVID-19 is one of the most important issues across the world, and many politicians show different opinions and social networks for COVID-19 according to their political party. This study highlights Donald Trump and Joe Biden's social networks for COVID-19 by employing social network analysis (SNA) for Twitter. This study finds some significant findings, which are consistent with (or inconsistent with) prior studies as follows:

First, this study highlights that Donald Trump and Joe Biden have different positions and social networks for COVID-19, which concurs with the prior studies (see e.g., Baccini et al., 2021; Gao and Radford, 2021; Mendoza Aviña and Sevi, 2021). For example, Gao and Radford (2021) exhibit that Joe Biden is more likely to adopt several health-protective behaviours, more likely to worry, and more likely to support social distancing policies, whereas Donald Trump appears to be less concerned about COVID-19. To be specific, Trump's Twitter tends to demonstrate more ability in building engagement with the public and show hate narratives against China. Trump's tweets often attack China and corner it as the country, which must be responsible for the COVID-19 pandemic. Biden are more likely to upload his tweets about his support for the fight against the pandemic. He frequently tweets about reports on handling the COVID-19 pandemic and encouraging people not to give up against the COVID-19 pandemic (see e.g., Rachmawati et al., 2021; Ugarte et al., 2021; Young, 2020).

Second, this study shows that news media play an important role in social networks of Donald Trump and Joe Biden since they have a significant effect on people's thinking and behaviour (see e.g., Bridgman et al., 2020; Krawczyk et al., 2021; Mach et al., 2021). For instance, Mach et al. (2021) report that news media play a crucial role in communicating public health and policy information during the COVID-19 pandemic. Also, news media deliver COVID-19 differently. In fact, there are the politicisation and polarisation of COVID-19 in news media (see e.g., Bolsen and Palm, 2022; Druckman et al., 2021; Hart et al., 2020). To be specific, left-leaning news media have more exposing and warning coverage than right-leaning news media (see e.g., Mach et al., 2021; Gollust et al., 2020; Zhang and Trifiro, 2022). Moreover, News media from liberal-leaning media are framed in a broader sense, broadcasting news updates from across the world. In contrast, news media from conservative-leaning media focus on attitudinal frames, placing heavy emphasis on China's role in the disbursement of the virus (see e.g., Dee and Khang, 2023; Gollust et al., 2020; Kerr et al., 2021; Mach et al., 2021; Zhang and Trifiro, 2022).

Third, this study finds that people are highly interested in COVID-19 vaccines and have different opinions for them according to their political party, which is consistent with prior studies (see e.g., Fridman et al., 2021; Le et al., 2020; Jeyanathan et al., 2020). For example, Fridman et al. (2021) highlight that a decline in general vaccine attitudes and intentions of getting the influenza vaccine is driven by Republicans, who reveal a negative trend in vaccine attitudes and intentions, while Democrats remain largely stable. In fact, according to the Centers for Disease Control and Prevention, and vaccination decisions are strongly associated with partisanship. Counties that support Trump at higher margins have substantially lower vaccination rates than those that support Biden at higher margins as of 28 February 2022 (Pew Research Center, 2022). Also, Alemi and Lee (2023) find that there is a statistically significant relationship between the percentage of

Republican supporters and rates of vaccine hesitancy, that is, the higher the Republican affiliation, the lower the vaccination rates.

This study has some limitations as follows: first, this study explores the different social networks between US presidential candidates regarding COVID-19, whereas other SNS, such as Facebook, YouTube, Instagram, may show different social networks. Future research should highlight them by utilising various SNS sources. Second, this study collects the Twitter data right after the US election, and social networks between them can be different since time passes. Future studies should explore their social networks based on the recent date. Third, this study employs between centrality, eigenvector centrality, and PageRank, whereas other centrality methodologies would demonstrate different social networks. Future articles should explore the social networks between US presidential candidates through other centrality methodologies.

6 Conclusions

COVID-19 has been one of the most sensitive issues for people to select their national leaders and political party. This is because COVID-19 is directly connected with their life, job, and economic status. Therefore, developing successful COVID-19 policies would be one of the most important political issues for politicians and presidential candidates. In this vein, this study highlights social networks between the US presidential candidates regarding COVID-19 by employing social network analysis for Twitter.

This study finds some important results as follows: first, while Donald Trump has strong social networks with his family, Joe Biden reveals those with news media. This is because Trump's family has a powerful effect on the US societies. For instance, Donald John Trump Jr. is an American businessman, television presenter, political activist, and author; Ivanka Trump is an American businesswoman and the director of the Office of Economic Initiatives and Entrepreneurship; and Melania Trump is a famous Slovenian American former model.

Second, Donald Trump has strong connections with his political supporters, whereas Joe Biden has many political opponents in the networks. In fact, Donald Trump exerts a significant impact on the public by employing SNS, especially Twitter. For instance, Donald Trump utilises Twitter as a strategic platform of power politics to disseminate his right-wing populist discourse (Kreis, 2017). Trump tends to communicatively organise and controls media systems by offering his followers an opportunity to connect with his campaign as well as exposed connections to overtly White supremacist groups in the US (Eddington, 2018).

Third, while Donald Trump has social networks with many doctors, whereas Joe Biden has strong connections with the prior president and prior president candidate. Fourth, while Donald Trump has only his party in his networks, Joe Biden has not only his political party but also the rival party in his networks. Fifth, Donald Trump does not have the CDC in his networks, whereas Joe Biden has a strong connection with the CDC. This may be the attributable fact that Donald Trump's COVID-19 policies are against the CDC's reports and guidance (see e.g., Gonzalez et al., 2021; Hahn, 2021; Halpern, 2020). For example, Trump refuses to wear a mask in public and does not recommend it to the public, whereas the CDC advises the use of the mask as an additional voluntary public health measure (see e.g., Grunawalt, 2021; Messerschmidt, 2021; Moss et al., 2022).

Sixth, Donald Trump has most key players in the inner circle, whereas Joe Biden shows most key players in the outer circle in the betweenness centrality. Seventh, while Donald Trump and the other three key players play an important role in the largest group, only Joe Biden exerts a significant impact on the group. eighth, while people highly criticise Donald Trump's response to COVID-19 in the Donald Trump networks, those support Joe Biden to be the US President by criticising the COVID-19 pandemic under the Trump's government.

This study contributes to the theoretical backgrounds for social networks as follows: first, this research highlights that social media data could be used to explore politicians' social networks, relationships, and deliver important news and data from politicians to the public. By exploring the Twitter data, this study demonstrates US candidates' social networks, important key players, and diverse groups. The findings could enhance the literature on the application of SNS on political and government studies (see e.g., Ashuri and Stoloro, 2022; Muñiz et al., 2019; Wandhöfer et al., 2012).

Second, this study shows how SNA can be utilised to enhance the understanding of politicians' relationships with other people and positions for COVID-19. Through the implementation of the SNA, the findings could contribute to the literature on the application of social networks for government studies. The findings of this study could support that SNA can be utilised to understand politicians' important people, their supporters, and opponents (see e.g., De Nooy and Kleinnijenhuis, 2013; Nir, 2011; Stevenson and Greenberg, 2000).

Third, this study employs between centrality, eigenvector centrality, and PageRank to show the social networks of US candidates for COVID-19. By employing the three centrality methodologies, this study could contribute to the literature, which employ the centrality methodologies for understanding social networks of people for SNS (see e.g., Ghafoor and Niazi, 2016; Li et al., 2015; Tsugawa, 2019).

This study suggests some important implications as follows: first politicians should understand their social networks to cope with the COVID-19 pandemic effectively. By doing so, they can release important news and information in a timely manner. Social networks could provide access to critical health information and news from the politicians to the public since the social relationships increase during the COVID-19 period (see e.g., Cheng et al., 2023; Phillips et al., 2022; Völker, 2023).

Second, COVID-19 response has been one of the most important factors for politicians to get the votes from the public. They should understand the relationship between the disease issue and public opinions to be supported by their citizens. For example, many authors highlight that there is the political polarisation of COVID-19 between liberals and conservatives in the US, and COVID-19 is one of the most important factors to be supported or not from the public (see e.g., Cole et al., 2023; Dolman et al., 2023; Stoetzer et al., 2023).

Third, politicians should explore online SNS to understand current public interests and to get grass-roots support since they provide a lot of information and data. The use of social media has largely increased during this COVID-19 pandemic since people are isolated and working from home, and people share their opinions and emotions on the online SNS (see e.g., Ali et al., 2023; Alshare et al., 2023; Gupta et al., 2023).

Fourth, politicians should actively build their social networks with politicians in the other party to develop COVID-19 policies successfully. The ongoing pandemic should be solved by the cooperation of national leaders and the political parties for their citizens

and country. Many existing articles highlight the importance of social networks among politicians to cope with the COVID-19 pandemic (see e.g., Bolsen and Palm, 2022; Hao and Shao, 2022; Theocharis et al., 2023).

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