NETWORK ANALYSIS OF SOCIAL MEASURES, CULTURE DIMENSIONS, AND COVID-19 RELATED BEHAVIOURAL CHOICES

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ABSTRACT

The aim of the study was to explore social measurements and COVID-19 -related behavioral choices from a network structure perspective. We tested network models by comparing network structures in 46 countries by cultural dimensions (Hofstede et al., 2010). The pre-registered hypothesis was that the network structure of variables predicting COVID-19-related behavioral choices will be robust across countries, regardless of the mean differences of these variables between countries characterized by high vs low culture dimension indices. Behavioural choices toward COVID-19 situation were: physical hygiene, policy support, and physical contact. In network analysis we used several social/psychological constructs: social belonging, trait optimism, collective narcissism, moral identity, self-esteem, national identification, trait self-control, morality as cooperation, conspiracy beliefs, political ideology, and narcissism. We analysed twelve conditions based on dichotomized culture dimensions (high vs. low Power distance, Individualism, Masculinity, Uncertainty avoidance, Long-term orientation, and Indulgence) across demographics (e.g., age, gender). We conducted network structure analysis using high-dimensional undirected graph estimation with glasso procedure splitting the data by culture dimensions in total with $N = 40\,795$ individuals. The study findings indicated that the network models were fairly consistent across cultures with different scores on each of Hofstede's six cultural dimensions. This similarity reflects the previous studies in terms of the stability of associations between variables regardless of sex, age, and political beliefs.

Keywords: behavioural choices, culture dimensions, COVID-19, network analysis, social measures

Introduction

The recent COVID-19 pandemic has spurred an active scientific debate on how to engage the public in following health behaviour guidelines (Albarracin & Jung, 2021; Hagger & Hamilton, 2022; Petersen et al., 2022; Van Bavel et al., 2020).

A recent multinational study (Azevedo et al., 2023) examined the relationships between COVID-19-related health behaviours and several psychological constructs

including identity and social attitudes, ideology, moral beliefs and motivation, as well as health and well-being. The results showed fairly robust associations among the measured constructs in 69 countries across the participant sex, age, and political orientation, at the same time showing some differences in mean values of the measured constructs between countries. These results pose an interesting question as to how similar are the associations among the measured constructs across the different cultures represented in the study. A number of studies have suggested that the relationships among COVID-19-related behaviours and attitudes may differ among countries (Donato et al., 2023; Sakib et al., 2023), and some of these differences have been explained in terms of cultural variation in individualism-collectivism (Donato et al., 2023). We aim to contribute to this line of research by further examining the role of cultural dimensions in between-country similarities and differences in relationships among COVID-19-related behaviours and psychological constructs. Previous research has identified 6 cultural dimensions: power distance (the extent to which it is expected and accepted that power is unequally distributed), individualism (the extent to which the ties among individuals in a society are loose), masculinity (the extent to which emotional gender roles in society are clearly distinct), uncertainty avoidance (the extent to which members of a culture perceive ambiguous or unknown situations as threatening), long-term orientation (the fostering of virtues oriented toward future rewards, such as perseverance and thrift), and indulgence (the extent to which the satisfaction of human needs and desires is valued in a society) (Hofstede, 2011; Hofstede et al., 2010).

Previous studies have identified a number of cross-cultural differences in variables measured by Azevedo et al. (2023). For example, social belonging has been shown to be a negatively related to individualism, power distance (Cortina et al., 2017) and indulgence (Zhou et al., 2015), and positively related to uncertainty avoidance (Kong, 2013) and long-term orientation (Lee & Dawes, 2005). Collective narcissism has shown positive relation to power distance (Van Prooijen & Song, 2021) and uncertainty avoidance (Gründl & Aichholzer, 2020). National identification has been positively related to uncertainty avoidance (Baker & Carson, 2011; Gründl & Aichholzer, 2020), whereas conspiracy beliefs tend to be positively associated with power distance, masculinity, and uncertainty avoidance, and negatively related to individualism (Adam-Troian et al., 2020). These results suggest that one can expect systematic differences in these variables between countries that strongly differ in terms of cultural dimensions. At the same time, there has been limited research addressing cross-cultural differences in relationships among these variables. Given the number of variables measured in this study, it was not feasible to formulate hypotheses about the predicted cross-cultural differences among the many possible relationships between pairs of variables. Instead, we chose an exploratory approach to examination of these cross-cultural differences, by looking at the overall network of relationships among a set of variables measured by Azevedo et al. (2023), and comparing these networks of relationships between the samples from countries high vs. low on each cultural dimension. Given the general robustness of relationships among variables across sex, age, and political orientation in the results reported in Azevedo et al. (2023), and

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insufficient empirical evidence signifying systematic differences in these relationships due to cultural dimensions, we formulated the following pre-registered hypothesis for our analysis: The network structure of variables predicting COVID-19-related behavioural choices will be robust across countries, regardless of the mean differences of these variables between countries characterized by high vs low culture dimension indices.

Method

Participants

This study uses data from the International Collaboration on the Social & Moral Psychology of COVID-19 Project which aimed to investigate how various psychological factors are related to people's behavior during the pandemic (Azevedo et al., 2023; Van Bavel et al., 2022). The analyzed data consists of surveys completed by residents of 46 countries and a total of 40,795 responses of individuals (51.8% females) aged 18 to 100 (M = 44.13, SD = 16.16) were used in this data analysis. Although the original data set contains 69 countries, after assigning a code to the cultural dimensions, only 46 countries remained in the data sample. There were 31 languages indicated by the participants, in which they communicate on a daily basis. 33.4% of respondents were single, 20.6% in a relationship, 45.8% married.

Accordingly, participants also reported the number of children if they had children (44.8% no children, 18.9% one child, 23.2% two children, 9.1% three children, and the others more than three children). The participants were addressed by purposefully creating representative samples as well as convenience samples.

Measures

The survey consisted of several parts containing items from different instruments, but the following psychological/social constructs were used in this data analysis:

a) Collective narcissism, measured using three items of the Collective Narcissism scale (de Zavala et al., 2009); b) National identification (Postmes et al., 2013); c) Conspiracy beliefs, endorsement of COVID-19 conspiracy theories (Sternisko et al., 2023); d) Social belonging (Malone et al., 2012); e) Political orientation, measured using a single item, "Overall, what would be the best description of your political views?", on a scale ranging from very left-leaning ("0") to very right-leaning ("10"); f) Moral circle (Waytz et al., 2019), assessing the moral expansiveness across 16 different entities (human and non-human) deemed worthy of moral concern; g) Health condition as subjective physical health; h) Psychological wellbeing as subjective measure; h) Socio-economic status, using the wealth ladder question by asking the participants to place themselves on an 11-rung ladder, with the top rung representing individuals who are best off (in terms of education, jobs, and wealth), and the bottom rung the ones worst off. Unless otherwise indicated, the participants responded on an 11-point scale with higher values indicating higher levels of the measured concepts (after reversing the appropriate items).

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Regarding behaviour related to the COVID-19 pandemic, three questions were asked about behavioural choices toward COVID-19 situation: a) Physical hygiene; b) Policy support; c) Physical contact.

To divide countries with high and low scores on cultural dimensions, publicly available data on the average cultural dimension scores in countries represented in the dataset were obtained from geerthofstede.com website (https://geerthofstede.com/research-and-vsm/dimension-data-matrix/). We then used median split to divide the countries in two groups for each cultural dimension, resulting in a dichotomous score for each country for six cultural dimensions – Power distance, Individualism, Masculinity, Uncertainty avoidance, Long-term orientation, and Indulgence.

Additionally, demographic indicators were used: age, number of children, employment status, and family status.

Data analysis

This study was preregistered. JASP 0.14.1 and 1.1.456, running the R package bootnet (Foygel & Drton, 2010; Friedman et al., 2008; Zhao et al., 2012) were used for data analysis. We analysed twelve conditions based on dichotomized culture dimensions across demographics. We conducted network structure analysis using high-dimensional undirected graph estimation with glasso procedure splitting the data by culture dimensions across all countries.

In this analysis, we employed the glasso (or graphical lasso) procedure, which estimates a network where the edges are partial correlation coefficients (Zhao et al., 2012). This means that each edge represents the relationship between two variables, controlling for all other relationships in the network. The graphical representation of the networks is based on the Fruchterman–Reingold algorithm, which places nodes with stronger and/or more connections closer together. Undirected network analysis is a commonly used approach to describe the conditional independence and interrelationships of many variables. Each node in the graph represents one variable, and no connection between two variables indicates that they are conditionally independent of all other variables.

Results

At the beginning of the data analysis, all data were inserted into the network model, where simultaneous partial correlation calculations with all variables were performed. Partial correlations provide estimates of the strength of relationships between variables controlling for the effects of the other measured variables in the network model (Hevey, 2018). Therefore, nodes in the graph are connected only if there is a correlation between them and this covariance cannot be explained by any other variable in the network. As can be seen (Figure 1), all 16 variables form mutually significant connections, 105 out of 120 possible connections are formed with sparsity 0.18.
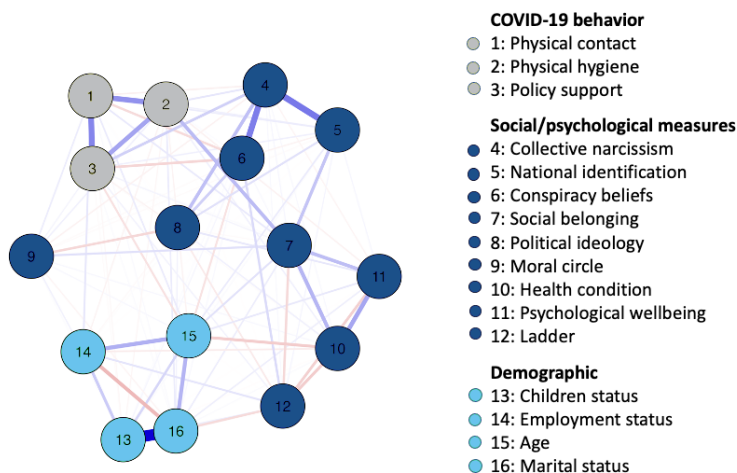
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COVID-19 behavior
○ 1: Physical contact
○ 2: Physical hygiene
○ 3: Policy support

Social/psychological measures
● 4: Collective narcissism
● 5: National identification
● 6: Conspiracy beliefs
● 7: Social belonging
● 8: Political ideology
● 9: Moral circle
● 10: Health condition
● 11: Psychological wellbeing
● 12: Ladder

Demographic
● 13: Children status
● 14: Employment status
● 15: Age
● 16: Marital status

Figure 1   Network graph of all study 16 variables. Blue lines represent positive correlations, and red lines repesent negative correlations

Table 1   Centrality measures of all study variables

Variable	Betweenness	Closeness	Strength	Expected influence
Collective narcissism	0.64	0.87	0.86	1.00
Children status	0.00	0.62	0.76	0.95
Social belonging	0.86	1.00	0.79	0.88
Physical hygiene	0.29	0.83	0.76	0.81
Marital status	0.50	0.67	1.00	0.78
National identification	0.29	0.79	0.62	0.76
Physical contact	0.04	0.79	0.75	0.73
Policy support	0.36	0.84	0.76	0.59
Age	1.00	0.82	0.77	0.45
Psychological wellbeing	0.00	0.83	0.56	0.41
Conspiracy beliefs	0.54	0.86	0.68	0.29
Political ideology	0.11	0.66	0.51	0.28
Health condition	0.43	0.91	0.64	0.23
Employment status	0.00	0.67	0.57	0.23
Moral circle	0.00	0.54	0.32	0.09
Ladder	0.00	0.79	0.57	−0.23

Centrality measures (Table 1) suggest that collective narcissism is the node with the greatest expected influence (1.00), followed by children count (0.95) and social belonging (0.88), while the Ladder question has the least expected influence in this variable network structure.
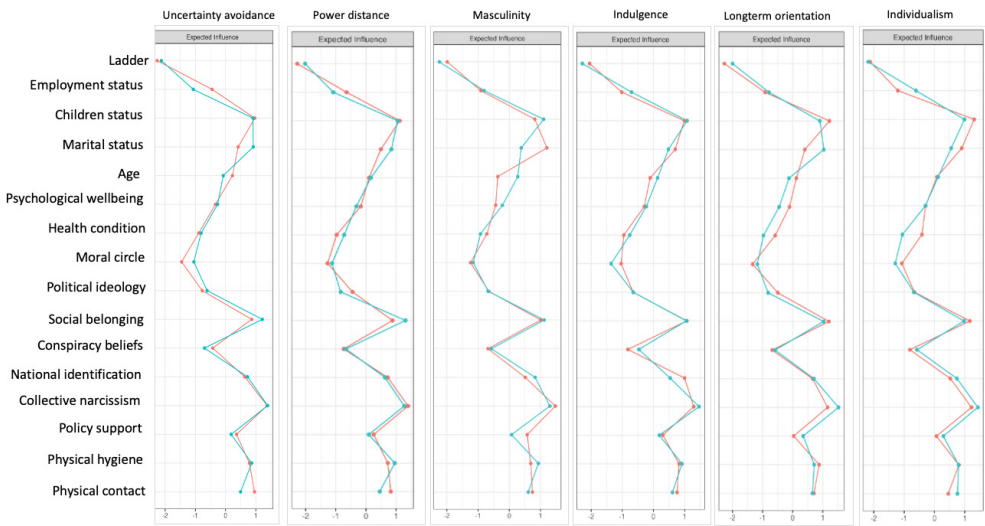
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Figure 2 Centrality measures of expected influence of the study variables for countries with low vs high cultural dimensions. Red line represents low, and blue line represents high indicator of the respective cultural dimension

In the next analysis steps to explore our hypothesis, we performed a network analysis with all variables, dividing them into countries with low or high respective cultural dimensions. Six network analyses were performed with the relevant cultural dimensions.

As can be seen in Figure 2, using cultural dimensions indicators, all expected influence graphs are similar, with very small differences for some variables. For example, the masculinity dimension has small differences between countries for marital status and age variables.

Analysing the other centrality indicators in more detail (full graphs are available upon request), for example, the Ladder node has less betweenness in countries with higher uncertainty avoidance. Also, the political ideology node has a smaller betweenness value in countries with higher uncertainty avoidance. This may mean that these nodes play a smaller role in connecting other nodes in this structure.

However, in general, these differences are small, and if one looks at the main indicator of centrality – expected influence, it can be seen that it does not differ between countries with low and high levels of this dimension. This model shows that the number of children, family status, social belonging, and collective narcissism have a relatively higher value of expected influence, regardless of the value of cultural dimension.

When calculating with the other dimensions, we observed similar, relatively small differences in only a few indicators. For example, dividing the network structure by the power distance dimension indicator, we observed small differences in the betweenness indicator at the health condition level, that is, in countries with a lower power distance dimension, this node does not form significant connections with others, in contrast to countries with a high power distance indicator.

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Dividing countries by the individualism dimension indicator, we observe that the Ladder node is less important in countries with a lower level of individualism, and the age node is less important.

Dividing the countries by the masculinity dimension indicator, we observed that the Conspiracy beliefs node has a lower importance in countries with a lower masculinity indicator, while in these countries the collective narcissism node becomes more important, forming more significant connections with other nodes.

In the distribution of the long-term orientation dimension, the only relative, small differences are in the betweenness indicator for the health condition node, which is less important in countries with a lower long-term orientation dimension.

Finally, in the distribution of the indulgence dimension, there are differences between the indicators of marital status and policy support node, where in countries with a lower level of indulgence, these nodes have less importance compared to countries where this cultural dimension is higher. On the other hand, health condition, social belonging, age, and marital status nodes have a higher betweenness index in countries with a higher level of indulgence.

In general, dividing all network structures with the help of six dimensions, we observed relatively small differences for some variables, looking at their betweenness indicators, but the main indicator – expected influence did not show any significant differences.

Table 2 Descriptive statistics of all study variables

Variable	Mdn	M	SD	Min	Max
Collective narcissism	5.0	4.93	2.82	0	10
National identification	8.5	7.80	2.53	0	10
Conspiracy beliefs	2.5	3.09	2.94	0	10
Social belonging	7.5	7.22	1.91	0	10
Political orientation	5.0	4.97	2.33	0	10
Moral circle	10.0	9.36	5.25	1	16
Health condition	7.0	7.02	2.10	0	10
Psychological wellbeing	6.0	6.02	2.33	0	10
Ladder	6.0	5.41	1.88	1	11
Physical contact	7.6	7.28	1.35	0	10
Physical hygiene	8.4	7.93	1.89	0	10
Policy support	8.6	7.87	2.27	0	10
Age	41.0	43.07	16.01	18	100

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Discussion

The results of the study showed that the network models were relatively similar in countries with high and low scores on all six Hofstede's cultural dimensions. This pattern signifies that the networks of relationships among the variables were fairly robust across the cultural dimensions, similarly to the robustness of relationships across sex, age, and political orientation in Azevedo et al. (2023).

Analysis of group differences allowed for observing relatively small differences in marital status, policy support, collective narcissism, age, health status, social belonging on the betweenness indicators. However, the main indicator of centrality – expected influence was highly similar in all groups of countries, regardless of the level of the cultural dimension, which may indicate its relative universality. Among all the nodes, collective narcissism, social belonging, national identity, marital, and children status nodes showed the greatest potential influence in this network structure. Looking at the network structure, one can observe that the former three variables are mutually related in line with previous findings and theoretical assumptions (Cichocka & Cislak, 2020; Marinthe et al., 2022). In addition, collective narcissism was positively related to conspiracy beliefs, again, in line with results of other studies (Golec de Zavala et al., 2022); however, conspiracy beliefs showed only average strength and expected influence in the calculated networks. More importantly for this analysis, social belonging and collective narcissism were related to COVID-19 behaviour related measures (physical hygiene and policy support, respectively). The relationship of social belonging to hygiene behaviour complements previous results showing correlation between belongingness and intentions to comply with preventive health behaviours (Marinthe et al., 2022). It is interesting to note that collective narcissism was more strongly linked with policy support, in comparison with the link between national identification and policy support. An opposite pattern might have been better predicted from theoretical reasoning (Van Bavel et al., 2020), and the observed result is generally not in line with findings from other related research (Cislak et al., 2021; Moscatelli et al., 2021). This result indicates that the relationship among collective narcissism, national identification, and COVID-19-related policy support requires further examination, and may depend, for example, on the measures used in each particular study. Collective narcissism was strongly related to conspiracy beliefs, in line with previous findings (Cislak et al., 2021; Golec de Zavala et al., 2022). Conspiracy beliefs were also negatively related to policy support and physical-contact-related preventive behaviours, showing a pattern that has been observed also in previous research (Earnshaw et al., 2020; Van Mulukom et al., 2022). Taken together, our results mostly confirm and complement previous findings about the psychological correlates of COVID-19-related behaviours; they also indicate the central role of social belonging and collective narcissism in the network of COVID-19 behaviour-related psychological constructs, suggesting these two variables as potential directions for further research.

The study has several important limitations. One limitation is the fact that the data were analysed using a dichotomized indicator of Hofstede's cultural dimensions, although

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cultural dimensions are originally measured on a continuous scale, and the dichotomous indicator we created may be a relatively imprecise divider of the sample along the six cultural dimensions. It should also be mentioned that the data are from both representative samples and convenience samples, which may affect the relatively sensitive calculations of partial correlations in the network analyses, and thus influence the network calculations in the subsamples created according to high vs. low cultural dimensions. In addition, the fact that the data are cross-sectional data collected during a limited and specific period of time (at the beginning of the COVID-19 pandemic) should be taken into account. One may speculate that other relationships of variables might be observed in the later stages of the pandemic and after the pandemic. It should also be mentioned that in the structure of partial correlations there are variables that mutually significantly form relationships due to their association with a common construct (for example, three variables related to behaviour), which may sometimes inflate some of the calculated partial correlations.

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