

**SOCIAL NETWORK ANALYSIS AND RESPONSE TIME TESTING:
CONSPIRACY THINKING AND CONSPIRACY THEORIES**

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ABSTRACT

Using Social Network Analysis methodology, specifically the Network of Similarity and Response Time Testing as a survey method, we measured and examined, based on conviction strength, the relationships between beliefs in various conspiracy theories. We employ Social Network Analysis (SNA) to uncover conspiracy thinking patterns. SNA facilitates the disclosure of interdependencies among variables and intricate direct and indirect relationships. The network of conspiracy convictions is mapped and scrutinized to discern the clustering of variables, which is achieved using greedy-modularity algorithms. Structural properties, such as nodal and subgroup density, are subsequently calculated to assess the quality of the clusters. A qualitative evaluation explores the semantic meanings underlying the observed patterns.

Our analysis revealed strong correlations between the items, indicating that individuals who believe in one conspiracy theory are highly likely to believe in others. Furthermore, Response Time Testing allowed for measuring the level of people's conviction in these beliefs. We discuss the implications of these findings, suggesting that conspiracy theories may serve as a means for individuals to confirm their positions and feelings in society. This insight calls for a reassessment of strategies to address the spread and impact of conspiracy theories, focusing on understanding the psychological and social factors driving belief in multiple conspiracies and the strength of these convictions.

Introduction

The spread of conspiracy theories has garnered significant attention due to their potential to undermine public trust in institutions, foster radicalization, and incite violence. Research shows a particular pattern in defining a conspiracy theory (Zonis 1994). They involve one or more actors who join hands together in secret to achieve a hidden and malevolent goal. Conspiracy theories are explanations for events that involve a secret group acting against

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the common good involving a concealed reality whose purpose is to help people understand why an event happened (Sedek, Kofta 2005; Zonis 1994; Uscinski, Parent 2014).

Beliefs in conspiracy theories are timeless. There are no precise records to determine the nature and time when these beliefs first appeared (Sedek, Kofta 2005; Zonis 1994; Grzesiak-Feldman 2013). It was in the 1940s that scientists first dived into the subject of the conspiracy by focusing on personality traits and psychological factors (Uscinski 2019; Thalmann 2019).

Studies have also dived into the reasons why people endorse conspiracy theories. One argues that conspiracy theories respond to the need for answers to epistemic, existential, and social motives (Douglas, Sutton, Cichocka 2017).

The creation of the internet was rejoiced by all who witnessed it, but as social media and news outlets gained popularity, its adverse effects began to be recognized, (Petros Iosifidis and Nicholas Nicoli 2020). One of these effects is the rise of conspiracy theories on social media platforms (Colbert 2020). Nevertheless, it is worth noting that the internet did not cause an immediate surge in the number of conspiracy theorists. Websites solely devoted to conspiracy theories receive very few visitors, (Douglas et al. 2019).

As proof, studies have shown that the use of social media correlates with conspiracy theories and misinformation. Conspiracy thinking is the sine qua non-factor for the idea to be accepted (Enders et al. 2021).

This study will focus on conspiracy thinking, a psychological pre-disposition also referred to as conspiratorial thinking, conspiracism, or conspiracy ideation (Zonis 1994; Walter, Drochon 2020).

Conspiracy Thinking is a cognitive tendency or mindset in which individuals attribute significant events or circumstances to secret, often malevolent, plots orchestrated by powerful and hidden groups or individuals. Conspiracy thinking is characterized by several key features, including:

1. A belief in mysterious and powerful forces working behind the scenes to control events or manipulate public opinion, often for nefarious purposes.
2. A tendency to dismiss official explanations for events or circumstances as cover-ups, lies, or manipulations, prefer alternative explanations that involve conspiracy instead. During times of crisis, people with anxiousness and uncertainty rises may use conspiracy theories to strengthen their beliefs, especially when the official explanations are lacking according to them (Bruder et al. 2013; Douglas, Sutton, Cichocka 2017).
3. A strong inclination to connect seemingly unrelated events or facts as part of a larger, hidden plot, often involving multiple layers of deception and control. The endorsement of conspiracy theories can serve as a cognitive mechanism through which individuals seek to comprehend the context of a particular event and rationalize their inability to exert control or influence over the situation (Douglas, Sutton, & Cichocka, 2017).
4. A heightened sense of suspicion and mistrust towards mainstream sources of information, authorities, or institutions, coupled with an increased reliance on

alternative sources that confirm or support conspiracy beliefs. The association between conspiracy thinking and paranoia has been referred to as schizotypy in the literature (Douglas et al., 2016; van Prooijen & Douglas, 2017; Klein, Clutton, & Dunn, 2019), represents a notable dimension of this cognitive tendency. Importantly, it should be emphasized that conspiracy thinking is not equated with a clinically diagnosed psychological disorder. Rather, individuals who endorse conspiracy theories may exhibit characteristics akin to those found in paranoia or paranoid personality disorder, albeit to a lesser degree. Such individuals typically believe that external forces are engaged in conspiratorial activities directed against them.

5. A feeling of being "in the know" or having access to exclusive or hidden knowledge that is not available to the general public or mainstream sources. The propensity to adopt conspiracy theories positively correlates with an individual's desire for distinctiveness and uniqueness (Imhoff & Lamberty, 2017). Consequently, individuals may gravitate towards conspiracy theories to attain a sense of control and distinctiveness in periods of uncertainty and crisis.

Conspiracy theories resonate with System 1 thinking (Kahneman, 2011), predicated upon intuitive judgments, emotional responses, and gut feelings, thereby giving rise to biased heuristics and rapid reactions (Stecula & Pickup, 2021). High-anxiety situations further activate this cognitive system, complicating the process of discrediting previously held convictions (Spasovski, Demuthova, & Kuzmanovic, 2021).

A dual-methodological approach

In the present study, our primary objective was to investigate the following research question: "To what extent does the level of conspiracy thinking influence an individual's endorsement of conspiracy theories?" To address this research question, we adopted a dual-methodological approach.

First, we applied the Response Time Testing (RTT) measurement approach, grounded in Fazio's attitude accessibility paradigm (Fazio & Williams, 1986; Fazio, 1989), to uncover genuine attitudes and better understand conspiracy thinking. This method allows for evaluating the extent to which an individual holds strong beliefs in specific conspiracy theories. According to the model, beliefs that are strong and accessible are expressed with high confidence, as indicated by faster response times. In contrast, weaker, less accessible beliefs are expressed with hesitation and are characterized by slower response times (Fazio, Powell, & Williams, 1989; Fazio & Williams, 1986). Fazio's research has demonstrated that correlations between beliefs and behavior are higher among individuals with faster response times when expressing their opinions, suggesting that strong beliefs exert a more considerable influence on behavior (Fazio et al., 1989; Fazio & Williams, 1986). Beliefs measured using declarative questionnaires are often subject to distortion, as people tend to report opinions that are socially acceptable or expected. Response time helps circumvent this issue. Furthermore, this tool enables the analysis of differences between values and beliefs, providing a comprehensive examination of the factors contributing to the endorsement of conspiracy theories and the level of conspiracy thinking.

Second, we employed the Networks of Similarity method from the Social Network Analysis toolkit to determine whether a strong belief in one conspiracy theory reliably predicts the endorsement of other conspiracy theories. This method allows for identifying correlations between beliefs in multiple conspiracy theories, offering insights into the interconnected nature of such beliefs.

By integrating these two approaches, we sought to understand the relationship between the level of conspiracy thinking and the endorsement of conspiracy theories. This understanding could potentially inform strategies for addressing the proliferation and impact of such beliefs on individuals and society.

Procedure

To ensure the relevance of the research and testing, a representative sample of the French-speaking Swiss population aged between 20 and 65 years was chosen. Data was collected through online surveys, in which respondents were asked to rate various affirmations using a three-point scale (yes-no-hard to tell). Employing Response Time Testing, we measured the duration required for participants' brains to reach a decision and respond to the questions. This approach allowed us to assess the involvement of "System 1" thinking in the decision-making process, determining whether responses are instinctive. Consequently, we measured the strength of beliefs held by individuals in Switzerland concerning the affirmations presented in the survey.

Survey

Considering the existing research on conspiracy theories and various field studies conducted, we utilized several validated questionnaires to address our research question.

The survey included questions derived from the "Conspiracy Mentality Questionnaire" (Bruder et al., 2013) designed to assess an individual's level of conspiracy mentality. The purpose of incorporating this specific instrument was to examine the hypothesis that a conspiratorial worldview is an underlying variable prompting individuals to endorse conspiracy theories (Bruder et al., 2013; Enders et al., 2021).

Additionally, the study aims to investigate whether the degree of societal ostracism contributes to endorsing conspiracy theories. To assess this factor, questions developed based on two different studies (Bunting, Gaskell, & Stoker, 2021; Edelman Trust Barometer, 2022) were incorporated as follows:

Moreover, respondents were presented with general conspiracy theories and asked to rate the extent to which they believe in these theories (Enders et al., 2021). Certain statements from the original American study were excluded, as the Swiss population may not necessarily share the same beliefs or interests in the same conspiracy theories as Americans. The following statements have been selected from the American study for inclusion in the survey:

Finally, the following COVID-19 conspiracy theories were introduced to the survey. These theories are more contemporary and, thus, highly relevant, as the coronavirus pandemic has had far-reaching impacts on everyone's lives. These statements have been previously investigated in the United States (Cassese, Farhart, & Miller, 2020). This study also incorporated vaccine conspiracy theories to provide a more comprehensive assessment of participants' beliefs in this context.

Data preparation:

The initial data preparation phase involved removing low-quality responses by excluding extremely fast (presumably random) and excessively slow answers (indicative of distraction during the test). Responses below 500 ms were considered too fast, and those above 10,000 ms were considered too slow (Karylowski & Mrozinski, 2016).

Subsequently, individual reaction and processing speed differences were accounted for by standardizing the response time data, measured in milliseconds, using z-scores of log (latency). This process created an Std-RT (Standardized Response Time) score with $M=0$ and $SD=1$.

The final step entailed the development of an RTC (Reaction Time Confidence) index, a measure that combines explicit responses with response time outcomes. To achieve this, the following formula was employed:

For explicit Yes answers (RTC values ranging from 0 to 2): $RTC = [1 - (\text{Std-RT}/2)]$

For explicit No answers (RTC values ranging from -2 to 0): $RTC = [(\text{Std-RT}/2) - 1]$

Std-RT values exceeding two and those below -2 were truncated and assigned values of 2 or -2, respectively. Hard to Tell responses were coded as 0.

Subsequent data analyses were conducted using the RTC scores, wherein the range from -2, -1, 0, +1, and +2 corresponded to a five-point Likert scale.

Cleaning procedure of the raw data from iCode

To control for individual differences, we created a bivariate ordinal least square regression model in which we predicted, for each individual, the expected amount of time taken for each statement. In this model, the dependent variable is the observed latency for each statement, and the independent variable is the length of the statements, defined in terms of letter counts. For each individual, we ran a personalized linear regression model. We then took the residual to assess if the observed values per statement were higher or lower than the expected ones. The lower the value, the more the individual was faster than expected and hence the greater the attitude toward the statement. The next step was to standardize the residual to assess the strength of the attitude. To do so we used the z-scores of the absolute values of the residuals. The greater the z-score, the more significant the observed latency compared to what was expected. We finally created a continuous variable ranging from zero to – potentially – infinity, with 0 meaning no attitudes and a greater value representing greater attitude. To do so for each individual, we took the absolute result of all values subtracted from the maximum. The last step was to consider whether the response was positive or negative. Therefore, we multiplied the obtained score with the explicit data. We eventually have a continuous variable ranging -still potentially- from minus infinity to plus infinity.

The network construct

We use Social Network Analysis (SNA) (Wasserman and Faust, 2018) to reveal conspiracy thinking patterns. SNA enables the disclosure of interdependences amongst variables and complex direct and indirect relations.

To operationalize the variable network, we proceeded in two steps. First, we consider the cleaned individual-items matrix a two-mode matrix representing two-mode networks (Borgatti and Everett, 1997; Borgatti and Halgin, 2011). The two modes are, on the rows, the respondents, and on the columns, the different questions of the survey. Thus, the

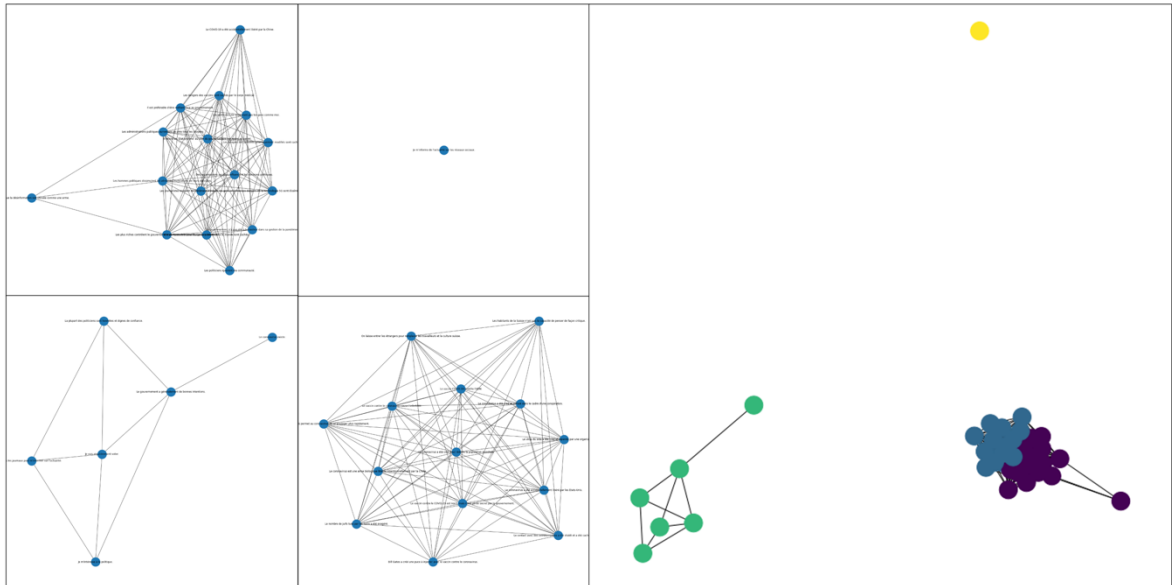
network can be represented by an N-by-M matrix, where N=788 individuals and M=37 items for the answers.

Second, we projected it into a one-mode network focusing on the variables. This process enables inferring variables' similarities (Borgatti and Halgin, 2011). We do the transformation using a standardized method (Wasserman & Faust, 2018; Borgatti, Everett, Johnson, 2018; Borgatti et al., 2002; Borgatti and Halgin, 2011). Namely, we proceed with structural similarity measures using Pearson's correlation (Borgatti and Halgin, 2011; Wasserman and Faust, 2018). We now have a correlation coefficient for each pair of individuals, which enables us to show how similar the two individuals are. The coefficient varies from '-1' to '+1', where '-1' means perfect dissimilarity, '0' means no relation, and '+1' means perfect similarity, meaning that the same persons answered both items. Finally, we keep the 'backbone of the network' (Neal, 2014) by selecting what can be considered strong ties (Granovetter, 1973); namely, we only keep ties that aims for strong similarity. We chose a threshold that determines if individuals are similar enough to be categorized as such. We use what Neal (2014, p.87) calls the 'agent-degree conditioned threshold' to decide which ties are strong enough. From our correlation similarity matrix, we keep ties for which the level of similarity is $r=0.2$ and above. The choice of 0.2 is made after evaluating the visualization of the network after testing different threshold levels, as Borgatti and Quintane (2018) recommended. The $r=0.2$ allows for a good tradeoff between the clustering of the network and tie removal and reveals the underlying structure of how the network is organized. To do so, we dichotomize the network by recoding each relation between pairs of actors as '0' if the relation has a correlation coefficient inferior to $r=0.2$ and the one above. We thus have a binary and non-directional network of similarity. Please see Figure 1 for the visualization of this network.

Clusters

To reveal clusters, we use the greedy-modularity algorithm (Blondel et al., 2008), a common community detection technique (Al-mukhtar and Al-Shamery, 2018). This algorithm aims to maximize the network's modularity; that is, it searches for the partition for which nodes in the clusters have dense connections and few connections with nodes belonging to other clusters. The network of conspiracy convictions is plotted (Fig. 1) and analyzed to identify the clustering of variables. Structural properties such as nodal and subgroup density are computed (Figure 2).

Figure 1: Visualization of the network and the clusters



For the intradensity, we count the ratio of ties present within the cluster compared to the total amount of relations possible. The density ranges from 0 to 1, with one indicating perfect density and, thus, the best clustering. To understand to what extent each cluster is exclusive to the others, we also compute the extra cluster density. The procedure is the same as the intra-density, except we now consider the ratio of ties created outside the cluster out of the number of possible relations created outside. The measure again ranges from 0 to 1, with a zero indicating perfect impermeability and thus revealing a cohesive cluster. As we can see, Cluster 1 and Cluster 2 are entirely internally well-clustered. We also observe many interactions amongst variables of the two different clusters. The clusters are finally evaluated qualitatively to address the semantical meanings.

Figure 2: Cluster characteristics, intra-, and extra density

	intracluster density	extracluster density
Clusters		
Cluster 1	0.88	0.84
Cluster 2	0.99	0.70
Cluster 3	0.6	0
Cluster 4 (Isolated)	0	0

We also evaluate to what extent each node falls into its cluster and is related to other clusters. To do so, we compute the intranodal and extra nodal density. The former is calculated by counting the number of ties one node entertains with all other nodes within its cluster out of the number of possible relations. The score ranges from 0 to 1, with one meaning that the node is well integrated into its cluster. For the extranodal density, we

compute the ratio between the ties each node creates with other nodes outside of its cluster and the number of possible relations. This measure ranges from 0 to 1, with a zero telling that the node has no connection outside its cluster and is thus well integrated.

Figure 3: Distribution of the nodes and clusters

	intra nodal density	extra nodal density	Source ⁶
Cluster 1			
- I think that many very important things happen in the world, which the public is never informed about.	0,933333333	0,523809524	1
- I think that there are secret organizations that greatly influence political decisions.	0,933333333	0,619047619	1
- It is best to be cautious about trusting the government.	0,999999999	0,571428571	2
- There is a “deep state” embedded in the government that operates in secret and without oversight.	0,933333333	0,666666667	3
- I worry about false information being used as a weapon.	0,2	0	2
- The virus was accidentally released by China.	0,799999999	0,428571429	4
- The government did not do well on their pandemic response.	0,866666666	0,571428571	2
- I think that government agencies closely monitor all citizens.	0,933333333	0,666666667	1
- The dangers of 5G cellphone technology are being covered up.	0,866666666	0,619047619	3
- The dangers of genetically-modified foods are being hidden from the public.	0,933333333	0,476190476	3
- The dangers of vaccines are being hidden by the medical establishment.	0,933333333	0,666666667	3
- I think that politicians usually do not tell us the true motives for their decisions.	0,999999999	0,333333333	1
- Journalists and reporters are purposely trying to mislead people.	0,933333333	0,666666667	2
- The one percent (1%) of the richest people in the U.S. control the government and the economy for their own benefit.	0,933333333	0,333333333	3
- Politicians usually ignore my community.	0,866666666	0,666666667	2
- Politicians don't respect people like me.	0,933333333	0,619047619	2
Cluster 2			
- Bill Gates is creating a tracking device to be injected with the coronavirus vaccine.	0,923076922	0,52173913	4
- 5G technology is causing the coronavirus to spread faster.	0,999999999	0,391304348	4
- Humans have made contact with aliens and this fact has been deliberately hidden from the public.	0,999999999	0,47826087	3
- The virus was accidentally released by the US.	0,999999999	0,565217391	3
- Coronavirus was purposely created and released by powerful people as part of a conspiracy.	0,999999999	0,652173913	3
- The coronavirus was intentionally created to reduce the world's population.	0,999999999	0,652173913	4
- The virus is a biological weapon intentionally released by China.	0,999999999	0,608695652	4
- The number of Jews killed by the Nazis during World War II has been exaggerated on purpose.	0,999999999	0,260869565	3
- The COVID-19 vaccine alters the DNA.	0,999999999	0,652173913	4
- The coronavirus vaccine is harmful, but it is kept secret by the government.	0,999999999	0,652173913	4
- The coronavirus vaccine causes infertility.	0,999999999	0,652173913	4
- The AIDS virus was created and spread around the world on purpose by a secret organization.	0,999999999	0,52173913	3
- People in this country lack the ability to think critically.	0,923076922	0,434782609	2
- Businesses and corporations are purposely allowing foreigners into the country to replace Swiss workers and culture.	0,999999999	0,652173913	3
Cluster 3			
- I read newspapers to inform myself about events.	0,599999999	0	
- I am interested in politics.	0,599999999	0	
- I vote regularly.	0,799999998	0	
- Most politicians are honest and trustful.	0,599999999	0	2
- The coronavirus exists	0,2	0	4
- The government usually has good intentions.	0,799999998	0	2
Cluster 4 (Isolated)			

⁶ (1= Bruder et al., 2013; Enders et al., 2021; 2=Bunting, Gaskell, & Stoker, 2021; Edelman Trust Barometer, 2022; 3=Enders et al., 2021; 4= Cassese, Farhart, & Miller, 2020)

	intra nodal density	extra nodal density	Source ⁶
- I inform myself about events on social media.	0	0	

Discussion

The observed strong correlations between beliefs in different conspiracy theories and the varying conviction levels identified through Response Time Testing suggest that conspiracy theories may serve as a means for individuals to confirm their positions and feelings in society. The interconnected nature of these beliefs could be driven by a need for individuals to maintain a consistent worldview, where beliefs in multiple conspiracy theories reinforce each other, strengthening their overall conviction.

Furthermore, the strength of conviction in these beliefs may be influenced by various psychological and social factors, such as personality traits, cognitive biases, and social identity. Understanding these factors is crucial for developing targeted interventions and strategies to address the spread and impact of conspiracy theories on individuals and society.

Conclusion and Recommendation

Our study demonstrates the value of combining Social Network Analysis methodology, specifically the Network of Similarity, and Response Time Testing, in investigating the interconnected nature of beliefs in conspiracy theories and the strength of conviction behind these beliefs. These findings contribute to a better understanding of the psychological and social factors driving belief in multiple conspiracies, which is essential for developing effective strategies to counteract the negative consequences of conspiracy theories on individuals and society. Future research should further explore the factors that influence the strength of conviction in conspiracy theories and develop targeted interventions to address these interconnected beliefs.

Keywords: Conspiracy theories, Conspiracy thinking, Social Network Analysis, Response Time Testing

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