The interplay among paranoia, social relationships and negative affectivity in a heterogeneous clinical sample: A network analysis

Jakub Januška, Alexandra Straková and Daniel Dančík
Department of Psychology, Faculty of Arts, Comenius University, Bratislava, Slovak Republic; Mental Disorders Research Centre, Science Park, Comenius University, Bratislava, Slovak Republic

Ján Pečeňák
Mental Disorders Research Centre, Science Park, Comenius University, Bratislava, Slovak Republic; Department of Psychiatry, Faculty of Medicine, Comenius University, Bratislava, Slovak Republic

Anton Heretík
Department of Psychology, Faculty of Arts, Comenius University, Bratislava, Slovak Republic; Mental Disorders Research Centre, Science Park, Comenius University, Bratislava, Slovak Republic

Michal Hajdúk
Department of Psychology, Faculty of Arts, Comenius University, Bratislava, Slovak Republic; Mental Disorders Research Centre, Science Park, Comenius University, Bratislava, Slovak Republic; Department of Psychiatry, Faculty of Medicine, Comenius University, Bratislava, Slovak Republic

Abstract
Previous evidence suggests paranoia affects people’s functioning in interpersonal relationships. However, less is known about the interconnections among specific aspects of paranoia and domains of social relationships. The goal of the current study was to explore the interplay among different aspects of paranoia, social relationships and negative affectivity (depression, anxiety and social anxiety) in a diverse clinical sample using network analysis. A sample of 366 participants (84.4% female) with a history of mental illness was recruited online. The mean age was 35.31 years. Data were modelled using the Gaussian Graphical Model with regularization. The network included the following scales: R-GPTS, SAD-D, National Institute of Health Toolbox Adult Social Relationship scales, PHQ-9 and GAD-7. The results revealed substantial connections between aspects of paranoia (ideas of reference and ideas of persecution) and both perceived hostility and perceived rejection. Furthermore, significant associations of ideas of reference with social anxiety and loneliness with depression were observed. Perceived rejection and loneliness were the most central nodes in the estimated network. The current study provides robust evidence for the interconnections of paranoia, social relationships and negative affectivity, present across different diagnoses. This further supports the transdiagnostic approach to paranoia research and the related important role of social relationships.

Keywords
Paranoia, social relationships, negative affectivity, network analysis, transdiagnostic

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Corresponding author:
Michal Hajdúk, Department of Psychology, Faculty of Arts, Comenius University, Gondova 2, Bratislava 811 02, Slovakia.
Email: michal.hajduk@uniba.sk

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**Introduction**

Paranoia is a complex psychopathological symptom. It is typically present in schizophrenia but also occurs in other psychiatric conditions including depression, bipolar disorder, post-traumatic stress disorder, obsessive-compulsive disorder, personality disorder and dementia (Alsawy et al., 2015; Bebbington & Freeman, 2017; Bentall et al., 2009).

One of the studied consequences of paranoia is its widespread and detrimental effect on an individual’s social life. Patients with more severe persecutory delusions experience a serious decline in social functioning (Phalen et al., 2017). Impact on day-to-day functioning is predominantly seen in the interpersonal aspect of functional outcomes (Buck et al., 2016; Hajdúk et al., 2019). Similarly, in nonclinical samples, individuals with frequent and intense paranoid thoughts reported significantly worse social functioning, compared to individuals with low levels of paranoia (Combs et al., 2013; Freeman, 2007). In recent research on patients with schizophrenia and healthy controls, severe paranoia was associated with poorer social functioning (Strassnig et al., 2020). Other studies focused more closely on interpersonal relationships, as an essential part of social functioning, with similar results. Pinkham et al. (2016) observed worse real-world interpersonal relationships and social acceptability in paranoid patients when compared to patients without paranoia. A study utilizing network analysis highlighted the importance of social representations of others in the context of paranoia (Bell & O’Driscoll, 2018). Another network analysis study showed associations of paranoid ideation with interpersonal functioning (less prosocial behaviour, impaired social relationships, social withdrawal and ineffective communication) in both patients and healthy individuals (Hajdúk et al., 2019).

Bebbington et al., (2013) identified four factors of paranoia, namely, interpersonal sensitivities, mistrust, ideas of reference and ideas of persecution. The abovementioned study by Bell and O’Driscoll (2018) identified these four factors in the same dataset using exploratory graph analysis, with the items measuring ideas of reference and ideas of persecution being most central. The second study utilizing a network analysis in this context also found ideas of reference and ideas of persecution to be most central in both clinical and non-clinical sample (Hajdúk et al., 2019).

These two aspects of paranoia, therefore, remain particularly important in connection with interpersonal relationships. Accordingly, aspects of interpersonal relationships like loneliness, social support, social distress or social performance are each related to paranoia or psychotic symptoms (Crush et al., 2018; Lamster et al., 2017; Pot-Kolder et al., 2017; Riches et al., 2019; Sündermann et al., 2014). Additionally, in a temporal network analysis, lower paranoia was preceded by feeling close to others (Contreras et al., 2020). While these findings represent isolated relationships between these factors, the way how they are interconnected remains unclear.

There are also other relevant factors related simultaneously to paranoia and social dysfunction. Among these, a broad domain of negative affectivity has particular importance. Depressive symptoms appear to be associated with increased paranoia throughout life (Saarinen et al., 2018; Salokangas et al., 2016). Additionally, depression and anxiety are significantly related to social functioning (de Lijster et al., 2018; Santini et al., 2020; Saris et al., 2017). However, these relationships uncover only a part of a complex network of connections. Depressed patients with schizophrenia report more problems in interpersonal relationships (Harvey et al., 2019; Strassnig et al., 2020). Other research suggests that a lack of social support can affect both depression and paranoia (Wickham et al., 2014). Additionally, paranoid thinking co-occurs with social anxiety (Michail & Birchwood, 2009), and social anxiety has been found to interact with loneliness and predict paranoia (Lim et al., 2016). Simultaneously, depression, anxiety and social anxiety often appear in the context of internalizing psychopathology (Kotov et al., 2017).

Previous empirical research supports the potential links between paranoia, interpersonal functioning and negative affectivity. The abovementioned studies typically test these associations only within one diagnostic category, predominantly schizophrenia, and therefore do not account for the transdiagnostic nature of paranoia. The current study focused on a clinical population with various diagnoses in order to collect a large sample with variable levels of paranoia. The primary aim was to explore whether specific aspects of paranoia (ideas of reference vs. ideas of persecution) are uniquely related to different facets of social relationships (social support, companionship and social distress) as well as to negative affectivity, particularly depression, anxiety and social anxiety. To account for complex associations in the abovementioned variables, network analysis was utilized as an analytical tool in the present exploratory study.

**Methods**

**Participants and procedure**

Participants were recruited online via a paid social network advertisement. Information about the research was also shared by large organizations with mental health expertise. Overall, the study focused on the experience of people with mental health problems during the COVID-19 pandemic. At the time of the data collection, Slovakia experienced a gradual increase in people testing positive for SARS-CoV-2.

A total of 918 participants started completing the anonymous online survey. A substantial part of the participants did not finish the entire survey. Participants responding carelessly (failing the attention check), not having mental health problems and having missing data within the analyzed scales were
excluded from the current analysis. Participants were asked to report if they have been diagnosed with psychiatric disorders. A follow-up question asked about specific psychiatric conditions (participants were allowed to select more than one answer). People who reported not having a mental illness were excluded, as the overarching aim of the study was to investigate the experience of people with psychological disorders and the survey was targeting these respondents. The final sample consisted of 366 participants reporting having a mental illness history (84.4% female). The mean age was $M = 35.31$ and $SD = 10.75$. The most common disorders were depression (75.1%) and anxiety disorders (61.2%). A substantial proportion of individuals identified themselves as having more than one diagnosis. Detailed demographic characteristics and reported diagnoses are displayed in Table 1. The project was approved by the Ethical Review Board of the Faculty of Arts, Comenius University. Participants provided consent before filling out questionnaires.

Measures

The Revised Green et al., Paranoid Thoughts Scale (R-GPTS; Freeman et al., 2019) is a recent 18-item self-report measure of paranoia over the period of the previous month. It was developed to be used in both clinical and non-clinical individuals. Each item is rated on a 5-point Likert scale ranging from 0 (Not at all) to 4 (Totally). The questionnaire includes two subscales measuring ideas of reference (8 items, e.g. ‘People definitely laughed at me behind my back’) and ideas of persecution (10 items, e.g. ‘I was sure someone wanted to hurt me’). The scale was adapted from English using forward translation with reconciliation. The final version was edited by an English native speaker with high proficiency in the Slovak language.

NIH Toolbox Adult Social Relationship scales (Cyranowski et al., 2013) is a 45-item comprehensive measure of social relationships with six subscales focusing on areas of social support (emotional support – eight items, e.g. ‘I have someone to talk with when I have a bad day’; instrumental support – eight items, e.g. ‘I have someone to help me if I’m sick in bed’), companionship (friendship – eight items, e.g. ‘I feel like I have lots of friends’; loneliness – five items, e.g. ‘I feel alone and apart from others’) and social distress (perceived rejection – eight items, e.g. ‘People act like they don’t have time for me’; perceived hostility – eight items, e.g. ‘People get mad at me’). It focuses on the period of the previous month. Each item is rated on a 5-point Likert scale (1 = Never, 5 = Always).

Table 1. Demographic characteristics of the present sample and reported diagnoses ($N = 366$).

|                      | n/M | %/SD |
|----------------------|-----|------|
| **Gender**           |     |      |
| Male                 | 55  | 15   |
| Female               | 309 | 84.4 |
| Other                | 2   | 0.5  |
| **Age**              | 35.31 | 10.75|
| **Relationship status** |     |      |
| Single               | 114 | 31.1 |
| In a relationship    | 106 | 29.0 |
| Married              | 109 | 29.8 |
| Divorced             | 26  | 7.1  |
| Widowed              | 5   | 1.4  |
| Other                | 6   | 1.6  |
| **Diagnosis**        |     |      |
| Depression           | 275 | 75.1 |
| Anxiety/Obsessive-compulsive/Panic disorder | 224 | 61.2 |
| Personality disorder | 51  | 13.9 |
| Psychosis (Schizophrenia/Schizoaffective disorder) | 26  | 7.1  |
| Bipolar disorder     | 16  | 4.4  |
| Addiction – alcohol  | 17  | 4.6  |
| Addiction – other substances | 9  | 2.5  |
| Post-traumatic or other stress-related disorder | 15 | 4.1  |
| Eating disorder      | 8   | 2.2  |
| ASD/ADHD             | 6   | 1.6  |
| Other                | 9   | 2.5  |

Note. $N = $ number of participants; $M = $ mean; $SD = $ standard deviation; ASD = autism spectrum disorder; ADHD = attention deficit hyperactivity disorder.

*aComorbid diagnoses are recorded individually.*
Table 2. Descriptive statistics and reliability of the studied variables.

|                          | M    | Med  | SD    | α    |
|--------------------------|------|------|-------|------|
| Ideas of reference       | 10.05| 8    | 8.13  | 0.881|
| Ideas of persecution     | 6.27 | 2    | 8.57  | 0.922|
| Social anxiety           | 12.59| 10   | 9.46  | 0.918|
| Emotional support        | 28.51| 31   | 8.47  | 0.958|
| Instrumental support     | 30.66| 32   | 8.58  | 0.951|
| Friendship               | 23.39| 23   | 8.19  | 0.937|
| Loneliness               | 15.52| 15   | 5.26  | 0.919|
| Perceived rejection      | 19.41| 19   | 7.29  | 0.940|
| Perceived hostility      | 16.27| 15   | 5.8   | 0.910|
| Depression               | 12.41| 12   | 6.44  | 0.875|
| Anxiety                  | 9.51 | 9    | 5.43  | 0.888|

Note. M = mean; Med = median; SD = standard deviation.

Severity Measure for Social Anxiety Disorder (SAD-D; Lebeau et al., 2012) measures social anxiety based on the DSM-5 criteria, focusing on experience over the previous week. Ten items are rated on a 5-point Likert scale (0 = Never, 4 = All of the time).

The Patient’s Health Questionnaire (PHQ-9; Kroenke et al., 2001) is a 9-item measure of depression over the previous two weeks. The items are rated on a 4-point Likert scale (0 = Not at all, 3 = Nearly every day).

Generalized Anxiety Disorder 7 (GAD-7; Spitzer et al., 2006) measures anxiety over the previous two weeks with seven items scored on the same scale as in the PHQ-9.

Descriptive statistics and reliability of studied variables are shown in Table 2. All scales showed satisfactory reliability in the current study. To account for missing data, a prorated score was calculated by replacing the missing values with the mean score of answered items. Prorated scores and total scores were calculated only when less than 10% of responses were missed. To account for careless responding, four attention check items were placed throughout the survey. Failing to answer any of these items correctly led to an exclusion of the entire case. The measures were a part of a larger study in which other scales were administered, assessing prodromal psychotic symptoms, social functioning, insomnia, resilience and subjective reaction to the COVID-19 pandemic.

Statistical analysis

Descriptive statistics were analyzed using IBM SPSS Statistics 20 and the network estimation using R 4.0.4. For the network analysis, the Gaussian Graphical Model (GGM; Lauritzen, 1996) was used. The network edges represent partial correlations between two nodes while controlling for the effect of the remaining nodes. To ensure that the estimated network will be easily interpretable, spurious associations were omitted using the ‘least absolute shrinkage and selection operator’ (LASSO; Tibshirani, 1996), and the model selection was done using the Extended Bayesian Information Criterion (EBIC; Chen & Chen, 2008). The graphical LASSO is a suitable algorithm for estimating LASSO regularization for GGM networks and is used in the glasso R package (Friedman et al., 2008; Friedman & Tibshirani, 2019), which is implemented in the qgraph package (Epskamp et al., 2012). Node centrality was estimated using the following centrality estimates: node strength, closeness and betweenness. Node strength refers to the total strength of all edges directly connected to a node, closeness indicates how strongly a node is indirectly connected to other nodes and betweenness represents the importance of a node in connecting all other nodes.

The benefits of using network analysis in psychological research are that it allows for analyzing and displaying relationships among a large number of variables which are thought to be interconnected. Each link takes all other connections into consideration and this way it describes the relation between the two variables more clearly.

The R package qgraph (Epskamp et al., 2012) was used for the network estimation. The correlation stability coefficient (CS-coefficient) and bootstrapped difference test methods of the bootnet package were used to measure the centrality stability and to compare centralities and edge-weights, as introduced in Epskamp et al. (2018). To be able to interpret the differences between centrality values, the minimum recommended CS-coefficient cutoffs are 0.25 while it should ideally exceed 0.5.

Results

Network estimation

The estimated network of 11 nodes had 33 non-zero edges out of 55 possible ones. Both paranoia aspects were related to social distress subscales and social anxiety. Additionally, ideas of reference were connected to loneliness. Other relevant connections were between depression and loneliness and between anxiety and perceived hostility. The network structure can be seen in Figure 1.

Centrality indices estimations computed for strength, closeness and betweenness are shown in Figure 2. CS-coefficient for node strength (CS corr = 0.7) = 0.672) and closeness (CS corr = 0.7) = 0.596) reached satisfactory levels for interpretation. Betweenness (CS corr = 0.7) = 0.284) was below the ideal cutoff value, thus should be interpreted with caution. The plot depicting the stability of centrality indices can be seen in Supplemental Figure S1. The most important network nodes in terms of all centrality indices were perceived rejection and loneliness.

For strength, we were also able to investigate significant between-node differences in a bootstrapped difference test, shown in Supplemental Figure S2. Perceived rejection was
The estimated network structure of paranoia (REF and PER), social relationships (EMO, IND, FRE, LON, REJ and HOS) and negative affectivity (SAD, DEP and ANX). The network structure is a Gaussian Graphical Model, which is a network of partial correlation coefficients. Dotted lines represent negative correlations and continuous lines represent positive correlations. REF = ideas of reference; PER = ideas of persecution; SAD = social anxiety; EMO = emotional support; INS = instrumental support; FRE = friendship; LON = loneliness; REJ = perceived rejection; HOS = perceived hostility; DEP = depression; ANX = anxiety.

When comparing edge-weight differences, ideas of persecution were more strongly connected to perceived hostility than to depression and social anxiety, and ideas of reference were more strongly connected to social anxiety than to perceived hostility, perceived rejection or loneliness. Also, out of the two aspects of paranoia, ideas of reference had a significantly stronger connection to social anxiety. Furthermore, depression was significantly closer to loneliness than to any other social relationship subscale. All these relationships were positive. All significant differences of non-zero edges are presented in Supplemental Figure S3.

Discussion

The aim of the current study was to explore the interconnections of different aspects of paranoia, social relationships and negative affectivity, using a network analysis. The sample was diagnostically and demographically diverse, definitely not representative of all people with mental health problems. Despite that, the study offers an opportunity for examining paranoia across various clinical groups. The results of stability analysis showed robust patterns of interconnection, suggesting the observations are generalizable for individuals with diverse mental health problems. They further support the transdiagnostic nature of paranoia.

Significant connections between specific aspects of paranoia and social relationships were observed. Ideas of reference and ideas of persecution were both connected to perceived hostility and perceived rejection (social distress subscales). This is consistent with the previous studies revealing the link between paranoia and hostile attribution bias (Buck et al., 2016; Zajenkowska et al., 2021) as well as social distress (Riches et al., 2019). Moreover, out of the two aspects of paranoia, only ideas of reference were connected to loneliness. This suggests that feelings of being laughed at behind the back or similar, rather than feelings of being threatened by others, are related to loneliness. Previous research showed that people with paranoia tend to avoid social situations more (Brown et al., 2014). This relationship might also be explained by including perceived rejection. Feelings of being referred could trigger a person to perceive rejection from others more and further down lead to loneliness, due to decreased social interactions. However, the relationship between the variables would then have to be bidirectional, as the research suggests that loneliness precedes paranoia (Lim et al., 2016). Finally, paranoia was directly connected to perceived hostility, perceived rejection and loneliness, as opposed to the remaining three aspects of social relationships. This shows that paranoia relates more to individuals’ subjective evaluations of their own relationship-related experiences, for instance, feelings that others act like they do not care about them. On the other hand, it is less linked to a more objective assessment of support from others (e.g. ‘I have someone to I trust to talk with about my problems’).

Looking at the links between negative affectivity and paranoia, ideas of reference were more strongly connected to social anxiety than ideas of persecution. This is in line with the previous research (Lim et al., 2016; Michail & Birchwood, 2009) and shows that paranoia is more directly related to social anxiety than to depression or anxiety. Freeman et al. (2005) also proposed that mild paranoid thoughts are based on social evaluative concerns (e.g. social anxiety). The present results add to the previous findings by showing that ideas of reference represent the factor of paranoia that is more determining in its connection to social anxiety. It might be that people concerned about others referring to them are also more anxious when trying to maintain their social bonds, as opposed to those experiencing more severe ideas of persecution, who are more convinced and in opposition to others.

Node centrality analysis revealed the two most important network nodes. Perceived rejection and loneliness were the most central in the network, with perceived rejection connecting all social relationship aspects to paranoia, and loneliness bridging social relationships with negative affectivity. The crucial role of loneliness in the network suggests an
important implication for clinical practice. Reducing loneliness might result in a decrease in social anxiety, depression, as well as paranoia, namely, ideas of reference, as previously observed in a longitudinal study in a non-clinical sample (Lim et al., 2016). However, the subjective evaluative aspect still cannot be omitted. Lamster et al. (2017) identified interpersonal negative schemata as an important element in the paranoia–loneliness relationship. More studies of these mechanisms and interconnections would be valuable.

The presented results should be interpreted with respect to several limitations. Firstly, the final sample naturally included mostly participants with more prevalent disorders (depression and anxiety) and fewer people with diagnoses like schizophrenia or Autism spectrum disorders. In order to gather more participants with these disorders, obtaining a considerably larger sample or stratified sampling method would be necessary. This limit can influence the generalizability of the results over the less prevalent diagnoses. Larger samples are needed for testing the structural differences across networks in specific clinical conditions. The sample consisted primarily of females; therefore, future studies are needed whether the same pattern of interconnections holds also for males. Next, only self-report questionnaires were used, including self-reported mental disorder diagnosis, creating potentially biased data. Certain participants might not have provided the true and most accurate description of their

Figure 2. Centrality indices of the network nodes. Centrality indices are shown as standardized z-scores. REF = ideas of reference; PER = ideas of persecution; SAD = social anxiety; EMO = emotional support; INS = instrumental support; FRE = friendship; LON = loneliness; REJ = perceived rejection; HOS = perceived hostility; DEP = depression; ANX = anxiety.
condition. Thirdly, Bringmann et al. (2019) argue the centrality indices betweenness and closeness are not particularly suitable for psychological networks; therefore, the current results should be interpreted with caution. Lastly, the COVID-19 pandemic could potentially affect the observed relationships, as evidence partially suggests (Kowalski et al., 2020; Suthaharan et al., 2021). However, after adding the variable measuring fear of COVID-19 into the model, no changes in the studied relationships were observed and it was the least important network node according to all centrality indices.

There are several implications of the current results. They reveal the key focus areas of supporting people with mental illnesses, among which loneliness was already mentioned. The network model offers a unique depiction of mutual interconnections among all observed variables, although it does not describe temporal associations. This study also pushes forwards the understanding of paranoia and social relationships by showing a unique analysis of the differences among their aspects in detail. Particularly, the use of a six-factor social relationships measure offers unprecedented insight into the social functioning of people with mental diseases.

**Conclusion**

Paranoia, social relationships and negative affectivity are robustly connected across disorders. Even in people with affective and anxiety disorders, paranoid thoughts impact day-to-day social relationships. Both ideas of reference and persecution have strong connections to ideas of reference and loneliness. Social anxiety and depression have strong connections to ideas of reference and loneliness, respectively.

**Declaration of conflicting interests**

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**Data availability**

The data that support the findings of this study are available from the corresponding author upon reasonable request.

**ORCID iDs**

Jakub Januška  
https://orcid.org/0000-0002-8090-1102

Daniel Dančík  
https://orcid.org/0000-0002-9532-959

Anton Heretík  
https://orcid.org/0000-0001-9440-6586

**Supplemental Material**

Supplemental material for this article is available online.

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**Author biographies**

Jakub Januška is a clinical psychology PhD candidate at Comenius University in Bratislava, focusing more closely on paranoia and social relationships research using a broad multimethod approach.

Alexandra Straková is a PhD candidate in the Department of Psychology at Comenius University in Bratislava. Her main area of research is the impaired processing of social stimuli across the paranoia continuum.

Daniel Dančík is a PhD candidate in clinical psychology at Comenius University in Bratislava. His research focuses on attachment and social relations in daily life using the Experience Sampling Method.

Ján Pečenák is a professor of psychiatry at Comenius University in Bratislava. He specializes in psychopharmacology and biological mechanisms of mental disorders.

Anton Heretík is a professor of clinical psychology at Comenius University in Bratislava with a research focus on anxiety, affective, and personality disorders.

Michal Hajdú is an associate professor of clinical psychology at the Department of Psychology and Department of Psychiatry at Comenius University in Bratislava. His research focuses on social-cognitive impairments in patients with schizophrenia.