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A network analysis of DSM-5 avoidant personality disorder diagnostic criteria☆

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ABSTRACT

Network analysis conceptualises psychopathology as systems of symptoms that interact and influence each other. It is hypothesised that network analysis can identify core symptoms relevant to the diagnosis and treatment of the disorder. We applied network analysis to avoidant personality disorder DSM-5 diagnostic criteria to identify such symptoms in a non-clinical and clinical sample ($N = 718$, $N = 354$). We estimated the networks as unregularised Ising models by fitting a log-linear model to each sample. Further on, we examined centrality indices, network stability, and normalised accuracy to determine which nodes are more central amongst avoidant personality disorder diagnostic criteria. "Fear of criticism and rejection" and "Certainty of being liked" emerged as the most central nodes in both networks. Symptom "Inferiority" had the lowest centrality levels. Results are discussed in terms of implications for the conceptualisation of avoidant personality disorder and similarities with other studies that focused on DSM-5 criteria.

1. Introduction

1.1. Avoidant personality disorder

Avoidant personality disorder (APD) is an impairing psychiatric disorder characterised by severe inhibition in social situations, feelings of inadequacy, and hypersensitivity to criticism and rejection (American Psychiatric Association, 2013). APD was reported as one of the most prevalent personality disorders (PD), both in general (0.8%–5.2%) (Samuels, 2011) and clinical populations (14.7%) (Zimmerman et al., 2005). Several studies have shown a high degree of impairment in individuals with APD. For example, compared with other PDs like paranoid, borderline, dependent, obsessive-compulsive, and not otherwise specified PD, APD presented the lowest score on Global Assessment of Functioning (GAF) (Wilberg et al., 2009). The presence of an APD diagnosis is associated with low levels of education and quality of life, a weak sense of belonging, and a low likelihood of being appreciated by a friend or having a close committed person (Wilberg et al., 2009). Despite having high prevalence rates and showing high levels of impairment in individuals, there is insufficient research on this disorder (Weinbrecht et al., 2016). APD is rarely studied directly but is more frequently examined in relation to social phobia (SP) or other comorbid PDs (Alden et al., 2002). Given the suggested need for individual APD studies, we examined the centrality of DSM-5 APD diagnostic criteria from the recently emerged network analysis perspective. While mental disorders are traditionally viewed as sets of symptoms that have an underlying latent common cause (e.g., sad mood, anhedonia, fatigue are caused by depression), the network approach to psychopathology shifts its attention from assuming the presence of a common cause to studying directly observable aspects of disorders (symptoms) and their interactions (e.g., sad mood is associated to anhedonia, which then leads to fatigue) (Borsboom, 2017). In the following section, we briefly introduce the network analysis perspective on psychopathology and describe its main claims, with a focus on APD.

1.2. The network perspective on psychopathology

According to the Diagnostic and Statistical Manual of Mental Disorders, APD has seven diagnostic criteria. A patient who manifests at least four can be diagnosed with APD (American Psychiatric Association, 2013). The current conceptualisation and diagnostic practice see mental disorders like APD as latent unobservable constructs that are the

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underlying cause of symptoms, considered mere manifestations of the disorder. In this idea, symptoms do not have a causal role for the disorder, but their frequency is deemed to be informative regarding the disorder's presence or absence (Borsboom et al., 2021). The network perspective takes into account not only the presence of symptoms but also their interactions. It conceptualises mental disorders as networks of interconnected and interdependent symptoms (Borsboom, 2017). In this view, symptoms and their interactions are seen as responsible for the emergence, stability, and severity of disorders. Consequently, symptoms are not just passive indicators of a disorder but are its active components, which need to be put at the centre of research studies and psychotherapeutic interventions.

Borsboom and Cramer (2013) have argued that psychopathological symptoms are "the only empirically identifiable causes of distress". However, according to the network perspective, not all symptoms are equally crucial for a disorder. The connectedness of a node with the rest of the network can vary, and some nodes emerge as more central (or more connected), having both stronger connections and a higher number of connections with other nodes. Therefore, we could reach a better understanding of how mental disorders function by focusing directly on psychopathological symptoms, which represent concrete difficulties experienced by individuals. Network analysis has been extensively applied and has proven helpful to the study of psychopathology (e.g., Borsboom & Cramer, 2013; Contreras et al., 2019; McNally, 2016). It is possible to explore which symptoms are the most important (most central) in a specific disorder and gain insight into how they interact.

Indices usually used to identify the core nodes of a network are strength, closeness and betweenness centrality (Costantini et al., 2015). *Strength* centrality represents the number of weighted connections of a particular node from the network. It has been suggested that successful improvement in high strength centrality symptoms through psychotherapeutic interventions should also lead to beneficial changes in other symptoms (Borsboom & Cramer, 2013; McNally, 2016; Borsboom, 2017). *Closeness* centrality reflects the average distance of a node to all other nodes and depends on how strongly a node is connected, directly or indirectly, with all other nodes in the network. *Betweenness* centrality is the frequency of a node lying on the shortest path between two other nodes. Nodes high in betweenness mediate a more significant number of connections between the other nodes in the network.

1.3. Centrality of APD features

To our knowledge, APD has not been yet addressed through the network approach, and previous results on the network structure of APD criteria is not available. However, there are findings and statements in the literature that denote the importance of specific APD symptoms. For instance, DSM-5 positions the social inhibition criterion as an essential feature of APD (American Psychiatric Association, 2013). Studies that relied on the factor analysis method have reported "Interpersonal inhibition" (criterion 5) to have the highest factor loadings on the APD factor, while "Restraint in relationships" and "Inferior self" (criteria 3 and 6) had the lowest factor loadings (Becker et al., 2009; Hummelen et al., 2006). Criteria "Interpersonal inhibition", "Inferior self" and "Needs to be liked" (criteria 5, 6 and 2) have the lowest rate of remission (McGlashan et al., 2005) and could be expected to be central in the APD network due to their high levels of persistence. Finally, "Avoidance" (criterion 1) can also be expected to have high centrality levels in the APD network due to the role that this symptom played in the conception of this disorder. APD was separated from Schizoid Personality Disorder (SPD) based on the particularities of the loneliness that individuals diagnosed with one of the two disorders experience. While the loneliness of schizoid patients is a wilful choice, patients with APD desire social interaction but avoid it due to the expected intense negative social stimulation (Millon et al., 2004).

1.4. Current study

In the present study, we examined the network structure of APD diagnostic criteria in two samples, one consisting of psychiatric in-patients and the other consisting of participants from the general population. By looking at two different populations, we aimed at identifying the similarities and specificities of the APD structure in patients and non-patients. Moreover, we computed strength, closeness and betweenness centrality to identify the most central symptoms. As shown in the previous paragraph, various criteria have been pointed in different studies as being essential or more important for the APD diagnosis. An exception is the "Interpersonal inhibition" criterion, whose importance was emphasised more consistently in the literature by high factor loadings, low remittance levels, and being described as an "essential feature" for the APD diagnosis. Therefore, we expected that "Interpersonal inhibition" would occupy a central position in both APD networks.

2. Method

2.1. Participants and procedure

We used two samples of participants, one based on the general population (non-clinical) and another on the clinical population. Data from the clinical sample was collected in paper-pencil format at a psychiatric hospital from Romania by clinical psychologists. This was a convenience sample consisting of in-patients from a city clinic who agreed to participate. The majority of participants from the general population were undergraduate students recruited via an online survey distributed through social networks in groups dedicated to students from a Romanian university. Other participants were also recruited through social networks. Seven respondents were removed due to missing data, and other 4 participants were removed due to being less than 18 years old. The study received approval from the Ethical Committee of the West University of Timișoara.

After providing written informed consent, participants/patients answered a brief questionnaire assessing their APD symptomatology. The final sample consisted of 718 participants from the general population and 354 participants from the clinical population. The demographic characteristics of each sample are presented in Table 1. Regarding psychopathological characteristics of the clinical sample, 47.8% had a depression-related disorder, 17.2% were diagnosed with a condition from the anxiety spectrum, 11.9% were diagnosed with substance use disorder, 9.1% were diagnosed with a psychotic disorder, and 4.8% had a bipolar disorder diagnosis, while 9.2% had a variety of other

Table 1
Participant's characteristics.

	Non-clinical		Clinical		Total	
Symptoms[a]	n	%	n	%	n	%
0	116	16.15	7	1.97	123	11.47
1	128	17.82	25	7.06	153	14.27
2	171	23.81	31	8.75	202	18.84
3	90	12.53	75	21.18	165	15.39
4	93	12.95	125	35.31	218	20.34
5	60	8.35	47	13.35	107	9.98
6	39	5.43	26	7.34	65	6.06
7	21	2.92	18	5.08	39	3.64
Gender[b]						
Male	201	27.99	144	40.91	345	32.24
Female	517	72.00	208	59.09	725	67.76
Age[b]						
	Mean	SD	Mean	SD	Mean	SD
	25.43	7.53	43.56	13.09	31.28	12.86

Note. [a]The column *symptoms* represents the number of selected items; [b]Two participants had missing values for age and gender. There were significant differences in gender, χ^2 (1, $N = 1070$) = 17.44, $p < .001$, and age, t (441.79) = −19.59, $p < .001$, between the two samples.

diagnoses, mainly with a prevalence of less than 1% in the sample.

2.2. Measures

Avoidant personality disorder symptoms were assessed with the Romanian version of the SCID-5 Screening Personality Questionnaire (SCID-5-SPQ) (First et al., 2016; First et al., 2017). SCID-5-SPQ is a screening self-report tool that assesses the diagnostic criteria of 10 DSM-5 personality disorders. The APD items of SCID-5-SPQ consists of 7 "Yes" or "No" questions that match the 7 DSM-5 diagnostic criteria for APD (e.g., "You have avoided jobs or tasks that involved having to deal with a lot of people?").

2.3. Data analysis

Data analysis was carried in R version 4.1.0. We used package *bootnet* and function *estimateNetwork* (Epskamp et al., 2017) to estimate an unregularised Ising model (van Borkulo et al., 2014) for each dataset. In particular, we estimated the network adjacency matrix using option *IsingSampler* in estimateNetwork. This function fits a log-linear model to the data, each element indicating the strength of association between any two variables. The parameters of the log-linear model were directly used to define the adjacency matrix, which was visualised and analysed as a network using package *qgraph* (Epskamp et al., 2012). We opted for an unregularised network because we anticipated a high rate of false negatives due to a low sample size (type 2 error) (Isvoranu & Epskamp, 2021).

To quantify the role of each node in the network, we used different centrality indices like strength, closeness, and betweenness and computed clustering coefficients and normalised accuracy. *Centrality indices* are described briefly in sub-chapter 1.2 of the current article and in more detail in Costantini et al. (2015). *Clustering coefficients* can be seen as measures of the redundancy of a node (Costantini et al., 2015). High values of clustering coefficients indicate that the nodes around the target node are highly correlated, and it does not affect the possibility of neighbouring nodes to interact. *Normalised accuracy* is a measure that indicates how well a node is predicted by all other nodes in the network (Haslbeck & Waldorp, 2018). To compute *normalised accuracy,* we estimated the same network as a mixed graphical model using package *mgm* (Haslbeck & Waldorp, 2020) and illustrated the results in Fig. 1 as a pie chart plotted around the nodes.

Further, to assess the accuracy of estimated parameters we used different bootstrapping procedures as described in Epskamp et al. (2017). We computed confidence intervals for edges and stability indices. As a rule of thumb, a value of 0.25 indicates that the network is stable, but a value above 0.50 is desirable (Epskamp & Fried, 2018). This analysis indicates the percentage of the sample that can be dropped to maintain a correlation of 0.7 between the centrality indices of the original network and bootstrapped networks built on smaller subsets of the data. As an additional exploratory analysis, we compared the two networks using the *NCT* function from package *NetworkComparisonTest* (van Borkulo et al., 2017). The results of this analysis are reported in the Supplemental Materials.

3. Results

3.1. Descriptive statistics

Table 2 shows the descriptive statistics of variables included in the network and the correspondence between nodes and DSM-5 APD criteria.

3.2. APD network

In the non-clinical sample, the first three most strong edges were between "Certainty of being liked" and "Fear of criticism and rejection", "Avoidance" and "Reluctance to risk", "Certainty of being liked" and "Inhibition". The first three edges with the highest edge weight in the clinical sample were between "Avoidance" and "Inhibition", "Certainty of being liked" and "Reluctance to risk", "Avoidance" and "Fear of criticism and rejection". The connections between nodes are visualised in Fig. 1. Additionally, Table S1 in the Supplemental Materials presents a

Table 2
Descriptive statistics.

Node	Node name	Non-clinical		Clinical		
		n	%	n	%	$\chi^2(1)$
Avo	Avoidance	240	33.43	184	51.98	33.35***
Like	Certainty of being liked	208	28.97	202	57.06	78.04***
Res	Restraint in relationships	207	28.83	162	45.76	29.37***
FCR	Fear of criticism and rejection	304	42.34	195	55.08	14.97***
Inh	Inhibition	377	52.51	218	61.58	7.54**
Inf	Inferiority	258	35.93	183	51.69	23.67***
Risk	Reluctance to risk	199	27.72	185	52.26	61.06***

Note. n – number of participants who answered "Yes"; % - the percentage of "Yes" responses from the total number of responses per item.
*** $p < .001$.
** $p < .01$.

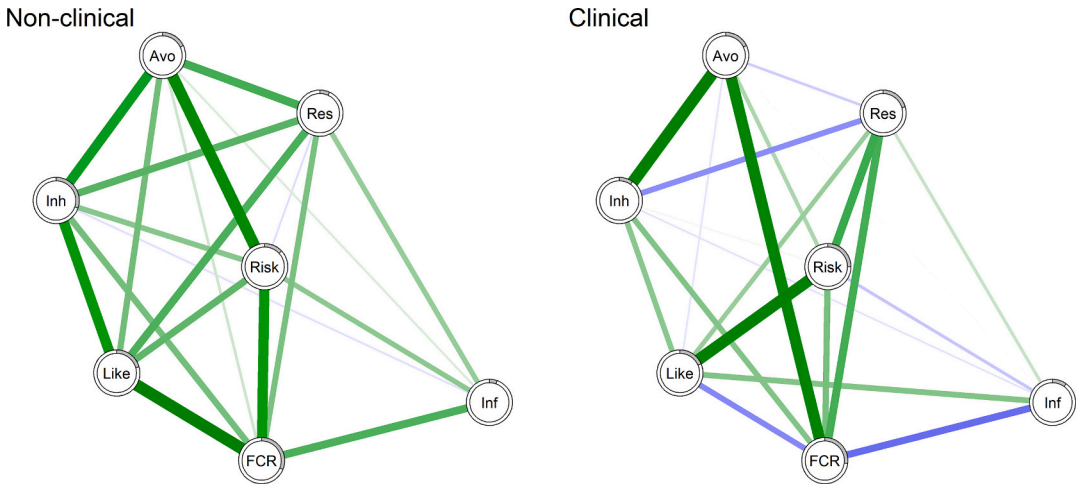

Fig. 1. Avoidant personality disorder networks. Positive connections are represented by green lines, and negative connections by blue lines. Grey areas around nodes indicates normalised accuracy. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

ranking of edge weights and a comparison of edges between the two networks.

3.3. Centrality, clustering coefficients and normalised accuracy

Fig. 2 presents centrality indices and clustering coefficients of estimated networks. In the non-clinical network, "Fear of criticism and rejection" and "Certainty of being liked" were the most central nodes. However, node "Certainty of being liked" also had a high clustering coefficient, which indicates that it does not impact the ability of neighbouring nodes to interact. Besides being highly central, "Fear of criticism and rejection" had the highest normalised accuracy (0.31). Symptom "Inferiority" had significantly lower strength centrality than all other nodes in the network, indicating that this node is only weakly correlated with other symptoms of APD. Differences in strength centrality are presented in Fig. 3. Similar to the non-clinical network, "Fear of criticism and rejection" and "Certainty of being liked", had the highest levels of centrality in the clinical network, and "Fear of criticism and rejection" had the highest value of normalised accuracy (0.27). At the same time, symptom "Inferiority" once again emerged as the least central.

Average normalised accuracy was 0.17 in the non-clinical network and subsequently 0.19 in the clinical network, which is relatively lower than values usually reported for this measure (Fonseca-Pedrero et al., 2018; Zhang et al., 2019). A more extensive presentation of normalised accuracy is presented in the Supplemental Materials in Table S2.

3.4. Network stability

Fig. 4 illustrates confidence intervals of edges computed through non-parametric bootstrapping. Regarding centrality stability, the non-clinical network showed good stability values for strength (0.51) and closeness (0.28) but not for betweenness (0). In the clinical network, stability indexes were all below the 0.25 threshold, 0.20 for strength, 0.12 for closeness and 0.05 for betweenness. Additionally, we computed a similar index to assess the stability of estimated edges and obtained a value of 0.595 for the non-clinical network's edge stability and a weight of 0.593 for the clinical network. In other words, a correlation of 0.7 with the original sample is maintained if we drop 59.5% of the non-clinical sample or 59.3% of the clinical sample. This analysis also helps understand the adequacy of the used sample size as it indicates the minimum required number of participants to obtain a close approximation to the true network (estimated on the full dataset). Fig. S1 in the Supplementary Materials depicts bootstrapped centrality stability results, and Fig. S2 represents the stability of edges.

4. Discussion

The purpose of this study was to analyse the network structure of avoidant personality disorder DSM-5 diagnostic criteria. "Fear of Criticism and Rejection" emerged as the most central node and had the highest normalised accuracy in both networks. "Certainty of Being Liked" was also a highly central node but had high clustering coefficients in the non-clinical network. On the other hand, criterion "Inferiority" had the lowest levels of centrality. We further discuss the implications of these findings and their similarities with results from other studies.

"Fear of criticism and rejection" has already emerged in other studies as an important feature of APD. For instance, Lampe and Malhi (2018) proposed that individuals with APD avoid expressing their emotions because they fear being criticised and rejected if doing so, which carries several "social costs" like being viewed as less agreeable, less extraverted or less compassionate. Ultimately, this provokes in others the same response that was initially feared (rejection). The same authors have also proposed the need for further studies examining therapeutic approaches for APD based on increasing tolerance towards criticism and rejection in social situations, which was accomplished in an older study by Renneberg et al. (1990). The authors have tested an intervention for APD, with focus on elements of exposure to rejection and criticism and training the ability to cope with it, and obtained significant results at post-test, maintained at one year follow-up. Centonze et al. (2021) have also previously emphasised the importance of "Fear of criticism and rejection" by describing its role for the therapeutical process. APD patients might expect the therapists to be judgmental, neglecting or dominant, which can damage the course of therapy and increase the risk of dropout. Therefore, this aspect should be addressed from the beginning of therapy by creating and maintaining a non-judgmental therapeutic alliance. "Fear of criticism and rejection" also seems to play a developmental role in APD. For instance, patients with APD perceive their parents more as rejecting and less encouraging of achievement than parents of healthy controls (Stravynski et al., 1989), experience

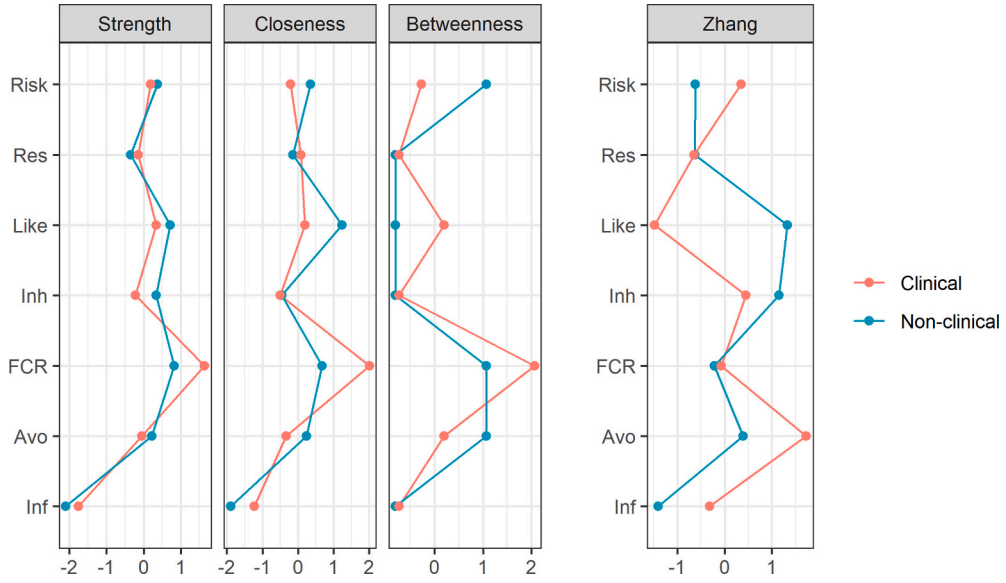

Fig. 2. Centrality and clustering coefficient.
Note. There were significant differences of centrality at 0.05 level between clinical and non-clinical networks for "Certainty of being liked", "Inhibition", "Avoidance" on strength, "Certainty of being liked", "Avoidance", "Reluctance to risk" on closeness.

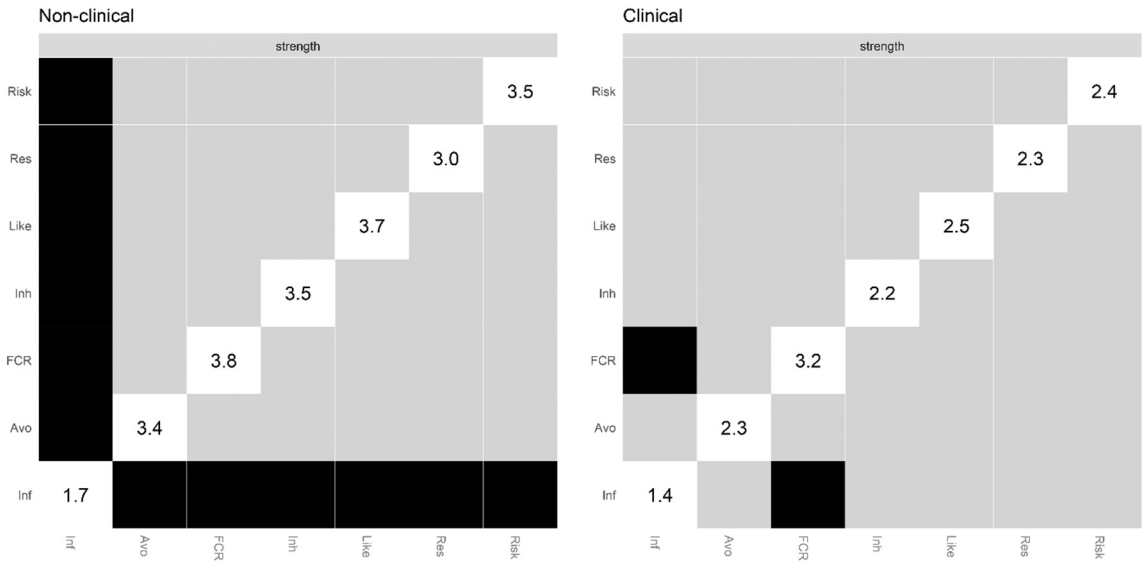

Fig. 3. Differences in strength centrality. The plot on the left shows significant differences between the strength centrality of the nodes in a non-clinical APD network. The plot on the right shows the same information for the clinical network. A black square indicates that a node's strength is significantly different from another node.

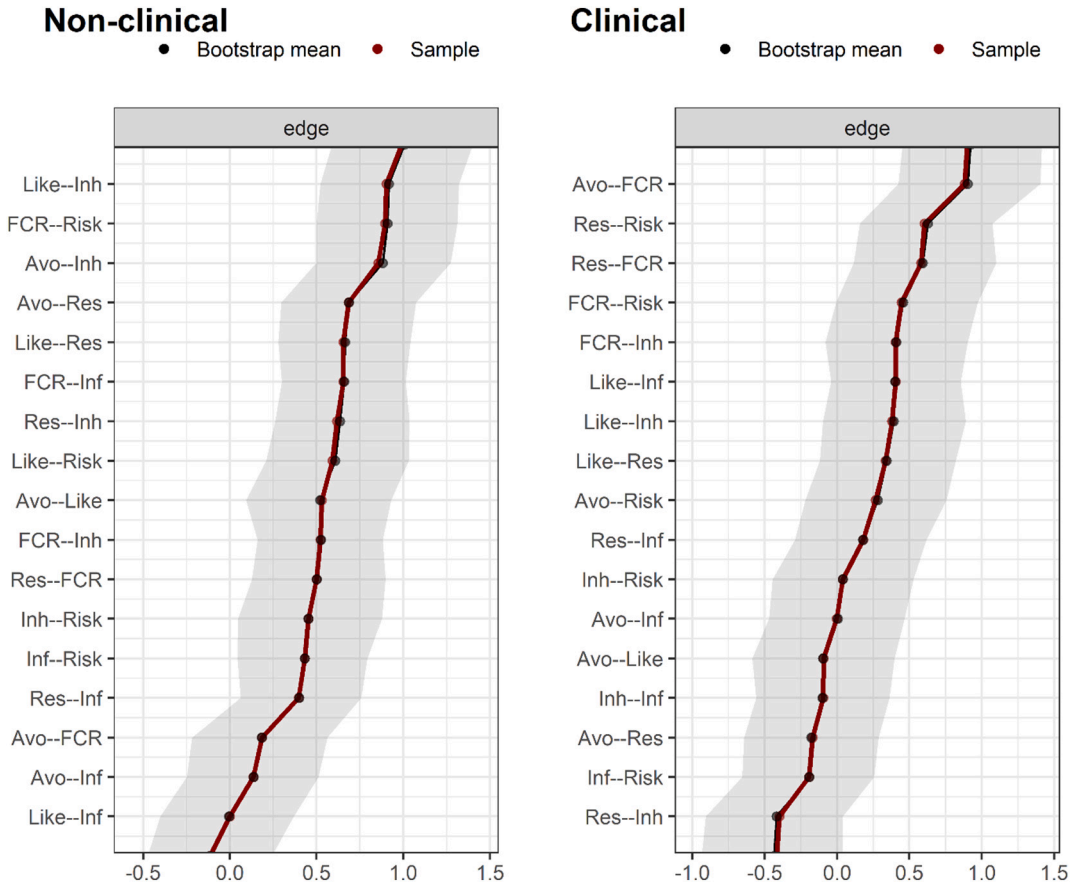

Fig. 4. Edge-weight confidence intervals.
Note. The grey area depicts confidence intervals.

physical and emotional neglect by parents in their childhood (Eikenaes et al., 2015), and are characterised mainly by a fearful childhood attachment style (Brennan & Shaver, 1998). It is possible that these types of parental behaviours, like overcriticising or rejection, lead to developing the fear of being treated the same way by others in general.

Another significant result of our study is that criterion "Inferiority" played a relatively peripheral role in both networks. It had the weakest association with the rest of the network and was poorly predicted by other nodes. Consistently with this finding, in Becker et al. (2009), "Inferiority" had the lowest factor loadings (though not very different from the other criteria) and the lowest diagnostic efficiency indices: it performed the worst as a predictor of the overall APD diagnosis, had the

lowest levels of specificity, sensitivity, and interrater reliability. However, these results are not consistent across studies (Farmer & Chapman, 2002; Hummelen et al., 2006). Studies show strong associations between APD diagnosis and problematic aspects of self, like low self-esteem (Lynum et al., 2008) and a malignant self-regard (Lengu et al., 2015). However, this does not necessarily point towards an inferior self or towards and low social self-efficacy as described in DSM-5. APD self-related issues may result from discrepancies with an idealised self rather than from the comparison process to others in which the person with APD always results as being "inferior".

Several strengths of the study can be pointed out. This is the first study to examine Avoidant Personality Disorder from the Network Analysis perspective. Another strength of this study is that we analysed the network structure of APD both in a non-clinical sample and a clinical sample and provided insight into the centrality of nodes in both samples. A third strength is that our results are an addition to the body of literature on APD that positions "Fear of criticism and rejection" as an essential aspect of APD, and that highlights the peripheral role of "Inferiority". Our results can be used as foundation for studies on "Fear of criticism and rejection" as target for psychotherapeutic interventions in APD.

This study has several limitations. First, we did not assess the distribution of personality disorders in studied samples as in other similar studies (e.g., Fonseca-Pedrero et al., 2018; Richetin et al., 2017). Besides this, future studies could apply network analysis to samples only of participants that have APD diagnosis. A second limit is that we used seven dichotomic items that could not represent well enough the concepts they refer to. A better alternative might be to use a short, conceptually close questionnaire for each variable, similar to Richetin et al. (2017). For example, to represent "Fear of criticism and rejection", one could use the Brief Fear of Negative Evaluation Scale (Carleton et al., 2006). However, this option is also not ideal because, generally, there are no questionnaires that measure specific DSM-5 criteria. Going in such a manner would mean assessing only tangentially close concepts that do not necessarily reflect what is envisioned by DSM-5 criteria. Another limit refers to the homogeneity of participants in the non-clinical sample, with most of them being undergraduate students and predominantly female, which could potentially impact the generalizability of the results. Finally, we could not reliably address the differences and similarities of the APD network between the non-clinical and clinical samples due to the significant differences between the samples, unfitted for this purpose.

5. Conclusion

Our results indicate that "Fear of criticism and rejection" is a core criterion in the Avoidant Personality Disorder network. Future studies should examine the effects of therapeutic interventions targeting aspects of this criteria on the overall APD diagnosis. Additionally, "Inhibition" was the least central node, which possibly points towards a more peripheral role of this criterion in the APD diagnosis as it is currently conceptualised.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2021.111454.

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