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► To cite this version:

Jonathan Bronchain, Patrick Raynal, Henri Chabrol. Does sex influence the network structure of psychopathy?. *Personality Disorders: Theory, Research, and Treatment*, 2020, 12 (5), pp.421-427. 10.1037/per0000462 . hal-03197032

HAL Id: hal-03197032

<https://hal.science/hal-03197032>

Submitted on 13 Apr 2021

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Does sex influence the network structure of psychopathy?

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Abstract

Sex-specific manifestations of psychopathy remain highly debated both at the dimensional and structural levels. The network theory provides a promising framework for investigating this question. Thus, our study aimed to explore the network structure of psychopathy across sex. Participants were 1990 college students (males: 43%, females: 57%) who received the Elemental Psychopathy Assessment-Short Form (EPA-SF). We first estimated a Gaussian Graphical Model including the eighteen EPA-SF facets, separately for males and females. We then computed centrality indices (i.e., strength and expected influence), predictability, and finally conducted a bootstrapping procedure to assess the accuracy of edge weights and the stability of the centrality indices. The results of the network comparison test provide support for the stability of the network structure of psychopathic traits across sex. Self-Centeredness was the most central trait in the two networks, followed by Unconcern, Rashness, and Anger for females, and by Callousness, Unconcern, and Rashness for males. Minor sex-differences and future directions are discussed.

Keywords: psychopathy; psychopathic traits; gender; sex; network analysis

Does sex influence the network structure of psychopathy?

The clinical presentation of psychopathy in males and females is the subject of extensive debates (Cale & Lilienfeld, 2002; Wynn et al., 2012). Psychopathy refers to a personality configuration that encompasses callousness, egocentricity, poor impulse control, and, in some models, boldness/fearless dominance (Cooke & Michie, 2001; Patrick et al., 2009). Behavioral outcomes of high psychopathic traits have been presented as heterogeneous and dependent on internal (e.g., traits configuration), external (e.g., comorbidities), and contextual factors (Lilienfeld et al., 2015a; Lilienfeld et al., 2015b; Steinert et al., 2017). Among these factors, sex represents a major determinant, still requiring investigation (for an updated review, see Verona & Vitale, 2018).

Issues regarding sex-specific manifestation of psychopathy can be approached in two ways: (1) prevalence rates and mean levels of psychopathy, and (2) differences in the construct structure. Concerning mean levels, studies in incarcerated populations using the Psychopathy Checklist-Revised (PCL-R; Hare, 1991, 2003) have consistently reported higher scores and higher rates of psychopathy for males compared to females (Jackson et al., 2002; Salekin et al., 1997; Strand & Belfrage, 2005; Vitale et al., 2002). Females generally display fewer and later-onset antisocial behavior and, therefore, lower scores on antisocial lifestyle items, leading to decreased global psychopathy scores. In community and undergraduate samples, studies have replicated these results with multidimensional models and self-reported data. At the factor-level, males exhibit higher scores on affective, behavioral, and interpersonal components (Anestis et al., 2011; Colins et al., 2016; Miller et al., 2011; Uzieblo et al., 2009). However, and despite these differences in mean levels, studies that used a broader definition of antisociality (e.g., rule-breaking, social aggression) depicted a more complex picture, with females high on psychopathy relying on indirect, verbal, manipulative, or sexual tactics to attain their goals, whereas males tended to more frequently use physical

violence and intimidation (Forouzan & Cooke, 2005; Kreis & Cooke, 2011; Nicholls & Petrila, 2005). In this line, external correlates of psychopathic traits suggest that affective-interpersonal features are stronger predictors of violence for females than antisocial lifestyle features, whereas the opposite is true for males (Richards et al., 2003; Salekin et al., 1998).

Additionally, the study of sex-specific manifestations of psychopathy implies to investigate structural differences and construct non-equivalence across sex. Research in this field indicates comparable interrater (for PCL-R) and internal consistency (for PCL-R and related self-reports) reliabilities of psychopathy measures between males and females (Miller et al., 2014; Sellbom et al., 2015; Vitale et al., 2002; Warren et al., 2003). Studies also regularly reported sex factorial invariance of the main instruments dedicated to assess psychopathic traits (e.g., Anestis et al., 2011; Drislane & Patrick, 2016; Warren et al., 2003). Regarding differences in item functioning, specific analyses have found that males more readily endorsed, and were better discriminated by criteria assessing affective components of psychopathy (Bolt et al., 2004; Eichenbaum, 2019; Gummelt et al., 2012). More specifically, affective items seem to outperform interpersonal items for discriminating psychopathy in males, while interpersonal items would outperform affective items in females (Schrum & Salekin, 2006).

Thus, despite convergent evidences supporting the relative construct's equivalence of psychopathy across sex, this question remains debated and needs further investigation. New statistical and conceptual approaches could be useful to supplement the data currently available. In this context, network analyses could be very promising (Borsboom & Cramer, 2013). While structural models of psychopathology usually describe symptoms as passive indicators of an underlying disease, in the network perspective constructs are conceptualized based on direct and causal relationships between measured dimensions. Network models graphically describe conditional associations between variables after controlling for all other

variables in the network and allow to discriminate the most central dimensions in the structure. Network analyses have been used to study psychopathy in both incarcerated (Preszler et al., 2018; Verschuere et al., 2018) and community mixed-gender samples (Bronchain et al., 2019; Tsang & Salekin, 2019). To our knowledge, there is no study reporting a network analysis of psychopathic traits across sex. So, this study aimed to investigate the network structure of psychopathy in males and females and to identify the more central traits in both networks. We expected to replicate the network structure observed in a previous study using the same measure (Bronchain et al., 2019). Regarding specific sex differences, this study should be considered as exploratory.

Method

Participants and procedures

Participants were college students from different French universities. Data were collected through an online survey available via social networks. The link was shared on groups specifically dedicated to students. The median completion time was 16.12 min. Twenty-eight participants were excluded for not meeting inclusion criteria (i.e., being a college student over 18 and under 28), and for finishing the study in a time deemed invalid (less than two seconds per item). The final sample ($N = 1990$) consisted of 856 males (43%) and 1134 females (57%) ranged from 18 to 28 years old; mean age of males = 21.76 ($SD = 2.41$), mean age of females = 21.20 ($SD = 2.32$). The study was presented as a survey on personality and behaviors, and no compensation was offered for participation. The participants were assured of the anonymity of their answers and have given their informed consent for participation in the study. This study was approved by the research ethics committee of our institution.

Measures

Psychopathic personality traits were assessed using the Elemental Psychopathy Assessment-Short Form (EPA-SF; Lynam et al., 2013). The EPA-SF is a 72-item scale, scored from 1 = "Strongly disagree" to 5 = "Strongly agree", that assesses eighteen psychopathy facets (e.g., callousness: "The suffering of others is not my problem"). Lynam et al. (2013) have identified and replicated a four factors structure: Antagonism (A; Callousness, Coldness, Distrust, Manipulation, and Self-Centeredness), Emotional Stability (ES; Invulnerability, Self-Contentment, and Unconcern), Disinhibition (D; Disobliged, Opposition, Rashness, Impersistence, Thrill-Seeking, and Urgency) and Narcissism (N; Anger, Arrogance, Dominance, and Self-Assurance).

Statistical analysis

Data analysis was conducted in R Version 3.4.0. Prior to the analysis, we imputed missing values (less than 1%) with the *missMDA* package (Josse & Husson, 2016). Skewed distributions of the eighteen EPA-SF facets scores were normalized with a nonparanormal transformation (Liu et al., 2009).

We then used the *qgraph* package (Epskamp et al., 2012) to estimate two Gaussian Graphical Models (GGM) including the eighteen EPA-SF facets, for both males and females. Spurious edges were removed by relying on the Graphical Least Absolute Shrinkage and Selection Operator (Friedman et al., 2014) with extended Bayesian Information Criterion Model Selection ($\gamma = 0.5$). We used the *mgm* package (Haslbeck & Waldrop, 2019) to estimate node predictability. Predictability, visually represented by a ring around a node, quantifies the proportion of variance explained by the other connecting nodes (akin to R^2). Strength and expected influence were computed as centrality indices to investigate the network structure. Strength refers to how well a node is directly connected to other nodes. From a clinical standpoint, a node high in strength is expected to activate many other nodes and represent a potential target for treatment (Fried et al., 2017). However, since simulations

have indicated that expected influence centrality can outperform strength when networks contain negative edges (Robinaugh et al., 2016) we only used expected influence to relate the centrality of facets in the network. Nonetheless, we reported strength to make our network comparable to previous studies that have used this metric.

Using the *bootnet* package (Epskamp et al., 2018), we conducted a bootstrapping procedure to assess the accuracy of edge weights and the stability of strength and expected influence metrics. It is recommended to use a correlation stability coefficient (*CS*-coefficient) to quantify the stability of centrality indices. *CS*-coefficient should not be below 0.25, and preferably above 0.5 to allow the interpretation of centrality differences. Finally, we conducted a network comparison test, with the *NetworkComparisonTest* package (van Borkulo et al., 2017), to examine differences for the overall network structure.

The final GGM obtained (Figure 1) was plotted with the *qgraph* package. In a psychological network, a "node" represents a dimension measured, and an "edge" represents the partial correlation between two dimensions after controlling for all other dimensions. Blue edges represent positive relations among variables and red edges depict negative relations. Thicker and more saturated edges represent stronger associations. The filled part of the ring around each node depicts predictability.

Results

Descriptive statistics

Descriptive statistics are presented in Table 1. Males scored higher than females on all EPA-SF factors, except for Distrust, Urgency, Rashness, and Anger.

Network analysis

Figure 1 shows the correlational structure of psychopathic facets in males and females. The results of stability and accuracy analysis indicated that our network was accurately estimated. Confidence intervals around edge weights were very small and the *CS*-coefficients

were all above 0.50, allowing to interpret differences in centrality for both males and females. Self-Centeredness was the most central trait in the two networks, followed by Unconcern, Rashness, and Anger for females, and by Callousness, Unconcern, and Rashness for males (Figure 2). The network comparison test showed that there were no statistically significant differences for the overall network structure for the two networks ($M = 0.10$, $p = .42$). We reported the network structure for the total sample (Figure 3) to make our results comparable to previous network analyses based on mixed-gender samples.

The two estimated networks were characterized by similar edges. At the factor level, Unconcern was strongly connected to both Invulnerability and Self-Contentment facets (ES). Dominance and Self-Assurance were the two N facets sharing the most important edge. Self-Centeredness and Callousness were strongly linked, as central A dimensions, and Rashness was closely related to the other D facets, except Impersistence.

Regarding inter-facets correlations, A, ES, D, and N displayed important mutual edges. Urgency (D) was negatively linked to both Self-contentment and Invulnerability (ES), and strongly positively link to Anger (N). Distrust (A) shared negative edges with Self-Assurance (N) and Self-Contentment (ES). Self-Contentment (ES) displayed the same structural configuration across sex and was positively linked to Unconcern (ES), Self-Assurance and Dominance (N), Self-Centeredness (A), and negatively linked to Urgency (D) and Distrust (A). Finally, it is worth noting that the only facet showing no edge with the others was Impersistence (D).

Despite these similarities, we could observe some structural differences between the male and female networks. For females, Manipulation (A) shared positive edges with Disobliged, Opposition (D), Self-Centeredness (A), Arrogance, Dominance (N), and Invulnerability (ES), while for males Arrogance and Invulnerability were not connected, and Thrill-Seeking (D) was positively linked to Manipulation. In this line, Callousness displayed

positive edges with Coldness, Distrust, and Self-Centeredness (A) in the two networks, but was positively linked to Arrogance (N) only in the male network, while it was positively linked to Anger (N) and negatively link to Self-Assurance (N) only in the female network.

Discussion

This study aimed to investigate the network structure of psychopathic traits across sex in an undergraduate sample. We first estimated a GGM including the eighteen dimensions of the EPA-SF. We then computed centrality indices (i.e., strength and expected influence) and predictability, and we finally conducted a bootstrapping procedure to assess the accuracy of edge weights and the stability of the centrality indices. The final model depicted strong inter-factor edges for ES, D, N, and A with a comparable correlational structure for males and females. The network comparison test also suggested a similar overall network structure. Self-centeredness (e.g., "I'm not all that concerned with other peoples' needs") was the most central trait for the two networks, followed by Unconcern and Rashness. This result is consistent with both classical description of psychopathy (Cooke & Michie, 2001; Hare, 1996) and previous network analyses (Tsang & Salekin, 2019) that identified egocentricity-related traits, as central to the psychopathy construct. Moreover, in line with recent reports (e.g., Lynam & Miller, 2019), Antagonism appeared to be very central in the psychopathy construct, with Self-Centeredness and Callousness among the three nodes with the highest level of expected influence.

Minor sex differences were observed in Callousness, more central in males, and Anger more central in females. These differences may illustrate clinical observations and empirical data reporting more emotional instability in female psychopathy (Kreis & Cooke, 2011; Sprague et al., 2012). Additionally, it is worth noting that, depending on sex, certain facets did not have exactly the same neighborhood nodes. For instance, Manipulation was related to a common root of Dominance, Self-Centeredness, Disobliged, and Opposition in the two

networks, but was connected to Thrill-Seeking only for males, and to Invulnerability and Arrogance only for females. This may express a different function of manipulative tendencies by sex, with females more driven by the grandiose/vulnerable narcissism aspect of psychopathy, while males could find there a way of facing danger and risk.

Conversely, other facets, such as Unconcern (e.g., "It takes a lot to make me nervous or anxious") displayed both a high centrality and a similar pattern of correlations in males and females. Unconcern, as well as Self-Contentment and Invulnerability, operationalized in part boldness-related traits (i.e., stress immunity, social potency, self-assurance, social efficacy) in the EPA-SF. Without concluding the relevance of boldness-related traits in the psychopathy construct (core trait vs. diagnostic specifier; see Lilienfeld et al., 2012; Lynam & Miller, 2012), our results suggest that these traits have the same structure in males and females and displayed consistent positive and negative associations with other, more established, psychopathic traits. Despite their divergence, our data complement the previous study that indicated no meaningful incremental validity of boldness for predicting PCL-R scores in female incarcerated samples (Murphy et al., 2016), and could express a specific centrality of boldness in non-incarcerated samples.

Several limitations should be considered in the present study. First, the current study used data collected from an online sample recruited via social networks. Although there is growing evidence that Internet data collection methods are consistent with more traditional sampling approaches (Ramsey et al., 2016; Walter et al., 2019), some caution must be used, as in all studies, regarding the generalizability of the results. Second, some authors argued that network characteristics vary substantially across samples, displayed poor replicability, limited generalizability, and therefore no substantial utility (Forbes et al., 2017b, 2017a). However, each of these points has been addressed and recent research reports evidence that psychopathological network replicates very well across samples (Borsboom et al., 2017;

Steinley et al., 2017). Additionally, we could note that the two networks generated in this study widely replicate findings from Bronchain et al. (2019). Third and finally, given this study was based on biological sex, future research would benefit from investigating the complex relationship between gender and psychopathy.

In conclusion, despite these limitations our study has several strengths, including a large sample of participants and the first use of the network theory to investigate the sex-specific manifestation of psychopathy. Our results brought information regarding the stability of the network structure of psychopathy across sex. The network structure of psychopathic traits in undergraduate does not seem to be influenced by sex and the minor underlined differences do not allow to claim the non-equivalence of the construct in males and females. However, there is a need to replicate these findings, and future studies should explore the stability of the network structure in high psychopathic traits individuals.

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Table 1. Descriptive statistics, *t*-test, and Cohen's *d* for the EPA-SF dimensions.

Variable	Range	Skewness	Kurtosis	Males <i>M (SD)</i>	Females <i>M (SD)</i>	<i>t</i>	<i>d</i>
Global psychopathy	119-284	0.42	0.34	188.92 (23.67)	175.99 (22.91)	12.28*	.56
Antagonism	24-92	0.82	1.10	47.86 (10.28)	43.29 (9.24)	10.40*	.47
Coldness	4-20	1.14	1.63	7.99 (2.65)	7.32 (2.47)	5.84*	.26
Distrust	4-20	-0.01	-0.33	12.16 (2.97)	12.43 (2.88)	-2.06	.09
Manipulation	4-20	0.55	-0.18	10.79 (3.53)	8.97 (3.09)	12.25*	.54
Self-Centeredness	4-20	0.91	0.99	9.03 (2.99)	7.66 (2.58)	10.91*	.49
Callousness	4-20	1.15	1.63	7.90 (2.80)	6.92 (2.46)	8.31*	.37
Disinhibition	30-96	0.28	-0.07	60.65 (10.68)	59.28 (11.05)	3.77*	.12
Urgency	4-20	-0.01	-0.73	11.29 (3.57)	12.83 (3.54)	-9.55*	.43
Thrill-Seeking	4-20	0.43	-0.61	10.45 (4.01)	9.24 (3.69)	6.99*	.31
Opposition	4-20	0.24	-0.57	10.98 (3.50)	10.20 (3.35)	5.03*	.22
Disobliged	4-17	0.79	1.10	7.13 (2.02)	6.58 (1.90)	6.24*	.28
Impersistence	5-19	0.19	0.09	11.25 (2.04)	10.81 (1.83)	5.09*	.22
Rashness	4-20	0.55	-0.22	9.54 (3.37)	9.61 (3.56)	-0.49	.02
Narcissism	16-76	0.23	-0.04	43.11 (9.04)	42.68 (8.28)	1.16	.06
Anger	4-20	0.23	-0.77	9.81 (3.46)	11.49 (3.75)	-10.23*	.46
Self-Assurance	4-20	0.14	-0.79	11.53 (3.62)	10.41 (3.69)	6.74*	.31
Dominance	4-20	0.01	-0.46	12.01 (3.25)	11.87 (3.26)	0.96	.04
Arrogance	4-19	0.72	0.64	9.76 (2.51)	8.91 (2.16)	8.10*	.36
Emotional Stability	12-60	0.25	-0.50	37.29 (8.94)	30.74 (8.33)	16.84*	.76
Unconcern	4-20	0.48	-0.62	11.50 (4.08)	8.95 (3.65)	14.70*	.66
Self-Contentment	4-20	0.33	-0.47	11.25 (3.54)	9.63 (3.29)	10.50*	.47
Invulnerability	4-20	-0.21	-0.38	14.54 (3.10)	12.16 (3.24)	16.50*	.75

* $p < .01$

Fig. 1. Network displaying the relationships between the 18 EPA-SF psychopathic traits, for females (left panel) and males (right panel). Blue edges represent positive partial correlations, red edges represent negative partial correlations. Thickness and saturation of edges depict the strength of associations. The filled part of the ring around each node depicts predictability: the variance of the node explained by all its neighbors.

Fig. 2. Centrality plot for the estimated network ordered by Expected Influence. The red line represents females, the blue line represents males. ANG = anger, ARG = arrogance, CLS = callousness, CLD = coldness, DSB = disobliged, DST = distrust, DOM = dominance, IMP = impersistence, INV = invulnerability, MNP = manipulation, OPP = opposition, RSH = rashness, SAS = self-assurance, SCD = self-centeredness, SCT = self-contentment, TSK = thrill-seeking, UCR = unconcern, URG = urgency

Fig. 3. Network displaying the relationships between the 18 EPA-SF psychopathic traits for the total sample ($N = 1990$)