Depressive personality traits and temperament and character personality traits in a clinical sample: Results from regression and network analyses

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A R T I C L E   I N F O

A B S T R A C T

Personality and psychopathology are highly relevant and easily relatable constructs. The current study investigated the relationships between dependency and self-criticism, sociotropy and autonomy depressive personality traits, and Cloninger's temperament and character personality traits postulated as vulnerability factors for depression, in relation to depressive and general psychopathology symptoms in a clinical sample of 100 patients diagnosed with major depressive disorder.

The results showed that self-directedness, a character trait of the temperament and character model, was positively associated with dependency, self-criticism, sociotropy, and autonomy. Applying more in-depth analyses with regression models revealed associations between self-directedness and depressive personality styles dependency and sociotropy, and general psychopathology symptoms was a significant clinical indicator in these relationships. Going beyond the regression models, network analysis showed that self-directedness is associated with self-criticism, sociotropy, autonomy, and general psychopathology symptoms. The relationship between self-directedness and sociotropy, self-criticism and autonomy suggests that these depressive personality traits may be attributable to aspects of self-determination, maturity, responsibility, discipline, and self-acceptance. General psychopathology research informed by literature incorporating personality traits has far-reaching implications for understanding individual differences as well as increasing efforts to contribute to the amelioration of disabling psychological disorders like major depressive disorders.

1. Introduction

Major depressive disorder (MDD) is characterized by depressed mood lasting for a minimum of 2 weeks (American Psychiatric Association, 2013). The World Health Organization predicts MDD as a leading contributor to the global burden of disease and predicts that MDD will be a major contributor to the global burden of disease by the year 2030 (World Health Organization, 2008). MDD is a highly prevalent and recurrent disorder associated with high mortality (Whiteford et al., 2013). The prevalence of personality features in MDD is documented by both researchers and clinicians (Bagby, Quility & Ryder, 2008). The relationship between personality and psychopathology is said to be of a pathoplastic nature, i.e., influencing each other in terms of expression in an individual (Andersen & Bienvenu, 2011; Widiger & Smith, 2008) and this pathoplastic relationship can have significant and clinical implications.

There is a complex relationship between MDD and personality traits,

for one, personality can influence the expression of MDD. Previous research suggests that personality traits interact with each other and the effects are related to depression (Matsudaira & Kitamura, 2006). The relationship between personality traits and mental health disorders like MDD should be examined from various angles due to the complexity of MDD and personality. Evidence suggests that the risk for depressive psychopathology is influenced by predisposition for or as an expression of the disorder (Hirschfeld, 1999; Jylhä & Isometsä, 2006).

The relationship between personality characteristics and psychopathology have been extensively discussed in the literature (e.g., Akiskal et al., 1983; Cloninger et al., 1998; Enns & Cox, 1997; Gong et al., 2020; Kendler et al., 1993; Klein et al., 2011; Kopala-Sibley et al., 2015; Zaninotto et al., 2015; Zaninotto et al., 2016). There is evidence supporting the notion that expression of depressive psychopathology differs depending on risk factors (Fried et al., 2017), and associations with personality traits (Lux & Kendler, 2010). Beck, Epstein, and Harrison (1983) suggest that personality traits may serve to identify more

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homogeneous subgroups of depressive psychopathologies presenting with differing developmental pathways and etiological factors. Kendler et al. (2004) reported personality traits as risk factors for major depressive disorder. Outlining the trajectories between depressive psychopathology and personality traits can help clarify proximal processes linked to the development and expression of mood disorders (Compas et al., 2004; Lahey, 2009), making it possible for treatments to be tailored to individuals (Zinbarg et al., 2008).

An important line of inquiry to be considered in the study and treatment of depressive psychopathology which depicts individuals as active fabricators of their own distress, is one which brings the role of personality features linked to depression to the forefront. This line of inquiry brings the notion of pathoplasticity to mind; the notion that psychopathology occurs in the larger context of a person's personality, thus making it illogical to assume that the expression of depressive pathology is unlikely to be influenced by how one would characteristically perceive things, think, feel, and relate to their environment (Widiger & Smith, 2008). Personality characteristics have been identified as risk factors relating to depressive psychopathology (Boyce et al., 2001). Zuroff et al. (2004) reported an association between interpersonal personality features with increased vulnerability for major depressive disorder and Mongrain et al. (2004) reported and association heightened depressive symptomatology and interpersonal personality features. The psychopathology of depression has identified several risk factors, specifically psychoanalytic and cognitive theorists have associated personality traits as risk factors for vulnerability to depression (and or psychopathology). Blatt (1974, 2008) and Beck, Epstein, and Harrison (1983) put forward personality dimensions or styles that contribute to vulnerability to depression.

This paper explores the association between three models of personality traits implicated in depressive psychopathology; Blatt (1974, 2008), Beck, Epstein, and Harrison (1983), and Cloninger et al. (1993) models of personality. The models approach personality traits from differing perspectives. Although these models have previously been studied in respect to depressive symptomatology (Kopala-Sibley et al., 2017; Martínez et al., 2020; Mochcovitch et al., 2012; Rajewska-Rager et al., 2022; Vandenkerckhove et al., 2020), they have not been investigated simultaneously in one study. Given this, investigating the various factors that allow us to understand depressive psychopathology as a clinical and heterogeneous disorder is critical for diagnosis, intervention, and prognosis. From a clinical standpoint, it is important to gain an understanding of the vulnerabilities that underpin symptomatology (in this case, personality traits) and their associations. Making it possible to develop approaches that not only address current symptomatic expressions, but also consider complexity and heterogeneity, resulting in interventions that are beneficial to the patient's profile and encompass a distinct and patient-centred treatment approach (Dagnino et al., 2017, 2020).

Blatt and Beck's theory each describe dichotomous personality traits demonstrating behaviours that are too invested or overly dependent on others (dependency and sociotropy), and an inordinate investment in personal achievement (self-criticism and autonomy). Blatt (1974, 2008) approaches these personality traits as dependency and self-criticism from a psychodynamic point of view whist Beck's (1983) sociotropy and autonomy stem from a cognitive perspective. The core of both theories are diathesis-stress models of depression in which personality traits are supposed to increase the individual's vulnerability to stressful life events (Beck, 1983; Beck, Epstein, & Harrison, 1983; Zuroff & Mongrain, 1987).

From a different angle, the relationship between personality traits and depression has been studied using the psychobiological model of personality. Cloninger et al. (1993, 1994) uses a psychobiological perspective of personality to integrate social and biological mechanisms, accounting for variation in personality along dimensions of temperament nond character. The model is two-tiered, one of temperament and the other of character. Temperament comprises four traits related to

prelogical emotional processes of associative conditioning, whilst character comprises of three traits representing complex cognitive processes. The temperament traits are harm avoidance, novelty seeking, reward dependence and persistence (Cloninger et al., 1993). Harm avoidance quantifies individual differences in terms of shyness, fearfulness and inhibition in social situations; novelty seeking describes impulsivity, enthusiasm for new experiences, actively avoiding frustration, and a disposition to being quick-tempered; reward dependence, describes the need for social approval, warmth and support; and persistence describes perseverance which is best described as a dedication to achievement in spite of setbacks.

Character traits are self-directedness, cooperatives and self-transcendence (Cloninger et al., 1993). Self-directedness is the extent to which an individual identifies as autonomous and goal-oriented; cooperativeness is the capacity for empathy and acceptance of others; and Self-transcendence, is associated with the presence of spirituality i. e., the feeling of belonging to a unified whole.

Previous research (Brown et al., 1992; Peirson & Heuchert, 2001; Richter et al., 2000; Halvorsen et al., 2009) found support for the relationship between Cloninger et al. (1993) temperament and character model and mood. Specifically, they found that the personality dimensions correlated highly with depressed mood in clinical and non-clinical samples. Reviews and meta-analyses (e.g., Fassino et al., 2013; Kampman et al., 2014; Kampman & Poutanen, 2011; Mochcovitch et al., 2012) have maintained the role of temperament or character dimensions in mood disorders (e.g., major depressive disorder, social anxiety disorder, panic disorder). The Cloninger et al. (1993) model is assumed to provide a comprehensive account of normal and maladaptive individual differences. Zaninotto et al. (2016) in a meta-analysis confirmed that, personality traits of the temperament and character model are consistently associated with mood disorders. The psychobiological model of personality posits that the temperament dimensions function as automatic emotional responses to experiences whilst the character dimensions are centred on self-concepts representing goals and values (Richter et al., 2003).

Extending the existing corpus of research on personality dimensions as vulnerabilities to psychopathology presents the opportunity to contribute to a more concrete approach and understanding of the risk personality traits exhibit in the occurrence, expression, and treatment of depression. The concept of personality is a challenging one in the field of behavioural science and psychiatry, and the debate surrounding the relative merit of the different theories and perspectives continues (Kavirayani, 2018; Rumsey, 2020). Although Blatt and Beck's theories have little interaction with Cloninger et al.'s approach, these theories, like many exist side by side and tend to be associated to mood disorders like MDD.

The relationship between the pairs of Blatt and Beck's personality dimensions (dependency and sociotropy; self-criticism and autonomy) has been discussed in the literature (e.g., Blaney & Kutcher, 1991; Nietzel & Harris, 1990; Zuroff, 1994). Previous research as discussed, the personality models of Blatt and Beck in conjunction with the Cloninger et al. temperament and character model separately. Zohar (2007) presented a comparison of Blatt's and Cloninger et al.'s theories with regard to the association between personality and psychopathology.

Otani et al. (2011) examined the relationship of the Beck, Epstein, and Harrison (1983) personality dimensions with the Cloninger et al. (1993) dimensions of temperament and character in healthy participants. They found significant correlations between sociotropy, autonomy and Cloninger et al.'s personality dimensions. Otani et al. (2011), suggests that the observed patterns of correlations support the original idea that sociotropy is oriented to interpersonal relationships and autonomy is oriented towards skilfulness and independence.

Dependency and self-criticism; sociotropy and autonomy personality traits have been previously explored in relation to a broad personality dimension like the Five Factor model (Cappeliez, 1993; Gilbert & Reynolds, 1990; Mongrain, 1993). Zuroff (1994) examined the Blatt and

Beck personality traits in relation to the five-factor (FFM) model of personality. The study reported significant associations between the Blatt and Beck personality traits and the FFM personality traits - neuroticism, extraversion, agreeableness, conscientiousness, openness to new experiences. Research (Hakulinen et al., 2015; Jeronimus et al., 2016; Kotov et al., 2010) demonstrated strong associations between the FFM personality trait neuroticism and depressive psychopathology and other mental disorders. Furthermore, neuroticism was significantly associated with MDD, and then correlated with harm avoidance of the psychobiological model (Kotov et al., 2010; Rajewska-Rager et al., 2022.

Though dependency and self-criticism; sociotropy and autonomy have been examined independently (e.g., Cappeliez, 1993, Mongrain, 1993, Otani et al., 2011) and simultaneously (Zuroff, 1994) in relation to broad personality dimensions like in the FFM, these personality traits theories exist side by side and to our knowledge, have yet to be simultaneously studied alongside a personality framework like the temperament and character personality model in a clinical sample.

Klein et al. (2011), speaks to the necessity of exploring the interrelationship between personality and psychopathology. Understanding the relationship between psychopathologies like MDD and personality traits, may be central in helping elucidate proximal processes involved in the occurrence, creating specific treatments, and predicting treatment response (Gabbard & Simonsen, 2007; Quilty et al., 2008).

In this study, our aim was to present empirical data exploring the associations between personality traits from different schools of thought by examining these relationships with clinical variables using complementary regression and network analytic methodologies in a clinical sample. Studying the relationships between personality traits and psychological states from complementary analytic perspectives allows for the presentation of a robust methodology on the relatability/association of personality traits linked to symptoms of psychopathological disorders, which play a role in the etiology of such disorders and allows researchers find more effective interventions for symptom reduction (Cramer et al., 2010; Robinaugh et al., 2016). Moreover, network analysis theory has emerged as a major topic of discussion in psychopathology research (McNally et al., 2015; Oude Maatman, 2020).

2. Method

2.1. Participants

The study involved 100 adults aged between X and X years ($M = 36.9$, $SD = 11.8$), who were 33 male and 67 female' 59 % employed; 40 % with post-secondary level education and 53 % with university level education. Participants were part of a larger randomized controlled trial (The Ghent Psychotherapy Study, Meganck et al., 2017) and voluntarily gave informed consent prior to participating in the study. Informed consent also covered use of data for educational and research purposes.

2.2. Measures

This study was conducted using participant data measurements collected at baseline (pre-treatment) before participants were randomly assigned to one of two psychotherapy treatment conditions. In this research, we used self-reports that yielded information on temperament and character personality traits, depressive personality traits and psychopathological symptoms (see Meganck et al., 2017, for more detailed information on baselines data collection, inclusion and exclusion criteria).

2.2.1. Depressive Experiences Questionnaire (DEQ, Blatt et al., 1976)

This 66-item self-report questionnaire assesses dependent and self-critical personality styles. Items are scored on a 7-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree). The DEQ has multiple scoring methods. On the basis of previous comparative research (Blatt, 2004; Desmet et al., 2007; Falgares et al., 2018), we selected the

reconstructed DEQ (RecDEQ) scoring method (Bagby et al., 1994) to be used in the present study. Bagby et al. (1994) developed the Reconstructed Depressive Experiences Questionnaire (RecDEQ) by selecting 19 items (9 dependency, 10 self-criticism) that showed high and differential loadings in an exploratory factor analysis. Desmet et al. (2007) replicated the RecDEQ by means of confirmatory factor analysis in a student and a clinical sample. According to Desmet et al. (2007) the RecDEQ demonstrated the most ideal psychometric properties. They reported that the RecDEQ reduces the complexity of the original scoring method, they concluded that the RecDEQ scoring system is valid and less complex than its counterparts.

2.2.2. Personal Style Inventory -II (PSI-II; Robins et al., 1994)

A 48-item measure for the assessment of sociotropy and autonomy. On the PSI-II scale, sociotropy and autonomy consists of three subscales each. The sociotropy is made up of concern about what others think, dependency and pleasing others while the autonomy scale is made up of perfectionism, need for control and defensive separation. The PSI-II is scored on a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree) with a total score ranging from 24 to 144.

2.2.3. The shortened Dutch version of Cloninger's Temperament and Character Inventory (VTCI, Duijsens & Spinhoven, 2001)

The shortened VTCI was administered to assess temperament and character dimensions. The VTCI consists of seven scales; novelty seeking (NS), harm avoidance (HA), reward dependence (RD), persistence (PS), self-directedness (SD), cooperativeness (CO), and self-transcendence (ST) (Cloninger et al., 1994; Svrakic et al., 1993). Each of the seven scales contains 15 items without any sub-scales leading up to a total of 105 items.

2.2.4. The Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996)

The BDI-II is well known and most used self-report measure of depression. It is a 21 item self-report questionnaire that measures severity of depressed mood. For each symptom, statements are listed in ascending order, from 0 (non-depressed) to 3 (severely depressed) with total scores ranging from 0 to 63. The BDI-II is generally considered to have good validity and reliability (Beck, Steer, Ball, et al., 1996; Burt & Ishak, 2002).

2.2.5. Symptom Checklist-90-Revised (SCL-90-R; Derogatis, 1992)

The SCL-90-R is a 90-item questionnaire for assessing a broad range of psychological problems and psychopathology symptoms. The items are scored on a five-point rating scale of distress, rated from 1 (not at all) to 5 (extremely). This self-report inventory contains 9 subscales: Depression, Anxiety, Phobic Anxiety, Hostility, Obsessive-Compulsive, Interpersonal Sensitivity, Somatization, Sleep Problems and items not scaled (Paranoid Ideation and Psychoticism). These nine subscales can be summarized in a global score of symptomatic distress; the Global Severity Index (GSI). The GSI is obtained by averaging all nine subscale scores. Respondents were asked to rate the items indicating to what extent the symptoms of the SCL-90-R manifested in the preceding week. General psychopathological symptoms were assessed by the Global Severity Index (GSI) of the SCL-90-R at intake. The SCL-90-R is a frequently used 90-item self-report symptom inventory using a 5-point scale, corresponding to a GSI score of 0–4.

2.3. Data analysis

Descriptive statistics of all measures were calculated; the data are described usings means, standard deviations, and we performed Pearson's correlation analysis and stepwise regression analysis.

A Network analysis was then estimated, wherein we employed the graphical lasso procedure, which estimates a network where edges are partial correlation coefficients. This means that each presented edge

represents the relationship between two variables, controlling for all other relationships in the network. The graphical representation of the network is based on the Fruchterman–Reingold algorithm, which places nodes with stronger and/or more connections closer together. Undirected network analysis is a commonly used approach to describe the conditional independence and interrelationships among variables. The Network structure consists of nodes; the nodes represent specific variables that are included in the analysis and connections (edges) represent the relationships between nodes, controlling all other nodes in the network structure.

Each node in the graph represents one variable, and no connection between two variables indicates that they are conditionally independent of all other variables. The role of each node in the network is determined using indications of centrality (strength, closeness, betweenness, expected influence). Strength indicates how strongly a node is directly connected (the absolute sum of the edge weights connected to a node); closeness indicates how strongly a node is undirectly connected (the average distance from the node to all other nodes in the network); betweenness indicates how well one node connects other nodes (the number of times that a node lies on the shortest path between two other nodes); and expected influence is the sum of all edges extending from a given node. The expected influence computes the node strength without taking the absolute value of the edge weights.

Relevant variables selected to be significantly associated with dependency, self-criticism, sociotropy and autonomy in the regression analysis were included in the network. This is an exploratory study so the statistical threshold retained was $p < 0.05$. The analyses were done using JASP version 0.170 software, running *R*-packages qgraph (Epskamp et al., 2012) and bootnet (Friedman et al., 2008).

3. Results

Descriptive statistics are displayed in Table 1.

3.1. Regression analysis

Pearson's correlation analyses were performed. Correlation analyses (see Table 2) showed significant correlations with depressive personality traits dependency, self-criticism, sociotropy and autonomy and temperament personality traits novelty seeking, harm avoidance, reward dependence, self-directedness and the clinical variables. No significant correlations were observed with cooperativeness, self-transcendence, age and gender. (See Supporting Information: Table S1 for the full correlation matrix).

To examine the variation in the temperament and character

Table 1
Descriptive values of study variables.

Variables	Mean	*SD*	Minimum	Maximum
Dependency	4.89	0.92	2.10	7.00
Self-Criticism	4.61	0.79	2.44	6.78
Sociotropy	61.66	10.88	32.00	90.00
Autonomy	41.99	8.02	12.00	62.00
NS	7.28	1.97	2.00	12.00
HA	7.20	2.07	2.00	12.00
RD	8.76	2.29	2.00	13.00
PS	8.07	2.12	3.00	14.00
SD	8.09	3.36	1.00	15.00
CO	7.38	1.87	3.00	12.00
ST	4.62	4.45	0.00	15.00
BDI-II	31.63	9.25	6.00	56.00
GSI	2.60	0.55	1.52	4.00
Age	36.98	11.84	20.00	60.00

Note. NS = Novelty Seeking; HA = Harm Avoidance; RD = Reward Dependence; PS = Persistence; SD = Self-Directedness; CO = Cooperativeness; ST = Self-Transcendence; GSI = Global Severity Index; BDI-II = Beck Depression Inventory II.

personality traits; clinical variables and the depressive personality trait variables 4 stepwise regression analyses were performed with dependency, self-criticism, sociotropy and autonomy as dependent variables respectively.

Analysis of the first stepwise regression with dependency showed that in model 5 of the equation the personality traits cooperativeness, self-directedness, and global psychopathology symptomatology (measured by the GSI) significantly explained the dependency dimension $F(4, 96) = 12.80$, $p < 0.001$, and the total variation was $R^2_{adj} = 0.33$ (see Table 3). The variables harm avoidance, reward dependence, persistence, self-transcendence and BDI were excluded from the model as there were insignificant.

The third stepwise regression with sociotropy showed that, in model 3 of the equation self-directedness and the global psychopathology symptoms significantly explained the sociotropy dimension $F(2, 96) = 22.82$, $p. < 0.001$, and the total variation was $R^2_{adj} = 0.31$.

Both the second and the fourth stepwise regression equations with self-criticism and autonomy respectively as the dependent variable showed that only one variable was significant. General psychopathology symptoms significantly explained self-criticism dimension $F(1, 96) = 22.63$, and the total variation was $p < 0.001$, $R^2_{adj} = 0.18$ in the second stepwise regression and global psychopathology symptoms significantly explained the autonomy dimension $F(1, 96) = 14.15$, and the total variation was $p < 0.001$, $R^2_{adj} = 0.18$ in the fourth stepwise regression. (See Supporting Information: Tables S2–4 for the stepwise regression Tables 2-4).

3.2. Network analysis

To further determine the relationships among the study variables, we performed network analysis. We computed a sparce Gaussian graphical model with graphical lasso. The tunning parameter was chosen using the Extended Bayesian Information Criteria (EBIC). The resulting network is a network of partial correlation coefficients controlled for spurious connections. The network model is based on the idea that there are significant interrelationships between personality traits that interact with each other, and these dynamic relationships come into play in psychopathology disorders. To assess accuracy and stability of a particular network structure, we conducted bootstrapping analysis to estimate our network model under simulated and sampled data. This allowed us to estimate the sampling distribution of the particular parameters. Nonparametric bootstrapping analysis was performed with 1000 samples.

3.2.1. Network inference

All significant variables ($N = 11$) associated with depressive personality traits (dependency, sociotropy, self-criticism and autonomy) were entered in the network model. Novelty seeking, persistence, self-directedness and self-transcendence, total BDI (depressive symptoms) and GSI (general psychopathology measured by the SCL-90-r [global severity index]) were the remaining variables entered into the model. The total sparsity was 0.618. The networks representation is summarized in Fig. 1.

Respectively, 11 nodes formed 21 significant connections out of 55 possible connections. The network analysis was based on a partial correlation matrix (see supporting information Table S5). Partial correlations provide estimates of the strength of relationships between variables controlling for the effects of the other measured variables in the network model (Hevey, 2018). Thus, nodes in the graph are connected only if there is a connection between them and this covariance cannot be explained by any other variable in the network.

Dependency and sociotropy in this observed network structure were the most closely related nodes (0.42). Self-directedness was significantly associated with sociotropy (0.24), self-criticism (0.05), and autonomy (0.03). Novelty seeking was significantly associated with dependency (0.03) and self-criticism (0.01). Self-transcendence was significantly

Table 2

Pearson correlations between depressive personality traits, temperament and character traits and clinical variables.

	Dependency	95 % CI	Self-Criticism	95 % CI	Sociotropy	95 % CI	Autonomy	95 % CI
NS	0.21*	0.01–0.40	0.20	−0.01-0.38	−0.01	−0.21-0.20	0.13	−0.08-0.32
HA	0.11	−0.01-0.30	0.21*	0.02–0.40	0.12	−0.09-0.31	0.16	−0.04-0.35
RD	0.10	−0.01-0.30	0.03	−0.17-0.23	0.25*	0.05–0.43	−0.01	−0.21-0.20
SD	0.31**	0.11–0.48	0.27**	0.07–0.44	0.48***	0.30–0.61	0.23*	0.03–0.41
BDI-II	0.31**	0.12–0.48	0.43***	0.26–0.58	0.25*	0.05–0.42	0.30*	0.10–0.46
GSI	0.50***	0.34–0.64	0.43***	0.25–0.58	0.45***	0.28–0.60	0.37***	0.18–0.53

Note: NS=Novelty Seeking; HA = Harm Avoidance; RD = Reward Dependence; SD = Self-Directedness; BDI-II = Beck Depression Inventory; GSI = Global Severity Index (general psychopathology symptoms); 95 % CI, confidence interval.

* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

Table 3

Stepwise regression 1: Relationship between dependency, temperament and character dimensions and clinical variables.

Model		B	95 % CI	SE	β	R^2_{adj}	F	t
1	(Intercept)	4.868	4.68; 5.05	0.094				51.91
2	(Intercept)	0.821	0.52; 1.12	0.150	0.491	0.23	30.11***	6.94
	GSI							5.58
3	(Intercept)	3.41	2.45; 4.37	0.48		0.27	18.34***	7.04
	GSI	0.85	0.56; 1.14	0.15	0.51			5.77
	CO	−0.10	−0.19; −0.01	0.04	−0.20			−2.29
4	(Intercept)	3.38	2.44; 4.32	0.47		0.30	14.86***	7.16
	GSI	0.73	0.43; 1.03	0.15	0.44			4.86
	CO	−0.12	−0.21; −0.04	0.04	−0.25			−2.83
	SD	0.06	00.01–0.11	0.03	0.23			2.44
5	(Intercept)	2.94	1.94; 3.94	0.50		0.33	12.80***	5.82
	GSI	0.71	0.42; 1.00	0.15	0.42			4.80
	CO	−0.14	−0.22; −0.05	0.04	−0.28			−3.21
	SD	0.06	0.01; 0.11	0.03	0.21			2.35
	NS	0.09	0.01; 0.17	0.04	0.19			2.19

Note: β = regression coefficient (standardized); 95 % CI = confidence interval. GSI = Global Severity Index (general psychopathology symptoms); CO = cooperativeness; SD = Self-Directedness NS = Novelty Seeking. The following covariates were included in the model but removed in the stepwise regression: harm avoidance, reward dependence, persistence, self-transcendence and BDI.

*** $p < 0.001$.

Table 4

Centrality measures of personality traits and clinical variables.

Node	Betweenness	Closeness	Strength	Expected Influence
Dependency	1.23	1.22	0.82	0.81
Self-criticism	−0.89	−0.60	−0.23	−0.06
Sociotropy	1.32	1.31	1.02	0.97
Autonomy	−0.89	−0.59	−0.90	−0.60
Novelty seeking	−0.89	−0.10	−1.11	−0.78
Persistence	−0.10	0.12	−0.42	−0.21
Self-directedness	1.58	1.16	0.48	0.53
Self-transcendence	−0.10	−0.96	−0.78	−1.24
Depressive Symptoms	−0.89	0.23	0.46	0.51
General psychopathology symptoms	0.52	0.66	1.87	1.66
Age	−0.89	−1.54	−1.22	−1.60

negatively associated with age (−0.13).

With regards to clinical variables, BDI (symptoms of depression) was associated with self-criticism (0.16) and autonomy (0.03). GSI (general psychopathological symptoms) was associated with dependency (0.19), self-criticism (0.12), sociotropy (0.10), autonomy (0.14) and self-directedness (0.04). Thus, the personality traits self-directedness and novelty seeking were interrelated with sociotropy, autonomy, self-criticism and dependency; the self-transcendence personality trait was only related to the autonomy depressive personality trait.

The centrality measures showed that sociotropy was a core node among the depressive personality traits in the model and self-directedness was a core node from the temperament and character personality traits. Self-directedness was related to sociotropy and to other temperament and character personality traits and the clinical variables. General psychopathology symptoms were associated with all the depressive personality traits and the character personality trait self-directedness. Among the nodes with higher centrality indices (higher than $M = 1$), the most central node in the network was GSI ($M = 1.868$), followed by sociotropy ($M = 1.020$), dependency ($M = 0.823$) and self-directedness ($M = 0.480$).

The network analysis also highlighted a relatively independent cluster between self-criticism, self-directedness, self-transcendence, autonomy and GSI. In this cluster GSI was a mediator between self-criticism and autonomy and sociotropy was a mediator between self-directedness and GSI. Also observed in the network model was a weak negative relationship between self-transcendence and age.

3.2.2. Network stability

In checking the stability of the centrality indices, we observed that closeness and strength were relatively stable by dropping cases form the data set, which cannot be attributed to betweenness due to a wider confidence interval (see Fig. 2). Bootstrapped difference tests (with a = 0.05) between edge weights and centrality measures in the estimated network (see supporting Figs. S1 and S2) showed notable differences in node strength particularly for GSI, sociotropy and dependency.

In general, among the personality traits variables, the centrality measures (see Table 4) were high for self-directedness, which can be considered as a central variable in this network with the highest strength, expected influence, closeness and betweenness.

Centrality indicators are believed to be unstable, since they have wide confidence intervals and may have little predictive capabilities and
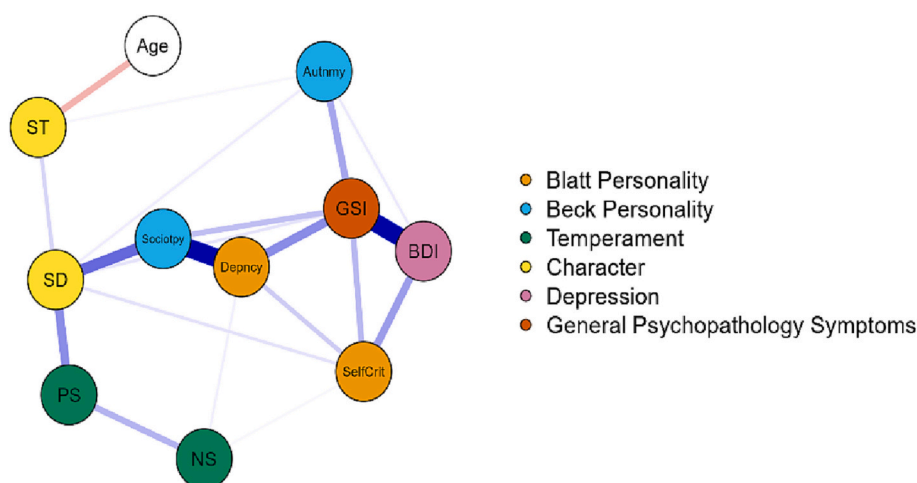
Fig. 1. Network analysis representation. Blue lines represent positive correlations, and red lines represent negative correlations. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
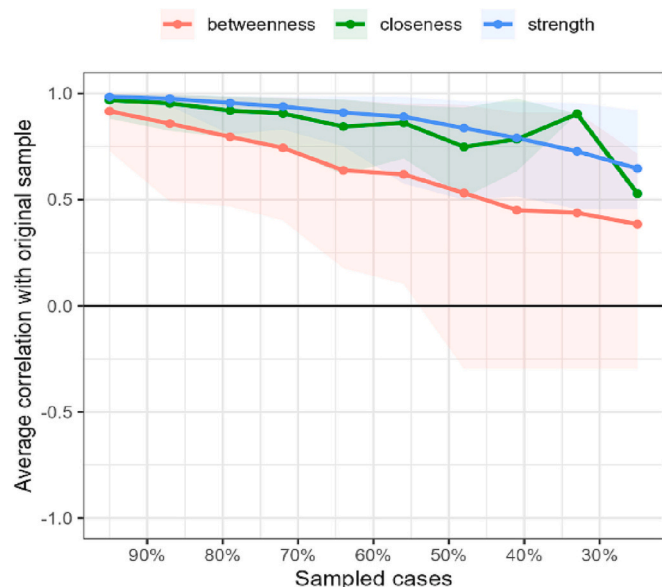

Fig. 2. Average correlations between centrality indices of networks sampled with participants (cases) dropped and in the original sample. Lines indicate the means and areas indicate the range from 2.5th quantile to the 97.5th quantile.

decreased/low stability overtime (Bringman et al., 2015). Thus, these indicators should be weighed with caution.

In general, the highest closeness measures were observed for dependency, sociotropy and self-directedness, which might suggest these personality traits have the closest distance to other nodes in the network model. Indicating that these personality traits can be linked by changes in the network. Additionally, the betweenness measure, which indicates the importance of a node in connecting any other two nodes, was high for only the self-directedness and dependency nodes. These nodes may act as possible bridge between other personality traits. The personality trait self-directedness is central to this network model, and this was also the case for the stepwise regression models with dependency and self-criticism respectively, where self-directedness made a statistically significant contribution.

4. Discussion

The primary goal of this study was to examined personality traits in a sample of adults with MDD. We deployed regression and network analyses to explore depressive personality traits and their relationship to temperament and character traits using multiple psychometric indicators. To the best of our knowledge, this is the first study to look at these personality traits using these approaches in one study. The traditional insistence on overstating the importance of one diagnostic factor at the expense of others is an antiquated model that does not take into account the phenomenon's (MDD) complex, dynamic, and contextual nature.

From the correlation analysis, we found that the character personality trait self-directedness was positively related to all four depressive personality traits ($r = 0.23$–0.47). The regression models revealed that three temperament and character personality traits and one clinical variable explained 33 % of the variation in the dependency personality trait: general psychopathology symptoms, cooperativeness, self-directedness, and novelty seeking, while self-directedness and general psychopathology symptoms explained 31 % of the variation in the sociotropy personality trait. Harm avoidance, reward dependence, persistence, self-transcendence, depressive symptoms, and age were excluded from the regression models because they did not contribute significantly to the models. As a result, one could argue that the excluded personality variables may overlap with other personality variables and are thus unrelated to the depressive personality dimensions.

To further examine how each significant variable simultaneously interacted with others and to examine variables beyond the regression models, network analysis was performed with temperament and character personality traits, depressive personality traits, with clinical variables and age as covariates. The analysis of the network topography showed that, the most central nodes in the network model were general psychopathology symptoms and sociotropy. According to the network, self-directedness is related to self-criticism, sociotropy, autonomy, and general psychopathology symptoms. It is important to note that network analysis allows for the examination of interrelationships between variables after the effects of all other nodes in the network have been considered and the strength centrality index provides specific information about each node's impact on the other nodes in the network.

Sociotropy and dependency had the highest centrality values among the four depressive personality traits. Overall, the depressive personality traits dependency and sociotropy were positively associated with novelty seeking though this association was relatively weak; self-criticism, sociotropy, and autonomy were associated with self-directedness; and autonomy was associated with self-transcendence. Furthermore, our observed relationship between sociotropy and autonomy and self-directedness; autonomy and self-transcendence confirms previous

findings supporting the relationship between sociotropy, autonomy, and self-directedness; autonomy and self-transcendence (Cappeliez, 1993; Otani et al., 2011). Cloninger et al. (1995) associate self-directedness with immaturity, fragility, self-striving, and unreliability, coupled with behaviours dominated by reactions to external stimuli. However, it must be noted that, interpretations of centrality measures must be approached with caution due to the relative confidence intervals of the edge weights and the minimal notable differences in the centrality indices.

In terms of covariate variables, our study found no independent effect of gender on any personality variables, contrary to previous research (Hansenne et al., 2005; Sasayama et al., 2011). Our study like in that of Zaninotto et al. (2015) reported no association between the temperament and character dimensions and severity of depressive symptomatology. This finding seems to be in contrast with previous research reporting that severity of depression was associated with self-directedness and harm avoidance (Bayon et al., 1996; Cloninger et al., 1998; Hirano et al., 2002; Sasayama et al., 2011; Spittlehouse et al., 2010). The current study, on the other hand, observed significant associations between general psychopathology and self-directedness, harm avoidance, and all four depressive personality traits.

The temperament and character traits, as well as the depressive personality traits, have previously been investigated (Cappeliez, 1993; De Fruyt et al., 2000; Dunkley et al., 1997; McBride et al., 2005; Mongrain, 1993; Zuroff, 1994), alongside the traits of the well-known Five Factor Model (FFM) of personality consisting of neuroticism, extraversion, agreeableness, conscientiousness, openness.

De Fruyt et al. (2000) found that temperament and character personality traits had significant overlap with the FFM. They discovered that the FFM significantly explains harm avoidance, novelty seeking, self-directedness, and cooperativeness, Furthermore, they discovered that temperament and character personality traits significantly explain the variation in neuroticism, extraversion, and conscientiousness. Indicating that Cloninger et al.'s model overlaps with the Five Factor Model (FFM) of personality, allowing for comparison.

General psychopathology symptomatology was associated with the depressive personality traits as well as self-directedness of the temperament and character personality traits. Furthermore, this result confirms previous findings supporting the association between psychopathology symptomatology and personality traits.

Self-directedness has previously been associated with greater severity of symptomatology in psychological illness (Abbate-Daga et al., 2007; Evren & Evren, 2006). Furthermore, associations between general psychopathological symptoms and personality traits of the FFM have also been observed (e.g., Caspi et al., 2014; Castellanos-Ryan et al., 2016; Etkin et al., 2020).

These findings are relevant because self-directedness has been proposed as an indicator in planning effective treatments and treatment response for MDD (Conrad et al., 2009; Corruble et al., 2002; Sato et al., 1999). Self-directedness assesses a person's cognitive coherence, which allows them to be resourceful, self-accepting, purposeful, and responsible. Cloninger et al. (2006) observed that mood changes were strongly related to self-directedness. Moreover, antidepressants and cognitive therapies have linked self-directedness to reduction in long-term vulnerability to depression and related psychopathology (Cloninger, 2004).

The importance of self-directedness in this study can be explained from a cognitive perspective. Self-concept within which self-directedness in included by nature is a cognitive construct. Therefore, it seems reasonable that depressive personality traits sociotropy and autonomy which are a part of depressogenic information processing i.e., overgeneralisation, arbitrary inference, selective abstraction, absolutistic cognitions as well as maximising failures and minimising successes be related to a lack of an internal organization principle (Richter & Eisemann, 2002). Furthermore, the self-directedness is important in this vein as it coincides with the aims of cognitive psychotherapies that result in changes in an individual's self-concept.

Dependency, sociotropy, self-criticism, autonomy, and self-directedness (the interrelated personality traits) were associated with general psychopathology symptoms but not with symptoms of depression alone. However, self-criticism and autonomy were associated with symptoms depression. Because the measure of depression symptoms used in this study (BDI-II) is of cognitive origin, the association with autonomy is not as surprising as the association with self-criticism, because while autonomy can be explained by cognitive theory, self-criticism is less so.

In terms of clinical variables (depression symptoms and general psychopathology symptoms), only general psychopathology symptoms were consistently significant in all four regression models. This result based on the regression models, might lead one to conclude that not all clinical variables in this study are statistically significant. However, it is possible that, in the regression models, symptoms of depression measured by the BDI-II have too much shared variance with the measure of general psychopathology symptoms (global severity index, [GSI] SCL-90) and were thus removed from the regression models, but the network model was able to calculate the shared variance and present them as an interrelated variables in the network model sharing relationships with other variables in the model.

Overall, this study suggests that the depressive personality traits are associated with self-directedness and general psychopathology symptoms, which may reveal an unexplained part of the heterogeneity of MDD. The analysis of personality traits implicated in MDD and general psychopathology symptoms from a network analysis approach has not been conducted in great detail, to our knowledge, no study has analysed the depressive personality traits alongside temperament and character personality traits as they pertain to MDD and general psychopathology symptoms in a clinical sample.

The inclusion of both depressive symptoms and general psychopathology symptoms was a significant strength in this study because it allowed us to examine relationships to personality traits beyond just depressive symptoms. Moreover, symptoms of depression and general psychopathology symptoms were measured in a clinical sample that met the DSM-5 diagnostic criteria for MDD, so the inclusion of general psychopathology symptoms accounted for other mental health burdens other than depressive symptomatology alone. Also juxtaposing personality traits from differing orientations offers a novel possibility of gaining insight into the interrelations among variables not normally studied together due to their differing perspectives but often associated with psychopathologies such as MDD.

Finally, network analysis methodology was used in this study to further examine the interrelationships among study variables. Network analysis proved to be an effective method for investigating how different personality traits and clinical variables are linked.

There are limitations to be considered in this study. Participant errors (duration neglect and recency effects) may occur in retrospective self-reported assessments, and symptoms based on a previous period (one week in the case of the SCL-90-R) may be underestimated or exaggerated (Robinson & Clore, 2002). Furthermore, assessing current mood may influence retrospective assessment of symptoms of depression and comorbidities. Another limitation of this study is the small sample size. The small sample size may have made it difficult to observe the diversity of all temperament and character personality traits, as well as possible interrelationships with depressive personality traits and clinical variables.

Relatedly, although the sample was representative of the socioeconomic makeup of the geographical region in Belgium, where this study was conducted, it had a larger proportion of Caucasians. It is therefore unclear whether results would generalize to other socioeconomic, ethnic, or racial groups. Furthermore, because the variables in this study were baseline measurements in a cross-sectional sample, it is impossible to determine how much each personality trait in the network changes over time as this was beyond the scope of the current study. The study's use of cross-sectional data makes it impossible to determine whether

self-directedness, novelty seeking, and self-transcendence influence depressive personality traits or vice versa, however, the findings show that both the regression and network models used in this study indicated relationships between these personality traits. These limitations preclude generalizing the main study findings.

In conclusion, this study examined personality traits that confer vulnerability to psychopathology, such as MDD, and their relationships with two statistical approaches. In addition to the regression models, the network approach allowed us to observe associations between depressive personality traits and temperament and character personality traits. Taken together, these findings suggest that there is some uncertainty about the role of certain personality traits in this network. Harm avoidance, reward dependence, persistence, and self-transcendence made no significant contributions to any of the regression models. However, in the network model, persistence and self-transcendence were active connected nodes, whereas cooperativeness, which was previously observed as a significant contributor in the first regression model, was not significant. Thus, it is likely that harm avoidance, reward dependence, and cooperativeness are not unique personality traits in this clinical population, so no associations between them and depressive personality traits where observable.

The network approach allowed for a more detailed examination of the relationship and dynamics of personality traits at the symptom level. From a practical standpoint, the interrelationships of personality traits with respect to depressive and general psychopathology symptomatology can allow for a better understanding of which personality traits are significantly related at a given point in time, as well as how to tailor treatment interventions and objectives.

This study sought to offer an inclusive, or at least different, understanding of the relationship between personality traits frequently associated with psychopathologies such as MDD. Psychological approaches such as network analysis can provide new insights into the conceptualization, understanding, and treatment of psychological disorders.

Declaration of competing interest

The Authors declare that there are no conflicts of interest.

Data availability

Data will be made available on request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.actpsy.2023.103860.

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