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ScienceDirect
Comprehensive Psychiatry 50 (2009) 38–47
Comprehensive PSYCHIATRY
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The association between bodily anxiety symptom dimensions and the scales of the Revised NEO Personality Inventory and the Temperament and Character Inventory

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Abstract

The association between anxiety disorders and different measures of personality has been extensively studied to further the understanding of etiology, course, and treatment, and to possibly prevent the development of anxiety disorders. We have proposed a hierarchical model of bodily anxiety symptoms with 1 second-order severity factor and 5 first-order factors: cardio-respiratory, gastro-intestinal, autonomic, vertigo, and tension. The aim of this study was to investigate whether personality traits were differentially related to distinct symptom subdimensions or exclusively related to the general severity factor. Structural equation modeling of data on 120 patients with a primary diagnosis of social phobia and 207 patients with a primary diagnosis of panic disorder was used to examine the association between anxiety symptom dimensions and the scales of the Temperament and Character Inventory and of the Revised NEO Personality Inventory. When both sets of personality measures were simultaneously modeled as predictors, the Revised NEO Personality Inventory scales, neuroticism and extraversion, remained significantly associated with the severity factor, whereas the association between the Temperament and Character Inventory dimensions, harm avoidance and novelty seeking, and the severity factor became nonsignificant. Harm avoidance was negatively associated with the vertigo first-order factor, whereas neuroticism was negatively associated with the cardio-respiratory first-order factor, indicating that personality factors may be differentially related to specific anxiety subdimensions.

1. Introduction

Understanding the relationship between personality and anxiety disorders is important as it may lead to a better understanding of the etiology, course, treatment, and possible prevention of anxiety disorders. Studies have shown an association between broad personality traits, such as neuroticism and extraversion [1,2] or harm avoidance, novelty seeking, and reward dependence [3,4], and different anxiety disorders. Aside from methodological issues, such as measurement methods with item content and conceptual overlap, personality and psychopathology may be associated for a number of reasons [5-9]. Personality may predispose to the development of an anxiety disorder; personality may affect the course or expression of the anxiety disorder; anxiety disorders may affect personality; or anxiety disorders and personality may be different manifestations of the same spectrum of behaviors and could have a common etiology.

One of the personality measures often used in the study of psychopathology has been the Temperament and Character Inventory (TCI) developed by Cloninger et al [10]. Clear hypotheses regarding the neurobiological basis of temperament have made Cloninger's model a prime candidate for use in genetic and other studies of etiology. A number of studies have compared patients with anxiety disorders to normal controls on the temperament and character dimensions of the TCI. The consistent result has been that both remitted patients and patients with current anxiety disorders have higher scores on harm avoidance than controls [3,11-24]. Differences with regard to novelty seeking or subscales of

The work reported was supported by grants from the Psychiatric Research Foundation in Aarhus County (Puljen til Styrkelse af Psykiatrisk Forskning i Aarhus Amt), the Lundbeck Foundation, the MD Ejlif Trier-Hansen and Wife Ane Trier-Hansen Foundation (Læge Eilif Trier-Hansen og hustru Ane Trier-Hansens Legat), the Augustinus Foundation, the Foundation for Research on Mental Disorders (Fonden til Forskning af Sindslidelser), and the OJ Rafaelsen's Foundation.

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doi:10.1016/j.comppsych.2008.06.005

novelty seeking have also been observed in studies of patients with panic disorder [11,15] and social phobia [3,20,23,24]. A few studies have found associations between anxiety disorders and the remaining TCI dimensions or their subscales: reward dependence [4,11,16,20], persistence [20], self-directedness [3,19,20,23-25], cooperativeness [3,19,20,24], and self-transcendence [19,20,24]. These associations have primarily been observed in studies of patients with social phobia.

The Revised NEO Personality Inventory (NEO PI-R) [26] has also been used in a number of studies exploring the personality-psychopathology relationship. In contrast to the TCI, the NEO PI-R is based on *the big five* personality model, building on a lexical approach to personality measurement [27]. High levels of neuroticism have consistently been found related to anxiety disorders [1,2,28-32], whereas low levels of extraversion have been found particularly associated with agoraphobia and social phobia [1,2,29,31,32]. Associations between anxiety disorders and the remaining NEO PI-R scales, openness [1,2,29], agreeableness [1,2,31], and conscientiousness [1,2,28,31], have also been suggested.

The dimensions of the TCI and the scales of the NEO PI-R have been found to overlap, and the extent to which they measure substantially different traits is unclear. The Eysenck Personality Questionnaire, which measures traits similar to those of the NEO PI-R, and the TCI have been argued to be not merely overlapping, but complementary measures [33]. By including both the NEO PI-R and the TCI, we hoped to clarify which traits were associated with anxiety symptom dimensions as well as illustrate how the measures overlapped.

A number of studies have explored the structure of anxiety symptoms to identify more homogeneous subtypes of the anxiety disorders [34-40]. The resulting endophenotypes are potentially very useful as they may specify different symptom clusters that are differentially related to etiologic factors or treatment response. The relationship between personality and bodily anxiety symptom dimensions has not, to our knowledge, been investigated in prior studies.

We have suggested that the structure of bodily anxiety symptoms in panic disorder and social phobia can best be described hierarchically as a factor structure with 1 general second-order factor and several specific first-order factors [41]. A second-order, general factor has also been found in the symptom structure of other psychiatric disorders [42-45]. A second-order factor may be interpreted as a general factor of severity of the disorder in question.

Studying the relationship between personality traits and symptom dimensions within a sample of patients with anxiety disorders is a different endeavor than investigating personality differences between patients and controls. Several prior studies, not investigating symptom dimensions, found an association between the severity of an anxiety disorder and harm avoidance [14,19,22,25] or neuroticism [46], although not all studies have replicated this finding [3,32]. Including a hierarchical factor model of anxiety symptoms in the present study made it possible to investigate whether personality traits were differentially associated with specific first-order factors without the severity factor confounding the picture.

The aim of this study was to investigate whether personality traits were differentially associated with distinct anxiety symptom dimensions or exclusively associated with a general severity factor. To investigate this question, we examined the pattern of association between anxiety dimensions and the scales of the TCI and the NEO PI-R.

2. Method

2.1. Subjects

Two samples were recruited through an anxiety clinic, advertisements, pamphlets, and the project's website. The first sample comprised 177 patients fulfilling the *DSM-IV* diagnostic criteria for panic disorder, agoraphobia, and/or social phobia before the age of 21. Their mean age was 36.1 years (SD 12.1) and 72% of the participants were female. They were included as part of an etiologic study conducted at the Centre for Psychiatric Research, investigating the genetic and environmental risk factors for developing panic disorder, agoraphobia, and social phobia. Inclusion and exclusion criteria were defined to optimize the investigation of genetic risk factors. Exclusion criteria were bipolar disorder, obsessive-compulsive disorder, schizophrenia, or psychotic symptoms in a lifetime perspective; bipolar disorder or schizophrenia in first-degree relatives; abuse of alcohol or drugs before onset of the anxiety disorder; depression immediately before, concurrent with, or immediately after onset of the anxiety disorder; mental retardation; language disabilities; ethnic background other than Danish; or being younger than 18 years. Four hundred ninety-one individuals, who volunteered to participate in the etiologic study, were excluded as they did not fulfill the diagnostic criteria for panic disorder, agoraphobia, or social phobia before the age of 21 or because they fulfilled one or more of the exclusion criteria.

The second sample consisted of 150 patients, who fulfilled the *DSM-IV* diagnostic criteria for panic disorder, agoraphobia, and/or social phobia in a lifetime perspective, but were excluded from the first sample because of onset at the age of 21 or older (71%), ethnic background other than Danish (8%), and/or depression immediately before, concurrent with, or immediately after onset of the anxiety disorder (44%). Patients with depressive pathology were only asked to participate if their anxiety disorder diagnosis was not limited to depressive episodes. The mean age was 40.5 years (SD 12.9) and 82% were female. Data from the 2 samples were combined before data analysis. All in all, 120 participants had a primary diagnosis of social phobia and 207 had a primary diagnosis of panic disorder. Primacy was determined on the basis of reported severity and duration.

Table 1
Correlations among raw scores of the NEO PI-R and the TCI scales

	NEO PI-R				
TCI	Neuroticism	Extraversion	Openness	Agreeableness	Conscientiousness
Novelty seeking	−.16	.51*	.41*	−.17	−.23*
Harm avoidance	.73*	−.61*	−.34*	−.11	−.34*
Reward dependence	−.03	.36*	18*	.26*	.11
Persistence	.13	−.01	.15	−.00	.35*
Self-directedness	−.72*	.46*	.22*	.28*	.53*
Cooperativeness	−.34*	.25*	.24*	.64*	.22*
Self-transcendence	−.08	.28*	.39*	.17	.01

* $P < .001$ (2-tailed).

2.2. Procedure

All volunteers were screened over the phone. Presence of a lifetime diagnosis of panic disorder, agoraphobia, or social phobia was assessed on the basis of selected questions from Schedules for Clinical Assessment in Neuropsychiatry (SCAN) [47,48] corresponding to the diagnostic criteria. The patients included in the first sample were additionally interviewed about present and prior psychiatric disorders using the full SCAN interview. The interviewers were 2 psychologists who had attended a 5-day SCAN training course. Interrater reliability was satisfactory (Cohen's κ = 0.93). Less than 2% of subjects in the first sample, who were initially invited to participate in the study on the basis of telephone screening, were excluded from the study after the SCAN interview, suggesting fairly high validity of the screening procedure.

Participation was voluntary and unpaid. Participants were informed about the project and of their rights, both verbally and in writing, before signing the consent form. The project was approved by the regional ethics committee and conducted in accordance with the Helsinki Declaration.

2.3. Questionnaires

A symptom questionnaire was constructed, inspired by the lexical tradition of test construction. The development of the questionnaire and the initial analysis of data from the questionnaire have been described in more detail elsewhere [41]. One hundred and eighty-seven anxiety symptoms, of which 110 were bodily, were presented as personal statements. Patients were instructed to answer according to how often they experienced each symptom during panic attacks or in the anxiety-provoking phobic situations on a 5-point Likert scale from never (0) to always (4).

Two personality questionnaires were administered: the NEO PI-R [26] and the TCI [10]. The scales of the NEO PI-R and the TCI have not been previously related to dimensions of anxiety symptoms.

The NEO PI-R consists of 240 items assessing 5 major personality dimensions: neuroticism, extraversion, openness, agreeableness, and conscientiousness. The Danish version has been standardized and published with Danish norms [49]. All NEO PI-R scales had high Cronbach α coefficients in our sample ($.87 < \alpha < .93$), reflecting good internal consistency.

The TCI consists of 240 items assessing 4 temperamental dimensions—harm avoidance, novelty seeking, reward dependence, and persistence—as well as 3 character dimensions—self-directedness, cooperativeness, and self-transcendence. A back-translation of the Danish version of the TCI [50] has been approved by Cloninger [10]. Most TCI dimensions showed good internal consistency ($.79 < \alpha < .90$), although 2 temperament dimensions, reward dependence ($\alpha = .65$) and persistence ($\alpha = .66$), had relatively low α coefficients in this sample.

The correlations between the scales of the NEO PI-R and the scales of the TCI were considerable (Table 1), although comparable to the correlations between these measures observed in a Dutch sample of psychiatric patients [51].

2.4. Statistical analysis

The 110 bodily symptoms from the symptom questionnaire were divided into groups, forming potential index scales, and fitted to graphical log linear Rasch models [52,53] with sex, sample, and diagnoses as exogenous variables. The resulting index scale scores were submitted to exploratory maximum likelihood factor analysis with Promax rotation. The number of factors to retain was determined on the basis of eigenvalues, scree test, and parsimony of factor structure. The analysis suggested correlated first-order factors, and we hypothesized a common second-order factor. Hierarchical factor analysis with Schmid-Leiman rotation [54] was performed to examine the second-order structure.

The resulting hierarchical symptom model was submitted to confirmatory factor analysis. Presented with findings of inadequate fit, the model was respecified to include additional parameters identified by the Lagrange Multiplier Test. Once a measurement model was established for the symptom dimensions, the structural model, in which personality traits were specified as predictors of symptom dimensions, was examined. Instead of including each personality trait in the structural model as a single scale score, each scale was defined by 3 domain representative parcels of items, as suggested by Little et al [55]. With neuroticism as an example, the 48 items that comprise the

neuroticism scale were divided into 3 item parcels. Each parcel included items from each of the 6 facet scales of neuroticism, representing each facet scale to the same extent.

All personality traits were conservatively hypothesized to affect only the general, second-order symptom factor. Three models were examined: Model 1 with the temperament and character dimensions of the TCI predicting the second-order factor, Model 2 with the personality scales of the NEO PI-R predicting the second-order factor, and Model 3 with the scales from both the TCI and the NEO PI-R which had been shown to predict symptom dimensions in the first 2 models. Each model was first submitted to the Wald test, which is a multivariate test of statistical significance, to see whether any of the hypothesized structural paths could be deleted. Then additional structural paths identified by the Lagrange Multiplier Test were added. Finally, the Wald test was applied again to prevent overfitting of the model. Differences between nested models were examined using the corrected Δ Satorra-Bentler χ^2 (Δ S-B χ^2) [56].

Multiple criteria were used in the assessment of model fit: the comparative fit index (CFI) [57], standardized root mean squared residual (SRMR), and the root-mean-square error of approximation (RMSEA). A cut-off value for CFI close to 0.95 has recently been suggested as an indication of good fit [58], although a value of greater than 0.90 was originally considered an indication of a well-fitting model [59]. A value close to 0.08 for SRMR and a value close to 0.06 for RMSEA were taken to indicate a good fit [58].

Post hoc analyses were conducted to examine whether specific subscales of neuroticism, harm avoidance, and self-transcendence were differentially related to factor scores on the severity factor. Factor scores were calculated on the basis of the fitted hierarchical model of anxiety symptom structure and standardized scores on the 18 index scales and the 4 retained single symptoms. Regression analyses were also conducted post hoc to investigate the effect of diagnosis on the association between novelty seeking and the severity factor and between extraversion and the severity factor.

Graphical log linear Rasch analyses were performed using the statistical software DIGRAM [60], explorative factor analyses were performed using SPSS 13.0 and STATISTICA 6.0 (StatSoft, Tulsa, OK), and confirmatory factor analyses and structural equation modeling were performed using AMOS 16.0 and EQS 6.1 [61].

3. Results

3.1. The measurement model for symptom structure

Sixty-five symptom items fitted 18 graphical log linear Rasch models with weak to moderate local dependence among items, but no differential item functioning. Four symptoms not fitting the Rasch models were considered important to retain because they were part of the *DSM-IV* or the *ICD-10* diagnostic criteria, and, therefore, they were included in the following factor analysis as single items. Factor analysis of the 18 index scales and the 4 retained single symptoms yielded 5 first-order factors that were positively correlated, suggesting a general, second-order factor. Hierarchical factor analysis with Schmid-Leiman rotation yielded a second-order solution with 1 general factor, severity, and 5 first-order factors: cardio-respiratory, gastro-intestinal, autonomic, vertigo, and tension.

We used the results of the hierarchical factor analysis to propose a confirmatory factor analysis measurement model for bodily symptoms. Mardia's [62] normalized estimates of 8.25 suggested problems related to kurtosis; namely, that the data may be non-normally distributed [61]. Therefore, corrected fit statistics, the Satorra-Bentler χ^2, robust CFI, and robust RMSEA were preferred to uncorrected statistics as they would provide a more valid assessment of model fit. The higher-order model for the symptom dimensions was initially found to have somewhat inadequate fit (CFI, 0.843; SRMR, 0.080; RMSEA, 0.085 [90% CI, 0.078-0.092]), and the measurement model was therefore respecified to include 10 error covariances, resulting in a better fitting model (CFI, 0.907; SRMR, 0.071; RMSEA, 0.067 [90% CI, 0.059-0.075]). Although some of the fit statistics, especially the CFI, still only indicated marginal fit, it was decided to refrain from further post hoc model fitting in the name of parsimony and to avoid overfitting. Fig. 1 depicts the fitted measurement model for symptom structure.

3.2. Model 1: symptom structure and the scales of the TCI

The hypothesized model with all TCI scales predicting the general severity factor did not fit the data well (CFI, 0.830; SRMR, 0.108; RMSEA, 0.063 [90% CI, 0.059-0.067]). An initial Wald test suggested that reward dependence, persistence, self-directedness, and cooperativeness were not predictive of the severity factor, and these paths were removed without reducing model fit (Δ S-B χ^2 = 4.83, *df*= 4, *P* = .305). The Lagrange Multiplier Test identified 6 correlations between TCI scales which were all included, improving the fit of the model substantially (Δ S-B χ^2 = 305.17, *df* = 6, *P* = .000). In addition, a structural path from harm avoidance to one of the first-order symptom factors, tension, was suggested, which also resulted in improved model fit (Δ S-B χ^2 = 5.66, *df* = 1, *P* = .017). Although the Lagrange Multiplier Test statistics indicated that additional improvement to the model could be obtained by adding further structural paths, none of these resulted in a substantially better fitting model. A final Wald test suggested removing self-transcendence as a predictor of the severity factor, but removing this path would result in a significant deterioration of model fit (Δ S-B χ^2 = 5.38, *df* = 1, *P* = .020), and, consequently, it was left in. The final, fitted model is depicted in Fig. 2. The model did not fit the data perfectly (CFI, 0.883; SRMR, 0.081; RMSEA, 0.053 [90% CI, 0.048-0.057]), but substantially better than the initially hypothesized model.

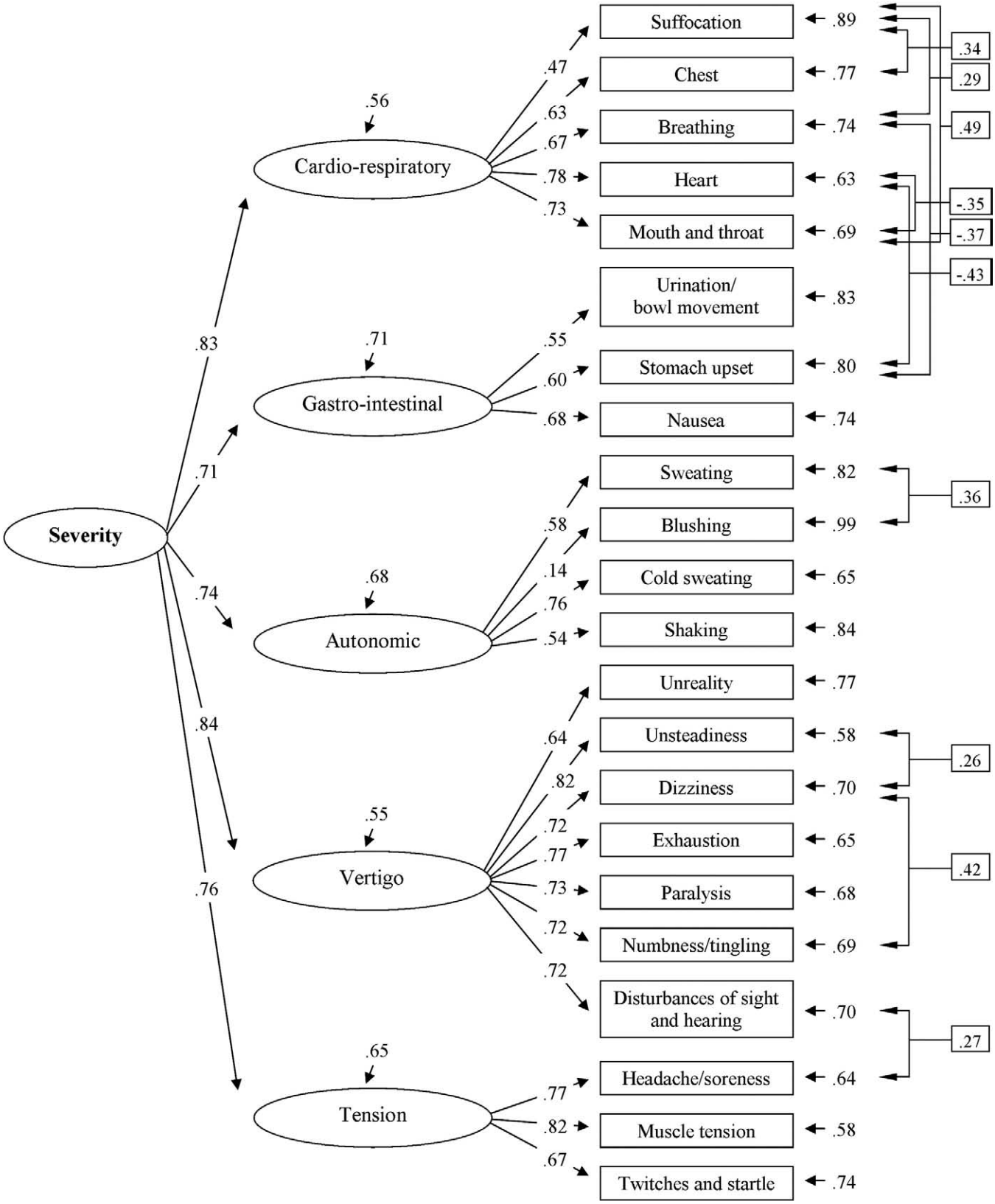

Fig. 1. The measurement model for bodily anxiety symptoms with added error covariances. Latent constructs are in circles. Indicators are in boxes. Numbers on the paths are statistically significant standardized path coefficients. The variances of the residual disturbance terms with each first-order factor and the variances of the error terms with each indicator are also depicted.

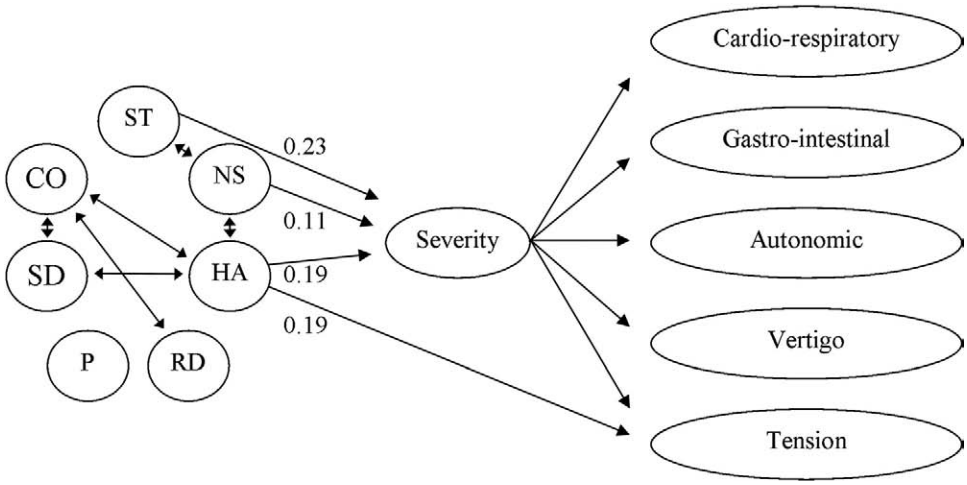

Fig. 2. Final structural model of TCI dimensions and symptom structure. Latent constructs are in circles, one-headed arrows represent standardized regression paths, numbers on the paths are statistically significant standardized path coefficients, and 2-headed arrows represent covariances. TCI scales: NS indicates novelty seeking; HA, harm avoidance; RD, reward dependence; P, persistence; SD, self-directedness; CO, cooperativeness; ST, self-transcendence.

3.3. Model 2: symptom structure and the scales of the NEO PI-R

The hypothesized model with the 5 NEO PI-R scales predicting the severity factor did not fit the data (CFI, 0.830; SRMR, 0.108; RMSEA, 0.063 [90% CI, 0.059-0.067]). A Wald test indicated that agreeableness and conscientiousness did not predict the severity factor, and the paths were removed without change in model fit (Δ S-B χ^2 = 1.27, *df* = 2, *P* = .529). Eight correlations among NEO PI-R scales were suggested by the Lagrange Multiplier Test and improved model fit substantially (Δ S-B χ^2 = 252.38, *df* = 8, *P* = .000). Two structural paths, one between neuroticism and the cardio-respiratory first-order factor and one between extraversion and the first-order factor labeled vertigo, were also suggested and provided further improvement in model fit (Δ S-B χ^2 = 27.69, *df* = 2, *P* = .000). The Lagrange Multiplier Test suggested no further addition of paths to the model. A final Wald test suggested removing openness as a predictor of the severity factor, and its removal had no effect on model fit (Δ S-B χ^2 = 2.03, *df* = 1, *P* = .154). The fitted model for hierarchical symptom structure and the NEO PI-R scales is depicted in Fig. 3. The model fitted the data nicely (CFI, 0.912; SRMR, 0.076; RMSEA, 0.055 [90% CI, 0.050-0.059]), considering the somewhat low CFI provided by the measurement model for symptom structure.

3.4. Model 3: symptom structure and associated scales of the TCI and the NEO PI-R

Model 3 included the scales of the TCI and the NEO PI-R that had a direct association with symptom factors in

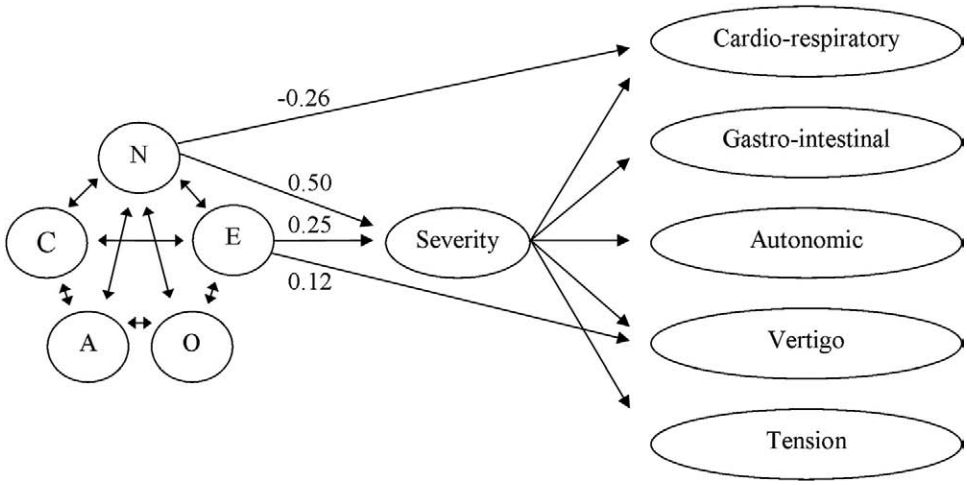

Fig. 3. Final structural model of NEO PI-R scales and symptom structure. Latent constructs are in circles, one-headed arrows represent standardized regression paths, numbers on the paths are statistically significant standardized path coefficients, and 2-headed arrows represent covariances. NEO PI-R scales: N indicates neuroticism; E, extraversion; O, openness; A, agreeableness; C, conscientiousness.

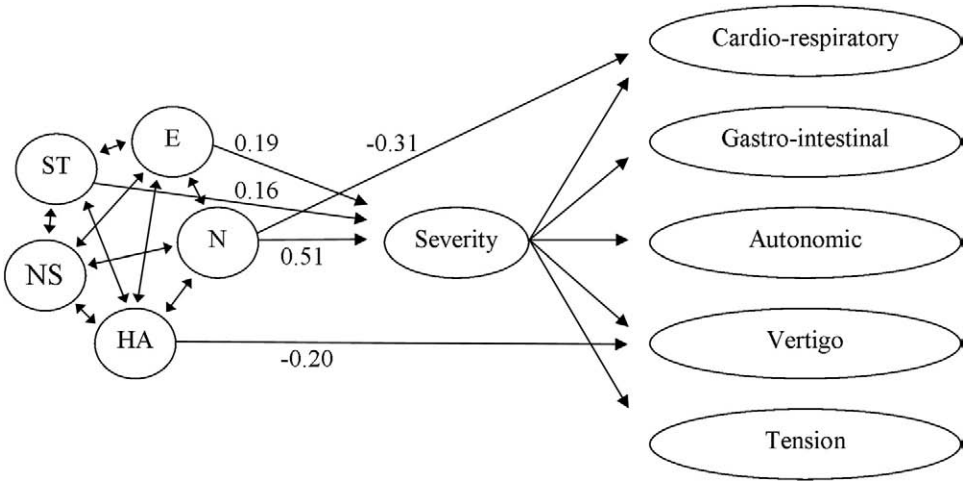

Fig. 4. Final structural model of TCI dimensions: harm avoidance (HA), novelty seeking (NS), and self-transcendence (ST); NEO PI-R scales: neuroticism (N), extraversion (E), and symptom structure. Latent constructs are in circles, one-headed arrows represent standardized regression paths, numbers on the paths are statistically significant standardized path coefficients, and 2-headed arrows represent covariances.

Models 1 and 2: novelty seeking, harm avoidance, self-transcendence, neuroticism, and extraversion. Again, we conservatively hypothesized that all personality scales would predict the general severity factor independently, and, not surprisingly, this model did not fit the data well (CFI, 0.829; SRMR, 0.152; RMSEA, 0.076 [90% CI, 0.072-0.080]). An initial Wald test suggested that paths from the TCI scales novelty seeking and harm avoidance to the severity factor could be removed without change in model fit (Δ S-B χ^2 = 0.29, *df* = 2, *P* = .866). Nine paths, suggested by the Lagrange Multiplier Test, among the scales of the NEO PI-R and the scales of the TCI improved the fit of the model (Δ S-B χ^2 = 496.56, *df* = 9, *P* = .000). In addition, a structural path from neuroticism to the cardio-respiratory first-order factor and 2 paths from harm avoidance to the first-order factors, vertigo and tension, were identified and also improved model fit substantially (Δ S-B χ^2 = 161.83, *df* = 3, *P* = .000). The Lagrange Multiplier Test suggested 2 further paths, but none resulted in a substantially better fitting model. A final Wald test suggested the path between harm avoidance and tension should be removed from the model again and this did not result in a significant deterioration of model fit (Δ S-B χ^2 = 1.04, *df* = 1, *P* = .308). The final fitted model is depicted in Fig. 4. It fits the data fairly well (CFI, 0.916; SRMR, 0.075; RMSEA, 0.054 [90% CI, 0.049-0.058]).

Neuroticism, extraversion, and self-transcendence were positively associated with the severity factor as in the previous models. Harm avoidance was negatively associated with the vertigo first-order factor, not with the tension factor as in Model 1. Neuroticism remained negatively associated with the cardio-respiratory first-order factor. The slight association between extraversion and the vertigo first-order factor included in Model 2 was not found in Model 3.

4. Discussion

4.1. Model 1 and 2

In the separate analyses of the NEO PI-R and the TCI, neuroticism and extraversion of the NEO PI-R and harm avoidance, novelty seeking, and self-transcendence of the TCI were found associated with symptom dimensions. As neuroticism and harm avoidance, as well as extraversion and novelty seeking, are associated concepts and measures, it was not surprising to find a similar pattern in both analyses. Neuroticism as well as harm avoidance predicted the severity factor as would be expected on the basis of prior research [14,19,22,25,46]. A couple of further associations also appeared: harm avoidance was positively associated with the first-order tension factor, whereas neuroticism was negatively associated with the first-order cardio-respiratory factor.

Extraversion and novelty seeking were also positively associated with the severity factor, which was more puzzling. Some of the previous studies on personality-psychopathology relationship found extraversion and novelty seeking to be negatively associated with the presence of phobia, that is, a lower level of these traits in phobic patients [1-3,20,23,24,29,32]; other studies found a higher level of these traits in samples of patients with panic disorder [11,15]; and, finally, a large number of studies failed to find an association in either direction [4,12-14,16-19,21,25,28,63,64]. Significant associations between the second-order severity factor and extraversion and novelty seeking may, to some extent, reflect differences between patients with social phobia and patients with panic disorder. Consequently, we conducted post hoc regression analyses including both primary diagnosis (panic disorder or social phobia) and extraversion or novelty seeking as variables predicting factor scores on the severity factor. With diagnosis in the model, the effects of both extraversion

and novelty seeking became insignificant, whereas primary diagnosis had an effect on severity; that is, social phobia was associated with a lower severity factor score than panic disorder (results not reported).

Finally, the TCI character dimension, self-transcendence, was positively associated with the second-order severity factor. Cloninger et al [10] initially described self-transcendence as the concept of oneself as an integral part of the universe and its source and high scorers on the dimension as wise, patient, and self-forgetful in contrast to self-conscious. Cloninger's [65] understanding of the character dimensions as measures of maturity and their stepwise development through life has been described further. His idea of what the scale measures seems at odds with our finding. Trying to understand the finding, we correlated the subscales of self-transcendence with factor scores on the severity factor and found that the first self-transcendence subscale, self-forgetful vs self-conscious, was the only subscale that correlated with severity (r = 0.23, P = .000). Although speculative, one possible explanation may be that a self-transcendent tendency to lose oneself in a situation or thought is parallel to a tendency to lose oneself in feelings or bodily sensations, hence experiencing anxiety more severely.

4.2. Model 3

When both sets of personality measures were simultaneously modeled as predictors, the NEO PI-R scales neuroticism and extraversion remained significantly associated with the severity factor, whereas the association between the TCI dimensions harm avoidance and novelty seeking, and the severity factor became nonsignificant. Despite the large positive correlation between neuroticism and harm avoidance (Table 1), there seems to be a difference between what the 2 scales measure. Post hoc analysis of correlations between the facet scales of neuroticism and factor scores on the severity factor hinted that the fourth facet scale, self-consciousness, was the only facet scale not associated with the severity factor (r = 0.07, P = .189). The remaining facet scales of neuroticism showed small, significant correlations with severity after controlling for multiple testing (r's ranging from 0.17 to 0.24, $P \leq .002$). When we correlated the subscales of harm avoidance with the general severity factor, only one of the subscales, fatigability vs vigor, was significantly correlated with severity after controlling for multiple testing (r = 0.18, P = .002). Hence, the broad measure of neuroticism, but only a subscale of harm avoidance, was associated with the symptom severity factor.

The negative association between neuroticism and the cardio-respiratory first-order factor indicated that the personality measure was differentially related to one specific subdimension of anxiety symptoms. This has at least 2 potential implications. Firstly, a heightened level of neuroticism has been associated with a wide range of psychiatric disorders [2]. Neuroticism has been argued to merely measure a person's level of distress and consequently be a noninformative marker of vulnerability to psychopathology [66]. If neuroticism can be shown to be associated with specific symptom dimensions and not just with a general severity factor, it may still have a role to play in phenotype definition.

Secondly, a respiratory subtype of panic disorder has received attention in a number of studies of treatment [35,67,68] and of neurobiological vulnerability [69,70]. Briggs et al [35] have proposed a respiratory subtype on the basis of factor and cluster analysis defined by the presence of at least 4 of 5 predominantly respiratory symptoms. This respiratory subtype has been found to be positively associated with a number of clinical characteristics, some of which may indicate severity of panic disorder: frequent spontaneous panic attacks [35,69], work impairment [35], amount of treatment required [67], nocturnal panic attacks [69], and family history of panic disorder [68,71]. Furthermore, the respiratory subtype has also been found to be associated with higher scores on the Anxiety Sensitivity Index [72], a measure related to some extent to neuroticism [73]. Our finding of a negative association between a cardio-respiratory factor and neuroticism may at a glance seem contradictory to this prior finding. Nevertheless, neuroticism is more strongly associated with the severity factor than with the cardio-respiratory factor in our study. Therefore, if we had not included a general severity factor in our model, a cardio-respiratory factor confounded by general severity would most likely have appeared to be positively associated with neuroticism. Including a second-order severity factor changes the picture because it enables us to pry out the specific effects of each first-order factor.

4.3. Limitations

We assessed the presence of a lifetime diagnosis of panic disorder, agoraphobia, or social phobia in both our samples, but only further assessed the presence of a current diagnosis in sample 1. Therefore, we could only test our findings for possible state effects in sample 1. Scores on harm avoidance and neuroticism have typically been found to change during treatment and to be related to acuity of affective disorders [2,14,24,74]. Post hoc regression analyses were conducted including both acuity of an anxiety disorder (current diagnoses of panic disorder, agoraphobia, or social phobia, or none of these disorders at time of interview) and neuroticism or harm avoidance as predictors of the severity factor. Those with current diagnoses had higher scores on both neuroticism and harm avoidance, but the acuity of an anxiety disorder was not significantly associated with severity when neuroticism or harm avoidance was taken into account. Both traits were still significantly associated with severity (results not reported).

Our sample was recruited through advertisements, pamphlets, and a website, clearly indicating that we were looking for individuals who had had panic disorder, agoraphobia, or social phobia before the age of 21. As this

entails potential sampling bias, future studies should be conducted on less selected samples. However, the included patients had no comorbid bipolar disorder, obsessive-compulsive disorder, schizophrenia, or psychotic symptoms, making it a pure anxiety disorders sample.

Finally, the sample used in the present study was cross-sectional and, as such, did not provide us with knowledge about the mechanisms involved in the development of either personality or bodily anxiety symptoms. Personality and psychopathology may be associated for a number of reasons, and the possible effects of personality on the development of anxiety symptoms may involve complex, nonlinear interactions among personality dimensions. Hopefully, future longitudinal studies will provide more knowledge about the direction, as well as the complexity, of the relationship between personality and anxiety symptoms.

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