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Temperament and Character Inventory in the Diagnosis of Personality Disorder

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ABSTRACT

Introduction: The Temperament and Character Inventory (TCI) is a self-report questionnaire that is theoretically able to provide both a categorical and a dimensional diagnosis of personality disorder. In keeping with Cloninger's theoretical model, according to which there is a linkage between personality disorders and character dimensions, (1) we investigated the relationships of TCI dimensions with personality disorders. Then (2) we tested the diagnostic accuracy of the TCI in the categorical diagnosis of any personality disorders using Cloninger's proposed cutoff. Finally, (3) we evaluated the efficiency of alternatives cutoffs.

Method: Through a retrospective observational study, a sample of 159 outpatients was assessed with the TCI, the Structured Clinical Interview for DSM-IV Axis II Personality Disorders (SCID-II), and the Mini International Neuropsychiatric Interview Plus version.

Results: Self-Directedness and Cooperativeness were meaningfully associated with the presence of personality disorders, although personality disorders were not exclusively explained by character dimensions. We found adequate agreement between TCI and the SCID-II diagnosis of personality disorders.

Discussion: In our sample personality disorders were better identified when a measure of impairment of the self, Self-Directedness, was combined with a measure of impairment of the interpersonal functioning, namely Cooperativeness or Reward-Dependence. Our results support the use of the TCI to assess personality pathology in both a categorical and a dimensional framework.

KEYWORDS: Dimensional Diagnosis; Categorical Diagnosis; Temperament and Character Inventory; Personality Disorder; Sensitivity and Specificity.

INTRODUCTION

The Temperament and Character Inventory is designed to assess differences between people on the basis of a psychobiological model of personality, defined as the result of a dynamic interaction between four *temperament* dimensions and three *character* dimensions [1, 2]. The four temperament scales are Novelty Seeking (NS), Harm Avoidance (HA), Reward Dependence (RD), and Persistence (P); the three character scales are Self-Directedness (SD), Cooperativeness (CO), and Self-Transcendence (ST).

Cloninger, the TCI's author, described various clinical and epidemiological applications of the TCI, one of them being the diagnosis of personality disorder (PD). Beside a dimensional model of PD classification, Cloninger suggests the use of the TCI as PD categorical diagnostic tool by adding specific cutoffs to a two-stage diagnostic process in which character dimensions measure whether an individual has a PD, while temperament dimensions define the subtype of PDs; see Method section for a description of the cut-off proposed by Cloninger) [1].

Several studies investigated the relationship between TCI di-

mensions and Diagnostic and Statistical Manual of Mental Disorders PDs (DSM; American Psychiatric Association [APA] [3-17]. In general, these findings suggest that SD is strongly associated with the diagnosis of any PDs, although the association between CO and PDs are less consistent. A minority of the cited studies also evaluated the diagnostic accuracy of the TCI in the categorical diagnosis of PDs, using specific cutoffs and measuring sensitivity and specificity statistics of the questionnaire[4,10,11]. Different cutoffs were evaluated with both SD and CO scales together or separately. Notably, not one of those studies used the cutoff proposed by Cloninger in TCI manual [1].

An open debate in the diagnosis of PDs concerns the comparison between the dimensional approach and the more common categorical approach described in the various version of the DSM [16-19]. While the DSM-5 has retained the same categorical diagnoses as in the DSM-IV-TR there also exists an alternative dimensional model for PD diagnosis in a separate section of the manual (see Section III-Emerging Measures and Models) [20]. The two methods of PDs classification (i.e., categorical and dimensional) are not exclusive, and one of the possibilities is to convert a dimensional model into a categorical model by applying cutoffs, which is already provided in the TCI [21, 22].

For these reasons, it seems particularly interesting to investigate the diagnostic features of the TCI, a self-report questionnaire that combines the categorical and dimensional approaches in the diagnosis of PDs. In keeping with Cloninger's theoretical model, according to which there is an association between any PD and low scores on character dimensions SD and CO, our aims of this study were threefold. First, we investigated the relationship between PDs, irrespective of subtype, and TCI dimensions. Second, we evaluated the diagnostic accuracy of the TCI as a categorical diagnostic test of the presence of PDs, regardless of subtype, using Cloninger's proposed cutoff. Third, with exploratory purposes and in order to improve the efficiency of TCI as categorical diagnostic tool in the diagnosis of any PD, we evaluated the diagnostic categorical ability of the TCI using alternatives cutoff scores that were based upon the results we obtained.

METHODS

Participants

This study included 159 outpatients (67 men, 92 women, M_{age} = 40.75 years; range = 17–68 years) attending the Outpatient Psychiatric Services, Psychodiagnostic Unit of Santa Maria della Misericordia Hospital in Perugia, from 2008 to 2011. The inclusion criteria were that participants must be adults, 18 years or older, and literate. The exclusion criteria were any significant medical condition (i.e., known mental retardation, neurocognitive disorders) that could compromise the patients' ability to understand or complete the tests. Five patients (3%) were excluded from the study, one for cognitive impairment and four for non-completion of the tests. There were no sociodemographic differences between the subjects who were excluded and included in the final sample.

Measures

Temperament and Character Inventory: The TCI is a self-report questionnaire comprising a series of 240 statements including questions on tastes, interests, emotional reactions, attitudes, goals, and values. Participants answer questions with *true/false* responses [1]. TCI results can be scored alternatively as raw score, T score and percentile score, and a conversion table between these three measures is provided, (Chapter 24) [1]. The conversion table is based on the score obtained in a standardization sample of 300 adults, called community sample; Cloninger state it is representative of the general population and supports the reliability and structure of the TCI dimensions (Chapter 8) [1, 2]. To determine the TCI's diagnosis of PDs, we referred to the cutoff proposed by Cloninger: scores below 33rd percentile scores on both SD and CO indicate the presence of PD (regardless of subtype) [1]. This cutoff score was derived from previous studies conducted in clinical settings in which consistently reported low scores on SD and CO dimensions in subjects with PDs [1]. Therefore, we assigned a TCI diagnosis of PD if a participant had a raw score below 27 on SD and below 29 on CO, corresponding to 33rd percentile score respectively on SD and CO [1].

Structured Clinical Interview for DSM-IV Axis II personality disorders (SCID-II): The SCID-II is a semi-structured assessment for PD diagnoses organized according to the DSM diagnostic categories with a minimum number of criteria to formulate each specific diagnosis. Validity, reliability and internal consistency of the scale have been demonstrated [23, 24].

Mini International Neuropsychiatric Interview Plus version: The MINI Plus is a structured diagnostic interview that allows the diagnosis of twenty-four current and "lifetime" Axis I disorders through the administration of applications and the use of hierarchical rules in case of comorbidities. Validity of the M.I.N.I. Plus and its Italian version was demonstrated with respect to the DSM-IV criteria [17, 25, 26].

PROCEDURE

This is a retrospective observational study approved from regional Ethics Committee (i.e., CEAS Umbria) which covers Santa Maria della Misericordia Hospital. All information was collected from clinical records. SCID-II and M.I.N.I. Plus are routinely administered to patients coming to the Psychodi-

agnostic Unit, as diagnostic instrument respectively of Axis II and Axis I disorders. During the period 2008-2011 TCI was also administered to all patients coming to the unit as a supplemental clinical instrument. A team of experienced clinicians administered the psychiatric evaluations, conducted a semi-structured/structured diagnostic interview, and diagnosed the patients.

Data Analysis

All statistical analyses were performed in SAS 9.3 for Windows. We considered as study variables the seven TCI raw scores (NS, HA, RD, P, SD, CO, ST), the PD diagnosis according to SCID-II criteria and finally the PD diagnosis according to the TCI's categorical cutoff proposed by Cloninger[1]. Both PD diagnosis are binary variables taking the value of 1 or 0, where 1 is a positive and 0 is a negative answer.

Descriptive statistics for the study variables were computed, and TCI score distributions were analyzed. Cross tabulation tables were created, and Pearson's χ^2 test or Fisher's exact test were computed to determine if an association existed between diagnosis of PDs provided by SCID-II and by TCI. The Kappa coefficient was also calculated to assess the agreement between TCI and SCID-II diagnoses. Mean differences in TCI scales between participants with and without PDs according to SCID-II were evaluated using Student's t-test.

In order to establish which relationship exists between SCID-II diagnosis of PDs and each TCI score, univariable logistic regression models were performed. The significance of the coefficients were tested by χ^2 Wald statistics. In addition, two logistic regression models were developed to evaluate which TCI scores would better explain the SCID-II diagnosis of PDs. The first model (Model I) considered SCID-II diagnosis of PDs as the outcome variable, and selected as covariates the TCI scores (both temperament and character dimensions) which had a p-value less than 0.25 in the univariable analysis. The second model (Model II) considered SCID-II diagnosis of PDs as the outcome variable, and selected as covariates the only TCI character dimensions which had a p-value less than 0.25 in the univariable analysis. We chose as model building method the stepwise selection of covariates. The selection process uses the Wald χ^2 test, and the significant level to stay in the model was fixed at a probability equal 0.05. Collinearity was assessed by analyzing the correlation matrix of all independent variables. The assumption of linearity for each continuous variable was addressed using the designed variables method suggested by Hosmer, Lemeshow and Sturdivant [20]. We compared the two models through ROC Curves, testing differences between the AUC; Misclassification tables were also used. Furthermore, diagnostic indices were considered (Sensitivity, Specificity, Hit Rate, negative and positive predictive values, and the Gini Index) to assess the predictive ability of the models. We tested different cutoffs on the basis of the two models. The point at which the ROC curve had the maximum distance from the bisecting line, which corresponds to the best combination of sensitivity and specificity, was chosen as the best cut-off point.

RESULTS

In this sample, 51 (32.08%) participants were diagnosed with a PD according to SCID-II, whereas 119 (74.84%) participants were diagnosed with at least one Axis I disorder according to M.I.N.I. Plus. All types of PDs were represented (see Table 1 for a complete list of all diagnoses using the DSM-IV classification). At the time of the evaluation, 31 (19.50%) participants did not meet criteria for an Axis I or II disorder (according to SCID-II or M.I.N.I. Plus), whereas 42 (26.42%) participants had comorbid PDs and Axis I disorders. Only nine (5.66%) participants were diagnosed with a PD without a comorbid Axis I diagnosis, whereas 77 (48.43 %) participants had at least one Axis I diagnosis without a PD.

Table 1: DSM-IV Axis I and Axis II Disorders.

	N
Axis I	
Psychotic disorders	8
Mood disorders	39
Anxiety disorders	42
Eating disorders	12
Somatoform disorders	3
Dissociative disorders	1
Adjustment disorders	12
Substance-related disorders	1
Axis II	
Cluster A	6
Paranoid	5
Schizoid	1
Cluster B	25
Antisocial	1
Borderline	20
Narcissistic	4
Cluster C	15
Avoidant	6
Dependent	4
Obsessive-compulsive	5
Not Otherwise Specified	5
Passive-aggressive	5

The mean values of the TCI scales were compared betwee participants with and without SCID-II diagnosis of PDs (Table 2). Among patients with PD diagnosis there was a significant

Table 2: Mean Comparisons among TCI dimensions in Patients with and without a Personality Disorder according to SCID-II.

	PD-		PD+				
	MEAN	STD	MEAN	STD	Cohen's d	t-value	p > |t|
NS	17.74	4.83	17.31	5.79	0.08	0.49	0.63
HA	19.79	8.35	25.16	5.88	-0.74	-4.13	<.01
RD	14.34	3.50	12.94	4.20	0.36	2.21	0.04
P	4.35	2.00	4.02	3.50	0.12	1.00	0.32
SD	28.67	7.94	19.73	7.47	1.16	6.75	<.01
CO	31.29	6.47	25.67	7.00	0.83	4.98	<.01
ST	13.19	6.81	13.39	5.90	-0.03	-0.18	0.87

Note: Significant values (p<0.05) are shown in boldface. PD- = participants without a diagnosis of PD according to SCID-II; PD+ = participants with a diagnosis of PD according to SCID-II; STD=Standard Deviation; Cohen's d=Cohen's distance.

higher value on HA and significant lower values on RD, SD, and CO.

According to the Cloninger's established TCI cutoff, 50 patients (31.45 %) had a diagnosis of at least one PD. The cross-instrument agreement for the presence-absence of PDs was significant (Pearson $\chi^2 = 29.98$, $p \leq 0.01$). This result is corroborated by the kappa coefficient of 0.43 (95% confidence interval, 0.28 - 0.58). The specificity and sensitivity of the TCI were 82.40 and 60.78, respectively. The false negative rate was 18.35, the false positive rate was 38.00 and the correct rate 75.47.

The univariable logistic regression analyses, showed that HA, RD, SD, and CO had a significant ($P > \chi^2 < 0.05$) linear relationship with the probability of PDs (as described in Table 3).

Table 3: Univariable Logistic Regression Model. Probabilities of TCI dimensions to predict the presence of personality disorders according to SCID-II diagnosis.

	Coefficient	STE	OR	95%CI	χ2	Prob > χ2
NS	-0.02	0.03	0.98	0.92 -1.05	0.24	0.62
HA	0.10	0.03	1.10	1.05-1.16	14.22	0.01
RD	-0.10	0.05	0.90	0.82 -0.99	4.62	0.03
P	-0.09	0.09	0.91	0.76-1.09	1.00	0.32
SD	-0.14	0.03	0.87	0.83-0.92	28.50	<.01
CO	-0.12	0.03	0.89	0.84-0.94	18.86	<.01
ST	0.01	0.03	1.01	0.96-1.06	0.03	0.86

Note: Significant value (p<0.05) are shown in boldface. STE=Standard Error; OR=Odds ratio; CI=Confidence Interval .

The first multiple logistic model (Model I) highlighted, as significant predictive variables of PDs, SD and RD: as SD increases by one unit, the probability of PD decreases by 14% ($P > \chi^2 < 0.01$, OR = 0.87, 95% CI: 0.82 | 0.91), whereas a one-unit increase in RD results in an 11% decrease in the probability of PD ($P > \chi^2 = 0.02$, OR = 0.89, 95%CI = 0.80 | 0.99). The best cutoff point for this model was found for a predicted probability equal to 0.56 ($e^{4.3451-0.1448*SD-0.1167*RD}/1+e^{4.3451-0.1448*SD-0.1167*RD}$). With this cutoff point, the correct rate of PDs diagnosis was 75.47, the sensitivity was equal to 43.14, the specificity was equal to 90.74, and the false positive and false negative rates were 31.25 and 22.83, respectively. At this cutoff point, the SD and RD sum of raw scores corresponded to 30, meaning that a sum lower than 30 indicated a PD diagnosis. In some cases, we noticed that low levels of SD were offset by high levels of RD and vice versa.

The model described above highlights a character (SD) and a temperament (RD) scales as significant predictors of PDs, while, with respect to Cloninger's theoretical system, only character dimensions determine the presence or absence of PDs. For this reason, we explored the possibility of a second multiple model (Model II) considering as covariates only the character dimensions. The results showed significant only the SD scale, which is the univariable model. For this model the best combination of sensitivity and specificity was found for a predicted probability equal to 0.58 ($e^{2.6338-0.1401*SD}/1+e^{2.6338-0.1401*SD}$), corresponding to an SD raw score equal to 17. With this cutoff an accurate PD diagnosis would occur with a probability equal to 73.58, a sensitivity equal to 35.29, a specificity equal to 91.74, and a false positive and false negative rate equal to 33.33 and 25.00, respectively.

We compared the two models (Figure 1), Model I had a lower AIC value (161.127 vs 164.55), a greater Negelkerke R^2 (0.3408 vs. 0.3041), a higher Concordant rate (0.81 vs. 0.79), and a higher Gini Index (0.6191 vs. 0.5797) and a greater area under the ROC Curve.

Discussion and Conclusion

Our findings support the prevailing assertion that SD and CO are meaningfully associated with the presence of PDs [2, 5, 8, 15]. As in our results previous studies reported lower scores on RD in participants with PDs compared to those without PDs [9, 11]. The association between RD and PDs is confirmed by the logistic model we further discuss. The association we found between HA and PDs is likely due to the high comorbid-

ity between PDs and Axis I disorders reported in our sample. The relationship between high scores on HA and Axis I disorders is consistently found in the literature [2, 3, 10, 27, 28]. Axis I disorders increase HA score, decrease SD and CO scores (Cloninger et al., 1994; Fassino et al., 2013), and generally blunt the TCI ability to detect PDs [1, 11, 15, 26]. Thus, the high rate of comorbidity conditions could explain the discrepancies between our results and Cloninger's predictions with regard to the fact that, in our sample, PDs are not exclusively explained by character dimensions.

Figure 1: ROC curves for comperisons between Model I and Model II: the firest considers as explanatory variables of personality disorder SD and RD, the second only the charater variable SD.

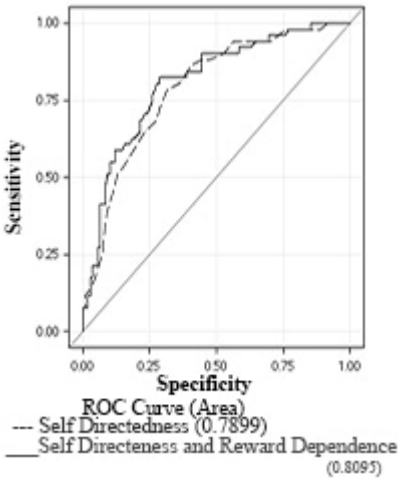

Figure 1: Combined use of self-Directedness and Reward Dependence had the greatest area and therefore a better ability then Self-Directedness by itself to discriminate between participants diagnosed with Personality Disorder and those who did not according to SCID-II.

Pertaining to our second aim, we found significant K coefficient, which suggests marginal to adequate agreement between TCI and the SCID-II diagnosis [29]. The categorical diagnostic accuracy of the TCI is comparable to previously reported: 75.47 (hit rate; our results), 77.0 [11]. To the best of our knowledge, the study is the only who tested a cutoff based on the combined score of SD and CO. [11] used a cutoff based only on SD scale, while Gutierrez et al. (2002) tested three different cutoffs, one for each of the character dimension [4].

Lastly, we tested the diagnostic categorical efficiency of two alternatives cutoffs. Multiple logistic regression confirm how SD is the most consistent dimension associated with PDs and reiterates the linkage between RD and the diagnosis of PDs. CO and RD dimensions measure some similar features of behavior, that is tendency to empathy, compassion and secure attachment and they could be generally considered both measures of interpersonal functioning. It might be reasonable that, in the multiple logistic regression, where they both compete in predicting the presence of PDs, the "role" of CO is somehow fulfilled by RD, despite CO showed a greater significance in the univariable analysis[1, 7, 9, 12, 14].

Looking at the diagnostic efficiency of the two alternatives cutoffs, the TCI demonstrated with both cutoffs high specificity and mediocre sensitivity. When we compared the two models (Figure 1), the one considering both SD and RD (i.e., Model I), showed a better ability to detect PDs (greater hit rate) and better sensitivity than the model considering the only SD dimension (i.e., Model II), despite a very slight difference in specificity between the two cutoffs.

According to our results, SD, although being the most significant TCI dimension associated with PDs, was not able to detect by itself the presence of PDs, nor dimensionally nor categorically. On the other hand, SD, alongside with CO, showed the strongest relationship with the presence of PDs, and, alongside with RD, resulted as the best predictor of PDs. Consistently, both combined cutoffs, SD/CO and SD/RD, demonstrated higher accuracy than the individual use of SD. In other words, in our sample, participants with a diagnosis of PD seem to be better identified when a measure of the impairment of the self is combined with a measure of the impairment of interpersonal functioning. This assertion complies with Cloninger's theoretical model, but, in keeping with our results, further research is needed to evaluate how this latter purpose could be accounted by CO dimension alone or along with other dimensions (i.e., RD).

In addition, the evaluation of personality functioning through an assessment of the self and interpersonal domains is in agreement with alternative DSM-5 model for PDs and with a recent literature review of measures of personality psychopathology [20,30]. Thus, our findings reiterate the validity of assessing personality functioning from a self-other prospective and, at same time, confirm the soundness of the principles underlying the TCI theoretical model.

In conclusion, our results support the use of the TCI to assess personality pathology, from both a categorical and dimensional framework (in detecting any PD but not subtypes of PDs).

Our study is subject to a number of limitations. SCID-II scores were not available, and therefore we referred only to SCID-II diagnosis of PDs. The sample size did not allow verifying the associations between subtypes of PDs and TCI scores, as proposed by Cloninger, neither to conduct further analysis in testing the associations between clusters of PDs and TCI temperament dimensions [1]. Finally, the SCID-II was considered

the criterion measures against which TCI scores were evaluated and we referred to the SCID-II diagnosis to check the accuracy of the TCI as a categorical diagnostic tool. Plenty of other semi-structured interviews for PD assessment should be considered besides the SCID-II, and this will be the object of future developments with the aim of testing whether the TCI could be adequately used in the diagnostic process [34, 35]. For these reasons, our findings should be carefully taken into account and considered as a starting point for future investigations.

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