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**Psychometric properties and factor structure of the Temperament and Character Inventory – Revised (TCI – R) in a Croatian psychiatric outpatient sample**

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Running head: Croatian adaptation of the Temperament and Character Inventory – Revised (TCI – R)

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## **Abstract**

**Objective:** The goal of this study was to investigate psychometric properties and factorial structure of the Croatian adaptation of the Temperament and Character Inventory - Revised (TCI-R) in a sample of psychiatric outpatients (n=328).

**Method:** The participants filled out the TCI-R, as well as self-report measures of the Big-Five personality traits (IPIP-50), trait impulsivity (BIS-11), depression (BDI-II), suicidality (SBQ-R), and life satisfaction (SWLS). We explored the internal consistency of 7 domains and 29 subscales and compared it with the Croatian version of the original TCI used in prior studies. Principal component analysis with promax rotation was conducted on temperament and character subscales separately, while concurrent validity was examined through the TCI-R's relations with the abovementioned psychological measures.

**Results:** The TCI-R scales showed adequate internal consistencies, with Cronbach's alpha values ranging from 0.77 to 0.93. The internal consistency showed to be higher in comparison with the Croatian version of the original TCI. The postulated four-factor structure of temperament and the three-factor structure of character were confirmed. The meaningful associations with other measures supported the concurrent validity of the TCI-R.

**Conclusion:** The Croatian adaptation of the TCI-R exhibited satisfactory reliability and validity in a sample of psychiatric outpatients. These findings support the use of the TCI-R in Croatian clinical settings over its predecessor (TCI).

**Keywords:** temperament, character, TCI-R, personality inventory, psychometric validation

## 1. Introduction

### *1.1. Cloninger's psychobiological model of personality and the Temperament and Character Inventory*

The Psychobiological Model of Personality, developed by C. Robert Cloninger and his colleagues [1], is derived from and integrates various scientific perspectives, including psychology, neurobiology, and psychopathology [2-3]. It is structured around 4 temperament dimensions (which can be thought of as the "biological core" of personality) and 3 character dimensions (i.e. "adaptive interface" of personality). Temperament is defined as individual differences in pre-conceptual emotional reactions, hypothesized to be based on unconscious procedural memory and learning. Temperament traits are independently heritable, manifest early in life, and are relatively stable throughout life [4]. The 4 independent temperament dimensions are as follows: Novelty Seeking (NS), Harm Avoidance (HA), Reward Dependence (RD), and Persistence (PS). NS is a measure of behavioral activation as it reflects the experience of intense excitement in response to novel and complex stimuli, or cues, that signal reward. HA, on the other hand, is a measure of behavioral inhibition associated with anxiety-proneness in the context of cues that signal punishment, uncertainty, or frustration. RD is linked to social relatedness and dependence, as it reflects individual differences in sensitivity to signals of social approval. PS measures individual differences in perseverance, i.e. resilience to extinction of behavior despite frustrative non-reward and fatigue.

Character is conceptualized as individual differences in higher cognitive processes (i.e. life goals and values) and, as such, includes responses to different aspects of one's own identity or self experiences. It is thought to develop as a nonlinear function of early temperament traits, socio-cultural factors, and individuals' unique life events, while being encoded in propositional memory and learning processes (episodic and semantic) [5-6]. The 3 character dimensions are as follows: Self-Directedness (SD), Cooperativeness (CO), and Self-Transcendence (ST). SD refers to one's awareness of being an autonomous individual and fulfilling life goals in a purposeful and responsible way. CO reflects the person's view of oneself as an integral part of the society and measures the levels of empathy, compassion and identification with other people. Lastly, ST reflects the sense of being an integral part of the universe through feelings of self-forgetfulness and spiritual identification with things outside the individual self. These character dimensions facilitate one's adaptation to the social environment and are clinically useful in establishing the probability of the presence of personality disorders [4,7].

Initially, Cloninger's model of personality consisted of three temperament dimensions - NS, HA, and RD, operationalized through the 100-item self-report Tridimensional Personality Questionnaire (TPQ) [8]. PS was a facet of RD in the original model but was later added as a fourth temperament dimension after multiple factor analytical studies confirmed its independent nature [1]. Cloninger's initial model was subsequently revised and the three character dimensions (SD, CO, and ST) were added to the four-dimensional model of temperament. In order to operationalize the measurement of the newly developed 7-factor personality model (4 temperament and 3 character dimensions), the Temperament and Character Inventory (TCI) was designed in 1993, and the manual became available in 1994 [9]. The TCI is a 240-item self-report instrument consisting of 7 higher-order and 25 lower-order scales, with a true/false response format. Despite its clinical relevance and use in thousands of peer-reviewed publications from various scientific disciplines [10], there was a need for further enhancement of the 25 lower-order traits and the increase of items tapping the content of PS and RD because these two higher-order scales showed somewhat inadequate internal consistencies [11].

Based on the abovementioned shortcomings, Cloninger [12] developed a refined version of the original TCI, the so-called Temperament and Character Inventory-Revised (TCI-R). The most noticeable modifications in TCI - R included the replacement of the true/false response format with the 5-point Likert scale; increased number of subscales that measure PS and RD (4 facets per each); same overall number of items but 189 unmodified and 51 new or rewritten items, including 5 validity items [10]. Studies that sought to compare psychometric properties of the TCI and TCI - R, concluded that the revised version of the instrument exhibited increased internal reliability coefficients for all seven scales and improved factor loadings for PS and RD [11,13-15].

### *1.2. Psychometric properties of the Temperament and Character Inventory-Revised*

The TCI-R has been translated into different languages, while its psychometric properties have been evaluated in samples from various countries, such as Belgium [16], Brazil [17], Czech Republic [15,18], Hungary [19], Italy [11], Serbia [20], and the United States [10]. However, of all such studies, only two have been carried out using clinical samples: 333 French psychiatric out- and inpatients [14] and 504 Italian psychiatric outpatients [11]. Thus, the application of the TCI-R in different clinical populations, including psychiatric patients, needs to be further supported by empirical validation studies.

Previous research has demonstrated satisfactory internal reliability coefficients for all 7 TCI-R dimensions, with PS and HA having the highest and NS and RD having the lowest internal reliabilities [19]. Cronbach's alpha values are generally lower for the 29 lower-order scales, although these values are considered adequate in the case of subscales with a limited number of items. Furthermore, the TCI-R has exhibited mostly satisfactory test-retest reliabilities for periods ranging from one week to six months, including those obtained on relatively small subsamples of psychiatric patients [11,14]. However, in the study conducted by Fossati et al [11], NS scale had only modest test-retest correlation coefficient (0.52) in a four-week interval, although the change in NS could be partly reflecting the impact of psychotherapy.

Majority of the validation studies used exploratory factor analysis (EFA) to examine the structure of the TCI-R and, based on the robust non-linear interactions between the two domains of temperament and character [2,5], they were factor-analyzed separately. In most cases, the postulated 7-factor personality structure with 4 temperament and 3 character dimensions, was confirmed [14,16,19,21], although one study documented inadequate structure for character dimensions [15]. However, the findings of these studies converged on some of the psychometric shortcomings of the TCI-R, most notably unsatisfactory factor loadings of some of the lower-order scales (NS1, RD1 and RD4, and SD4). Furthermore, Fossati et al [11] have confirmed the 7 factor structure in a sample of psychiatric outpatients, but it should be noted that many facets showed factorial complexity. Finally, two studies that conducted a more stringent technique- confirmatory factor analysis (CFA) - found an inadequate fit between the obtained factorial structure and the postulated 7 dimensions [10,22], although the use of CFA in personality research has been called into question [5,23]. Overall, although the TCI-R possesses superior psychometric properties over its predecessor (TCI), previous research using various factor-analytic techniques has pointed out its complex and somewhat inconsistent factorial structure. Thus, further empirical studies are needed to shed more light on the TCI-R psychometric properties, especially in clinical populations from various cultural settings. The exploration of the TCI-R in different cultural contexts is particularly needed given its applicability in the assessment of personality disorders [4] and

the well-known impact of cultural factors on the definition, measurement, and expression of personality pathology [24].

Previous psychometric research demonstrated mostly adequate concurrent validity of the TCI-R using measures of various psychological constructs. Only one such study has included a measure of general personality dimensions (e.g., the Big-Five) [19] documenting theoretically meaningful relations between the two personality inventories. Moreover, the comparison with the Big-Five model, another prominent theory of human personality, could shed more light on the points of agreement and disagreement between these two perspectives that cannot be considered conceptually equivalent. Other validation studies have investigated the relationships between the TCI-R and acute mental disturbances (e.g., depression, anxiety) [17], some aspects of well-being (e.g., life satisfaction) [17], and specific personality traits (e.g., impulsivity, aggression) [21]. Considering the need to provide further empirical evidence of the cross-cultural stability of the TCI-R, as well as some potential cultural variations, relations with measures of such relevant psychological constructs should be examined in different cultural contexts.

In Croatia, there have been no validation studies conducted with either the TCI or the TCI-R, at least none that have resulted in peer-reviewed publications. However, there are several studies that used the TCI in a sample of 120 schizophrenia patients and 240 control subjects [25,26] and 90 lung cancer patients [27]. The authors of these studies did not focus on psychometric properties of the TCI, although they reported the following internal reliability coefficients obtained in a diverse sample of 360 participants: NS (0.66), HA (0.79), RD (0.52), PS (0.47), SD (0.85), CO (0.70), and ST (0.81). It was concluded that the Cronbach's alpha coefficients are comparable to those in the TCI literature, namely the reduced values for PS and RD [26].

### *1.3. Objectives of the study*

The general objective of the current study was to investigate psychometric properties and factorial structure of the Croatian adaptation of the TCI-R in a sample of psychiatric outpatients. The first aim was to examine internal reliabilities, inter-correlations, and possible gender differences among the seven TCI-R dimensions of temperament and character. The second aim was to explore the factor structure of the TCI-R by conducting exploratory factor analysis with promax rotation. The final objective was to test the concurrent validity of the TCI-R via its associations with relevant measures of the Big-Five personality dimensions, trait impulsivity, depression, suicidality, and life satisfaction.

## **2. Methods**

### *2.1. Participants*

Participants in this study were 328 Caucasian adults seeking outpatient psychiatric treatment at two mental health hospitals in Zagreb, Croatia. All data were collected between February 2013 and March 2014. Patients were approached by their psychiatrists, and those who agreed to participate completed the battery of self-report measures, while waiting for their appointments, after the appointments had ended, or at home. No further participation was required. While 24 patients refused to participate, no differences in gender and age between these patients and those taking part in this study were observed.

Of the 328 participants, 189 (57.6%) were female. The mean age of the sample was 44.25 years ( $SD=12.4$  years). Regarding their educational status, 33 (10.1%) participants had completed elementary school, 203 (61.9%) had completed high-school and 92 (28%) held a college degree. In terms of employment, 168 participants (51.2%) were employed, 75 (22.9%) were unemployed, 58 (17.7%) were retired and 27 (8.2%) were students. Finally, the sample consisted of 185 (56.4%) married participants, 103 (31.4%) single participants, 32 (9.8%) divorced and 8 (2.4%) widowed participants.

The primary psychiatric diagnosis of the patients was determined using the ICD-10 diagnostic criteria [28] and involved a consensus between the attending psychiatrists and clinical psychologists. The prevalence of all diagnoses was as follows: depressive disorders ( $n=112$ ; 34%), anxiety disorders ( $n=72$ ; 22%), post-traumatic stress disorder ( $n=46$ ; 14%), adjustment disorder ( $n=40$ ; 12%), psychoactive substance use disorders ( $n=20$ ; 6%), eating disorders ( $n=16$ ; 5%), psychotic disorder ( $n=16$ ; 5%), and bipolar affective disorder ( $n=7$ ; 2%). Because this study did not include the use of structured clinical interviews, comorbid psychiatric and personality disorder (PD) diagnoses were not determined. Patients affected by a neurological disorder, organic mental disorder, acute psychotic disorder, mental retardation and those with low comprehension skills were not enrolled. Patients' written informed consent was obtained after the research protocol was thoroughly explained. This study was officially approved by the Ethical Committee of the institution in which the research was carried out.

## 2.2. Measures

The Temperament and Character Inventory-Revised (TCI-R) [12] is a self-report questionnaire designed to measure 4 temperament (Novelty seeking (NS), Harm Avoidance (HA), Reward Dependence (RD), and Persistence (PS)) and 3 character dimensions (Self-Directedness (SD), Cooperativeness (CO), and Self-Transcendence (ST)) within the Psychobiological Model of Personality [1]. Each of the 7 major dimensions contains several subscales (29 facets overall), as can be seen in Table 1. The questionnaire is made up of 240 items (235 research items and 5 validation items for the assessment of response accuracy and carelessness). All the items are rated on a 5-point Likert scale, ranging from 1 (*definitely false*) to 5 (*definitely true*).

The TCI-R was translated from English to Croatian independently by N. J. and B. A. M., and all initial discrepancies were resolved by a consensus between the two translators. The instrument was then back-translated to English by an experienced bilingual translator, after which several minor inconsistencies were amended through a discussion between the initial two translators and the back-translator. Finally, the translated Croatian questionnaire was reviewed by D. Svrakic, one of the coauthors of this paper and the TCI, who helped slightly modify several items so they would be more in line with the cultural context.

The International Personality Item Pool-50 (IPIP-50) [29] was used to assess the Big-Five personality dimension: *Extraversion*, *Agreeableness*, *Consciousness*, *Emotional Stability*, and *Intellect*. The IPIP-50 consists of 50 items (10 items for each of the 5 dimensions) that are rated on a 5-point scale, ranging from 1 (*very inaccurate*) to 5 (*very accurate*). The IPIP-50 has been previously translated and validated in a Croatian normative sample [29]. In the present study, Cronbach's alpha coefficients were 0.86 (Extraversion), 0.83 (Agreeableness), 0.76 (Consciousness), 0.91 (Emotional Stability), and 0.83 (Intellect).

The Barratt Impulsiveness Scale-11 (BIS-11) [30] is a self-report instrument developed to assess the personality/behavioral construct of impulsivity. It consists of 30 items that are scored on a 4-point scale from 1 (*rarely/never*) to 4 (*almost always/always*). The questionnaire contains three subscales (Attentional Impulsiveness, Motor Impulsiveness, and



Nonplanning Impulsiveness) that can be summed into a global impulsiveness score. In the present study, Cronbach's alpha coefficients were 0.83 (Global Impulsiveness), 0.78 (Attentional Impulsiveness), 0.58 (Motor Impulsiveness), and 0.73 (Nonplanning Impulsiveness).

The Beck Depression Inventory-Second Edition (BDI-II) [31] is a self-report measure used for the examination of the presence and severity of depressive symptoms. It contains 21 items in the form of statements that describe these symptoms. For each item, respondents are offered 4 statements and are asked to select the statement that best describes their mood in the last two weeks. It is measured on a 4-point scale, with higher scores indicating greater severity of depressive symptoms and a maximum possible score of 63. The BDI - II has been previously translated and validated in a Croatian clinical sample [32]. In the present study, Cronbach's alpha coefficient was 0.94.

The Suicidal Behaviors Questionnaire-Revised (SBQ-R) [33] is a short self-report instrument made up of 4 items each assessing a different dimension of suicidality (or risk for suicide). The four items can be summed into a total suicidality score that ranges from 3 to 18. Only the total score was used for the purposes of this research. Cronbach's alpha coefficient was 0.81 in the current study.

The Satisfaction With Life Scale (SWLS) [34] is a short self-report instrument designed to measure global cognitive judgments of one's life satisfaction (i.e. subjective well-being). It consists of 5 items that are rated on a 5-point scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). In this study, Cronbach's alpha coefficient was 0.87.

### 2.3. Statistical analyses

Means and standard deviations were calculated for each of the TCI-R 7 scales and 29 subscales. Their internal consistencies were assessed according to the Cronbach's alpha coefficient. Gender differences in the mean scores of the TCI-R scales and subscales were explored using multivariate analysis of covariance in which age was set as the covariate variable in order to control for its influence. F statistics, p values and effect sizes (partial  $\eta^2$ ) were estimated. Linear associations among the 7 dimensions of the TCI-R were analyzed using a series of Pearson correlation coefficients.

The factor structure of the TCI-R was analyzed through a Principal Component Analysis (PCA) with promax rotation. Temperament and character subscales were factor-analyzed separately because the relationships among the temperament and character dimensions are nonlinear and therefore cannot be adequately specified by the linear assumptions of factor analysis [5,35].

Concurrent validity of the TCI-R was examined by calculating the Pearson correlations between the TCI-R dimensions and measures of the Big-Five personality dimensions (IPIP-50), trait impulsiveness (BIS-11), depressive symptoms (BDI-II), suicidality (SBQ-R), and life satisfaction (SWLS). All statistical analyses were conducted using the SPSS version 19 (SPSS, Chicago, IL). The level of statistical significance was defined as P less than 0.05 (5%).

## 3. Results

### 3.1. Descriptive statistics and internal consistency of the TCI-R scales and subscales

The mean scores and standard deviations (SD) and Cronbach's alpha coefficients for the TCI-R scales and subscales along with gender differences are shown in *Table 1*. The Cronbach's alpha coefficients varied from 0.77 (NS) to 0.93 (HA and PS) for the temperament scales, and from 0.87 (CO and ST) to 0.90 (SD) for the character scales based on the total sample, which demonstrates a strong internal consistency. The Cronbach's alpha coefficients for the subscales varied from 0.51 (RD4) to 0.84 (HA1, HA3, HA4, and PS1) for temperament subscales, and from 0.53 (CO2) to 0.87 (CO4) for character subscales.

----INSERT TABLE 1 HERE----

Multivariate analysis of covariance in which the effect of age was controlled for, showed that women exhibited significantly higher scores on HA, RD, PS, and CO scales than did men (Table 1). It should be noted that the largest gender differences were observed for CO, where women scored significantly higher on all five subscales. Finally, men did not score significantly higher on any of the seven scales and on only one subscale - SD3.

### *3.2. Relations among TCI-R dimensions and their association with age*

The correlation matrices for the four temperament and three character dimensions and age are shown in *Table 2*. The highest correlations were observed between HA and SD (-0.66), RD and CO (0.63), as well as HA and PS (-0.61), while moderate correlation was found between PS and SD (0.52). All other correlation coefficients showed weaker associations (<0.50). Finally, age correlated negatively with NS (-0.33) and positively with SD (0.14).

----INSERT TABLE 2 HERE----

### *3.3. Factor structure of the TCI-R subscales*

Separate principal component analyses were performed for temperament and character subscales. Four factors were extracted with the condition of eigenvalues greater than 1, which accounted for 68.16 % of the variance in the temperament subscales. The eigenvalues for the four factors were 5.83, 2.20, 1.70, and 1.16, respectively. The standardized factor loadings following promax rotation in a four-factor solution are presented in *Table 3*. Subscale scores had loadings on their expected factors, except NS1 and RD1. The subscale NS1 had only weak loading (0.21) on its own factor (NS) and loaded on RD (0.59). The subscale RD1 loaded positively on Factor 2 (HA) and Factor 1 (PS), while RD4 loaded negatively on Factor 4 (NS).

----INSERT TABLE 3 HERE----

For the character scales, principal component analysis identified three factors with eigenvalues greater than 1, which accounted for 62.58 % of the variance (Table 4).

Eigenvalues were as follows: 4.21, 2.34, and 1.57. Subscale scores had loadings on their expected factors with no major loadings elsewhere, except SD4 and CO2. The subscale SD4 loaded on Factor 2 (CO), and the subscale CO2 loaded positively on Factor 3 (ST).

----INSERT TABLE 4 HERE----

### 3.4. Concurrent validity of the TCI-R

In Table 5, the correlations of the TCI-R scales with the validity measures are presented. Overall, a meaningful pattern of concurrent validity was revealed.

----INSERT TABLE 5 HERE----

Each TCI-R scale was significantly associated with multiple IPIP-50 dimensions. Strong correlations ( $>0.60$ ) were observed between HA and Emotional Stability (-0.76), CO and Agreeableness (0.73), RD and Agreeableness (0.71), SD and Emotional Stability (0.66), PS and Consciousness (0.62), and HA and Extraversion (-0.61), while the correlation between RD and Extraversion was 0.59. On the other hand, NS exhibited two non-significant associations with Agreeableness and Emotional Stability, while ST had either weak or non-significant correlations with the IPIP-50 dimensions.

With regard to trait impulsivity, NS scale showed significant positive associations with the BIS-11 total score, particularly with the motor impulsiveness subscale. HA was also positively associated with the BIS-11 total score, but correlated most highly with the attentional impulsiveness subscale. Conversely, PS, SD, and CO exhibited moderate negative correlations, while RD had a small negative association with the BIS-11 total score.

There was a high positive association between HA and the BDI-II score, and an inverse high correlation between SD and BDI-II. CO and RS exhibited weak to moderate correlations with the BDI-II, while ST showed a very small positive association.

A similar pattern of relations was observed in the case of suicidality (SBQ-R), except for its small positive correlation with NS and only a moderate correlation with HA.

Finally, SWLS was shown to have a moderate negative correlations with HS and moderate positive correlations with SD and PS. Associations with RD and CO were positive, albeit rather weak.

## 4. Discussion

The main objective of the present study was to examine the psychometric properties and factor structure of the TCI-R in a sample of adult Croatian psychiatric outpatients.

The obtained internal consistency reliabilities were either good or excellent for all seven TCI-R scales, with Cronbach's alpha ranging from 0.77 (NS) to 0.93 (HA and PS). This pattern of internal reliabilities is mostly in line with previous validation studies from various

cultures where NS had the lowest, whereas HA and PS had the highest consistencies [10,13,14,17,18]. In addition, the TCI-R exhibited stronger internal consistency in comparison with the original TCI previously used in Croatia [26], particularly with respect to the PS and RD scales. This finding mirrors the improved reliability of the TCI-R found in other cultures [11,17-19]. Finally, the internal reliabilities of the 29 subscales ranged from 0.51 (RD4) to 0.87 (CO4). The lowest Cronbach's alpha coefficients were observed in the case of two short facets - RD4 (6 items) and CO2 (5 items), in accordance with some other international studies [10,11,16,19,20] and somewhat expected given that internal reliability coefficients are highly dependent on the number of items in the scale [36,37]. Mostly adequate reliabilities found for all the TCI-R subscales support their clinical significance and use in personality assessment [2].

With regard to gender differences on the seven major dimensions, women had significantly higher scores on HA, RD, PS, and CO, over and above the effects of age. This was particularly evident for CO where women scored higher on all the subscales. Although the majority of international TCI-R validation studies with adult samples did not examine gender differences, those that did converge on more pronounced HA, RD, and CO among women [14,16,19]. As was the case in the present study, Hansenne et al [16] also obtained the strongest effect for CO, in accordance with evolutionary perspective on human personality [38], although a recent meta-analytic study called into question the assertion that women are generally more cooperative than men [39]. It seems that future assessments of gender differences in cooperativeness should take into account the moderating roles of specific social contexts (e.g., women are more cooperative in larger social groups but less cooperative in same-sex interactions). With regard to higher scores on HA, conceptualized as a serotonin-mediated temperament trait (1), among women who seem to be more fearful and doubtful than males, it might partly account for the larger prevalence of mood and anxiety disorders in female populations (40). Indeed, recent studies have documented significant sex differences in the central serotonin system (41), while gender differences in the serotonin-receptor function in specific brain regions may mediate expression of psychological characteristics such as anxiety traits (i.e., harm avoidance) (42).

We conducted separate principal component analyses for temperament and character subscales because of robust non-linear interactions between these two domains of personality [2,5]. More specifically, there seems to be significant equifinality and multifinality (i.e., one temperament configuration can lead to several character outcomes and *vice versa*) suggesting the inadequacy of joint factorial analysis. Overall, the Croatian version of the TCI-R exhibited consistent and expected structural validity for both temperament and character domains. The variances for temperament and character (68.16% and 62.58%) were somewhat higher than those found in most previous studies that used the same factor analysis procedure [e.g., 14,17-19], with the exception of Martinotti et al [21] who documented even higher explained variances in a sample of nonclinical Italian subjects. The temperament subscales conformed to the postulated four-factor solution, except for the following three subscales: NS1 facet loaded positively on RD, RD1 facet loaded positively on HA and PS, while RD4 facet loaded negatively on NS. Such scattered, theoretically unexpected loadings are found in other international studies of complex psychological constructs such as personality [15,18,20] are generally not considered in isolation, but rather in the context of other indices of construct validity. It should be noted that PS was shown to be the most robust factor in this research by demonstrating highest factor loadings, which supports the addition of 3 PS subscales in TCI-R.

The character subscales conformed to the postulated three-factor structure, except for the following two subscales: SD4 facet loaded positively on CO and CO2 facet loaded positively on ST. The unexpected loading of SD4 subscale has also been observed in prior validation

studies [14,18- 20]. Goncalves and Cloninger [17] were the only ones who also found CO2 subscale (Empathy) loading on ST dimension in a sample of Brazilian nonclinical volunteers. In line with their reasoning, it might be that empathy is particularly linked to spiritual beliefs in countries with strong religious backgrounds (such as Croatia and Brazil), although more research is needed in order to verify this potential socio-cultural effect on personality assessment.

Overall, a meaningful pattern of concurrent validity of the TCI-R was revealed via its relations with the relevant measures used in this study. Each TCI-R scale was significantly associated with at least one Big-Five dimensions, mostly in the expected directions and levels of strength (e.g., strong correlations were observed between HA and Emotional Stability, CO and Agreeableness, RD and Agreeableness, PS and Consciousness). The Self-Transcendence character dimensions displayed the weakest associations with the Big-Five traits, which represents one of the points of theoretical and empirical divergence between the two popular models of personality, found in previous studies as well [19,43]. It should be noted that the present study was the first one that compared the two models by using the IPIP as a measure of the Big-Five personality traits. Future research should put more emphasis on the facet level of analysis, since there are indications that facets outperform domains in the prediction of behavior, including psychopathology [e.g., 44].

Most TCI-R scales exhibited moderate associations with trait impulsivity (as measured by Barratt's Impulsiveness Scale). Not surprisingly, the lowest correlations with trait impulsivity were observed for RD and ST traits. Further support for the construct validity of the NS and PS temperament dimensions was demonstrated through their predominant (and opposing) associations with the motor impulsiveness (i.e., acting without thinking) and nonplanning impulsiveness (i.e., a lack of forethought) subscales, respectively. This finding suggests possibly different neurobiological mechanisms underlying a multidimensional construct of impulsivity [45]. Character dimensions SD and CO were also linked to trait impulsivity, in accordance with their postulated role in the development of cluster B personality disorders [4]. The strong relation between HA and attentional impulsiveness subscale was somewhat unexpected and not in line with previous research conducted on community samples [21]. We hypothesize that the general psychiatric distress found among our participants contributed to inflated correlation between HA and impulsiveness, particularly the facet of impulsiveness related to inability to focus attention or concentrate.

The TCI-R dimensions showed a similar pattern of relations with the measures of depression and suicidality, notably opposite associations with HA and SD found in previous research [17,46]. A recent study conducted in a large clinical sample showed that HA was independently associated with the history of suicide attempts, further supporting a primary involvement of the serotonergic system in suicide behaviors (46). Our findings also suggest that individuals who tend to perceive themselves as unable to influence a difficult situation positively and to solve a given problem (i.e., low SD) are at an increased risk of suicide, in line with poor decision making capacity of suicide attempters reported by prior research (47). Finally, NS was significantly associated (albeit weakly) with suicidality but not depression, confirming its postulated unique role in suicidal behavior (46). Since NS reflects excessive anger and poor impulse control, it seems that high NS scores may distinguish a particular subgroup of at-risk subjects, those prone to more frequent and especially violent suicide attempts (48). The application of the TCI-R in clinical practice might help to reduce the prevalence of suicide behaviors by detecting subjects with a personality profile characterized by high HS and NS and low SD.

One's global judgment of life satisfaction seems to be most strongly related with HA and SD, as seen in previous research (49). Being fearful, doubtful and pessimistic reduces one's subjective experience of well-being, whereas being responsible and purposeful promotes it.

SB serves as a foundation for the regulation of a person's hopes and desires, which influences all aspects of well-being, consistent with theories of self-efficacy and self-determination (50). Since low SD is a strong marker of personality pathology, our findings are in line with studies showing seriously impaired subjective quality of life in people with personality disorders (51). In contrast, CO was only marginally associated with life satisfaction, suggesting that the perception of social support did not have substantial influence on overall well-being. This unexpected finding could be explained by a relatively high percentage of depressed individuals in our sample, who tend to socially isolate themselves and place less importance on interpersonal relations during depressed periods. Finally, PS dimension was also positively associated with well-being, supporting theoretical formulations [2,52] that trait persistence promotes the development of mature character and greater life satisfaction. Although each personality dimension makes a distinct contribution to life satisfaction, future studies should investigate their mutual interactions because their influences on well-being are highly non-linear (i.e., perception of well-being depends on specific configurations of temperament and character dimensions) (53).

There are several limitations to the current study. First, this was a convenient sample that consisted only of outpatients, thus limiting the ability to extend our findings to other psychiatric populations, particularly inpatients. Moreover, this type of validation study should also be conducted on nonclinical samples in order to obtain normative data, although research suggests that structural relationships between variables tend to generalize in clinical and nonclinical samples [54]. Second, although widely accepted as reliable assessments of personality features, self-report measures are potentially susceptible to socially desirable and self-deceptive responding. Finally, a limited number of validation measures were used, indicating a need for a broader set of validation criteria, especially measures of various types of personality pathology given the usefulness of the TCI-R in the assessment of personality disorders [4,7]. Despite these limitations, the findings of the present study suggest that the TCI-R is a reliable measure of Cloninger's model of temperament and character, with satisfactory factorial and concurrent validity among Croatian psychiatric outpatients. The improved internal reliability supports the use of the TCI-R in Croatian clinical settings over its predecessor (TCI).

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Table 1

Internal consistency reliabilities ( $\alpha$ ), means, standard deviations (SD), and gender differences on the TCI-R scales and subscales

TCI-R scales and subscales	Number of item	$\alpha$	Women (n=189)		Men (n=139)		F (1,307)	p value	Partial $\eta^2$
			Mean	SD	Mean	SD			
<i>Novelty Seeking (NS)</i>	35	0.77	96.15	14.36	96.29	14.45	0.17	0.685	0.001
Exploratory excitability (NS1)	10	0.58	29.27	5.77	29.38	5.23	0.08	0.772	<0.001
Impulsiveness (NS2)	9	0.76	24.11	5.69	24.31	6.71	0.14	0.704	<0.001
Extravagance (NS3)	9	0.78	26.40	7.13	25.77	7.00	0.28	0.599	0.001
Disorderliness (NS4)	7	0.54	16.37	4.19	16.84	4.39	1.64	0.201	0.005
<i>Harm Avoidance (HA)</i>	33	0.93	114.87	21.89	107.03	22.98	9.19	0.003	0.029
Anticipatory worry (HA1)	11	0.84	37.30	8.13	33.88	8.68	12.53	<0.001	0.039
Fear of uncertainty (HA2)	7	0.67	26.63	5.11	23.81	4.67	25.88	<0.001	0.078
Shyness (HA3)	7	0.84	22.82	6.44	22.52	6.20	0.15	0.699	<0.001
Fatigability (HA4)	8	0.84	28.11	6.90	26.83	7.06	2.38	0.124	0.008
<i>Reward Dependence (RD)</i>	30	0.84	100.64	15.45	94.80	14.37	11.83	0.001	0.037
Sentimentality (RD1)	8	0.62	29.63	4.60	26.80	4.92	27.63	<0.001	0.083
Openness to warm communication (RD2)	10	0.81	33.25	7.32	31.34	7.29	5.43	0.020	0.017
Attachment (RD3)	6	0.78	17.61	5.86	17.12	5.13	0.47	0.492	0.002
Dependence (RD4)	6	0.51	20.16	3.84	19.55	3.59	2.56	0.111	0.008
<i>Persistence (PS)</i>	35	0.93	111.89	22.23	106.71	24.16	4.26	0.040	0.014
Eagerness of effort (PS1)	9	0.84	28.43	7.12	26.49	7.24	6.70	0.010	0.021
Work Hardened (PS2)	8	0.81	26.14	6.10	25.38	6.58	1.24	0.266	0.004
Ambitious (PS3)	10	0.81	31.38	6.66	30.28	7.35	1.91	0.168	0.006
Perfectionist (PS4)	8	0.72	25.93	5.65	24.55	5.63	4.93	0.027	0.016
<i>Self-Directedness (SD)</i>	40	0.90	127.38	21.48	131.81	23.06	2.59	0.109	0.008
Responsibility (SD1)	8	0.78	24.74	6.25	25.98	6.05	3.28	0.071	0.011
Purposefulness (SD2)	6	0.75	19.11	4.90	20.15	4.62	3.51	0.062	0.011
Resourcefulness (SD3)	5	0.74	13.95	4.03	15.68	4.53	12.46	<0.001	0.039
Self-acceptance (SD4)	10	0.81	34.96	7.87	35.35	8.51	0.01	0.913	<0.001
Enlightened second nature (SD5)	11	0.81	34.63	6.83	34.66	8.26	0.00	0.970	<0.001
<i>Cooperativeness (CO)</i>	36	0.87	135.97	15.37	126.79	18.57	24.28	<0.001	0.074
Social acceptance (CO1)	8	0.73	29.14	4.80	27.41	5.40	9.52	0.002	0.030
Empathy (CO2)	5	0.53	18.24	2.91	16.48	3.41	24.20	<0.001	0.074
Helpfulness (CO3)	8	0.57	29.13	4.05	27.98	4.38	7.02	0.008	0.022
Compassion (CO4)	7	0.87	29.12	5.27	26.48	6.57	17.13	<0.001	0.053
Pure-hearted conscience (CO5)	8	0.57	30.34	4.63	28.44	5.02	11.75	0.001	0.037
<i>Self-Transcendence (ST)</i>	26	0.87	74.34	16.97	73.56	16.14	0.15	0.696	0.001
Self-forgetful (ST1)	10	0.75	29.63	7.25	28.77	6.92	0.94	0.333	0.003
Transpersonal identification (ST2)	8	0.76	22.01	6.30	22.11	5.76	0.00	0.962	<0.001
Spiritual acceptance (ST3)	8	0.79	22.71	6.88	22.69	7.44	0.00	0.982	<0.001

Note: The F tests and effect sizes (partial  $\eta^2$ ) represent multivariate analyses of covariance with gender as the grouping variable, and age included as a covariate to control for the influence of age (women n = 183; men n = 128).

Table 2

Correlations between temperament and character scales and age (N=317)

	NS	HA	RD	PS	SD	CO	ST
<b>HA</b>	-0.06						
<b>RD</b>	0.06	-0.26**					
<b>PS</b>	-0.15**	-0.61**	0.39**				
<b>SD</b>	-0.21**	-0.66**	0.27**	0.52**			
<b>CO</b>	-0.17**	-0.31**	0.63**	0.45**	0.49**		
<b>ST</b>	0.10	-0.11*	0.23**	0.34**	-0.10	0.14**	
<b>Age</b>	-0.33**	0.04	-0.07	0.05	0.14*	0.01	0.06

NS: Novelty Seeking; HA: Harm Avoidance; RD: Reward Dependence; PS: Persistence; SD: Self-Directedness; CO: Cooperativeness; ST: Self-Transcendence.

\*\*P ≤ 0.01, \*P ≤ 0.05.

Table 3

Results of principal component analysis of the temperament subscales (Promax rotation including factors with eigenvalues > 1)

Temperament subscales	Factor 1 (PS)	Factor 2 (HA)	Factor 3 (RD)	Factor 4 (NS)
NS1	0.07	-0.24	<b>0.59</b>	0.21
NS2	-0.16	0.32	-0.10	<b>0.61</b>
NS3	-0.04	0.09	0.33	<b>0.70</b>
NS4	-0.16	-0.16	0.00	<b>0.72</b>
HA1	-0.17	<b>0.72</b>	-0.10	0.11
HA2	-0.12	<b>0.68</b>	-0.12	-0.14
HA3	-0.23	<b>0.52</b>	-0.36	-0.01
HA4	-0.27	<b>0.63</b>	-0.13	0.03
RD1	<b>0.54</b>	<b>0.80</b>	0.23	0.08
RD2	0.25	0.09	<b>0.74</b>	0.12
RD3	-0.30	-0.20	<b>0.93</b>	-0.02
RD4	-0.24	0.33	<b>0.59</b>	<b>-0.46</b>
PS1	<b>0.86</b>	-0.02	-0.05	-0.15
PS2	<b>0.81</b>	-0.20	-0.02	-0.05
PS3	<b>0.83</b>	-0.12	-0.06	0.06
PS4	<b>0.97</b>	0.10	-0.13	-0.07

Loadings with absolute values of 0.40 or more are shown in bold.

Theoretically expected loadings have a gray background.

NS: Novelty Seeking; HA: Harm Avoidance; RD: Reward Dependence; PS: Persistence.

Table 4

Results of principal component analysis of the character subscales (Promax rotation including factors with eigenvalues > 1)

Character subscales	Factor 1 (SD)	Factor 2 (CO)	Factor 3 (ST)
SD1	<b>0.69</b>	0.15	-0.25
SD2	<b>0.93</b>	-0.16	0.14
SD3	<b>0.93</b>	-0.14	0.03
SD4	-0.08	<b>0.61</b>	-0.33
SD5	<b>0.77</b>	0.16	0.00
CO1	0.08	<b>0.70</b>	-0.01
CO2	0.05	<b>0.43</b>	<b>0.49</b>
CO3	0.07	<b>0.75</b>	0.18
CO4	-0.14	<b>0.87</b>	0.06
CO5	-0.04	<b>0.66</b>	0.03
ST1	-0.22	-0.22	<b>0.77</b>
ST2	0.18	0.05	<b>0.82</b>
ST3	-0.02	0.09	<b>0.78</b>

Loadings with absolute values of 0.40 or more are shown in bold.

Theoretically expected loadings have a gray background.

SD: Self-Directedness; CO: Cooperativeness; ST: Self-Transcendence.

Table 5

TCI-R correlations with other questionnaires: IPIP-50, Barratt Impulsiveness Scale - 11, Beck Depression Inventory–II, Suicidal Behaviors Questionnaire–R, and Satisfaction With Life Scale

	NS	HA	RD	PS	SD	CO	ST
<b>IPIP-50</b>							
Extraversion	0.32**	-0.61**	0.59**	0.43**	0.38**	0.34**	0.12*
Agreeableness	-0.04	-0.23**	0.71**	0.47**	0.27**	0.73**	0.23**
Conscientiousness	-0.39**	-0.38**	0.22**	0.62**	0.50**	0.33**	0.01
Emotional Stability	-0.06	-0.76**	0.13*	0.37**	0.66**	0.33**	-0.11*
Intellect	0.24**	-0.44**	0.35**	0.49**	0.15**	0.22**	0.29**
<b>Barratt Impulsiveness Scale – 11</b>							
Attentional Impulsiveness	0.18**	0.59**	-0.18**	-0.35**	-0.61**	-0.34**	0.16**
Motor Impulsiveness	0.53**	0.11*	-0.08	-0.13*	-0.34**	-0.25**	0.29**
Nonplanning Impulsiveness	0.43**	0.37**	-0.26**	-0.54**	-0.42**	-0.38**	-0.01
Total score	0.48**	0.46**	-0.23**	-0.45**	-0.58**	-0.41**	0.16**
<b>Beck Depression Inventory–II</b>	0.02	0.61**	-0.19**	-0.35**	-0.58**	-0.28**	0.16**
<b>Suicidal Behaviors Questionnaire –R</b>	0.11*	0.30**	-0.15**	-0.26**	-0.38**	-0.30**	0.18**
<b>Satisfaction With Life Scale</b>	0.06	-0.51**	0.16**	0.34**	0.45**	0.15*	0.06

\*\*P < 0.01; \*P < 0.05.