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## Normative data and factorial structure of the Turkish version of the temperament and character inventory-revised (Turkish TCI-R)

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### ABSTRACT

**OBJECTIVE:** In this study, we aimed to examine the validity, reliability, and factor structure of the TCI-R in a Turkish sample.

**METHODS:** Participants were 1026 (786 female, 240 male) college students at Hasan Kalyoncu University in Turkey. The study protocol was approved by the local Ethics Committee. Sociodemographic information of the participants was collected and the TCI-R, Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI), and Personality Belief Questionnaire (PBQ) were administered. All statistical analyses were performed by using SPSS version 24 for Windows.

**RESULTS:** The internal consistency was satisfactory for all dimensions (Cronbach alpha coefficients above 0.7). The highest Cronbach alpha was found for Persistence Dimension (0.92) and the lowest Cronbach alpha was found for Novelty Seeking Dimension (0.73) and test–retest correlation coefficients for all dimensions were relatively high and statistically significant. TCI-R temperament and character scales were found significantly correlated with the BDI, the BAI, and the PBQ total scores. A principal-components analysis with Promax rotation yielded four factors with an Eigenvalue greater than one, representing 62.67% of the total variance for temperament dimension. A principal-components analysis with Promax rotation yielded three factors with an Eigenvalue greater than one, representing 56.14% of the total variance for character dimension. The addition of four new subscales to the original scale for Persistence has produced a very reliable dimension in the TCI-R with the loadings ranging from 0.82 to 0.86.

**CONCLUSIONS:** Our findings suggested that Turkish TCI-R was a valid and reliable tool with a robust factorial structure for further use in the assessing of personality psychopathology in clinical populations in Turkey.

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Temperament and character inventory-revised; reliability; validity; factor structure

## Introduction

Cloninger's psychobiological model is a dimensional model with a greater theoretical basis that includes both normal personality and personality disorders in the conceptualization and classification of personality. This model emerged as the synthesis of behavioural genetics and information from many areas including neurobiology, learning theory, psychometric personality studies, psychopharmacology, neuropsychopharmacology and longitudinal developmental studies [1–3].

In the beginning, Cloninger defined three temperament characteristics which are Novelty Seeking (NS), Harm Avoidance (HA) and Reward Dependence (RD). These three characteristics focused on the biological dimensions of the personality and represented the relationship between basic behavioural systems that enable, sustain and prevent the behaviour in the face of basic stimuli, such as punishment, reward, and novelty [3]. Persistence (PS) which initially considered as a subdimension of Reward Dependence (RD) as a result of twin studies and factor analysis studies it is

accepted as the fourth temperament dimension [3–5]. After defining three dimensions of character which are Self-Directedness, Cooperativeness, and Self-Transcendence to the four dimensions of temperament, a seven-factor psychobiological model of four temperament and three-character dimension has been developed [3].

Temperament dimensions are related to the temperament that represents the individual's differences related to emotional reactions such as fear, aggression, attachment which are inherited and accepted as invariant characteristics in the face of static and cultural influences throughout life [1,3,6]. Novelty Seeking (NS) refers to an inherited tendency towards active behavioural avoidance of harm signals and attitudes toward reward signals and activating desire for novelty. Harm Avoidance (HA) refers to the individual's tendency to passive avoidance behaviours such as fear of uncertainty and a pessimistic state of concern about future problems. Reward Dependence (RD) is the tendency to maintain the behaviour in response to external awards. Persistence (PS) reflects a hereditary predisposition to

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inhibition, fatigue, and sustained behaviour even when intermittently encouraged [1,3,4].

Character dimensions are related to one's gradual maturation structure that is influenced by life experiences, learning, and insight and are associated with individual differences in higher cognitive functions such as symbolization, abstraction, analysis, interpretation, and reasoning [3,4]. Self-Directedness (SD) means that the person who is conscious of being an autonomous individual has responsible, competent and personally meaningful aims. Cooperativeness (C) relates to the individual differences in the acceptance and identification of others. Finally, Self-Transcendence (ST) consists of interpersonal identification and moral acceptance [3,4].

To date, the validity and reliability of the Temperament and Character Inventory (TCI) has also been examined in clinical and non-clinical samples in Turkey [7–9] and is still used as an important tool in the measurement of personality in scientific studies. Despite the widespread use of TCI in many areas, findings have shown that the scale needs a revision. Therefore, Cloninger published the Temperament and Character Inventory-Revised (TCI-R) in 1999 [10]. TCI-R differs from TCI in the following respects: the “True/False” response type was changed to the 5-point Likert scoring type, the RD dimension was extracted from three dimensions to four dimensions, the Persistence (PS) temperament dimension was developed and divided into four dimensions consisting of 35 items. In addition to these; however, 51 items of 240 items (including five items of validity) were rewritten, and the remaining 189 items were taken from the TCI without any change [11]. TCI-R has been adapted to several languages in nearly 20 countries and has become a widely used tool for assessing personality.

In this study, we aimed to establish psychometric properties and factorial validity of the Turkish TCI-R in a representative Turkish university students sample and obtain normative data for future epidemiological and clinical studies in Turkey.

## Methods

### Study participants

Participants were 1026 (786 females, 240 males) college students at the Hasan Kalyoncu University in Gaziantep, Turkey. The study protocol was approved by Hasan Kalyoncu University Ethics Committee on 21 February 2017 with the file number 2017-06. Data were collected from February to March 2017. Written informed consents were obtained from the participants following the study protocol was thoroughly explained. Exclusion criteria included being diagnosed with psychiatric disorders, using psychotropic drugs, at that moment being under the influence of alcohol or a

similar substance in that would affect mental processes. In order to examine the test–retest reliability, Turkish TCI-R was re-administered to 84 students selected from 1026 students four weeks after the first application.

### Psychometric measures

*Sociodemographic data form.* This form includes demographic variables including gender, age, marital status, number of children, education, location, number of siblings, family history of chronic disease, parents' age and parental education status, and previous psychiatric treatments.

*The Turkish TCI-R.* The TCI-R is a 240-item self-report inventory that is the latest measure of Cloninger's theory of temperament and character. The scale measures four dimensions of personality and three dimensions of character and the seven dimensions have totally 29 subscales. The response option format of the TCI-R ranged from 1 = *definitely false* to 5 = *definitely true* [11,12]. TCI-R has been translated into many languages (e.g. Italian, French, Bulgarian, etc.) and reliability and validity studies have been conducted. In the study conducted by Hansenne, Delhez, and Cloninger [11] the Cronbach's Alpha value for all items of the TCI-R was reported as 0.90 and the 2-week test–retest reliability was reported as 0.94. Fossati et al. [12] in the validity and reliability study of the Italian version of the TCI-R on outpatients reported the highest internal consistency coefficient for the Persistence dimension (Cronbach's Alpha = 0.91) and the lowest internal consistency coefficient for the Reward Dependence dimension (Cronbach's Alpha = 0.79). The Turkish TCI-R has been translated into Turkish by Samet Kose and back-translated into English by Ercan Akin who was blinded to the original items. After establishing the semantic equivalence of the TCI-R items, the content equivalence of all items was examined, and no items were excluded as being irrelevant to Turkish culture. The final version was approved by Cloninger.

*Beck depression inventory (BDI).* BDI is a self-report scale composed of 21 items and measures somatic, emotional, cognitive, and impulsive symptoms of depression [13]. Each item takes a point between 0 and 3. The point that can be taken from inventory varies between 0 and 63 and high points indicate a rise in a depressive mood. The scale aims not to diagnosis but to convert the symptom's level to objective number [13]. Overall scores for all questions is evaluated like this: a score between 10 and 16 shows low depression symptom, a score between 17 and 29 is a middle depressive symptom, and a score between 30 and 63 is a severe depressive symptom. BDI has been adapted into Turkish and the reliability and validity has been examined by Hisli [14].

*Beck anxiety inventory (BAI).* BAI is a self-report scale composed of 21 items and measures the severity of anxiety in children and adults. Each item takes a point

between 0 (not at all) to 3 (severely). The point that can be taken from inventory varies between 0 and 63 and higher total scores indicate more severe anxiety symptoms [15]. BDI has been adapted into Turkish and the reliability and validity has been examined by Ulusoy [16].

**Personality belief questionnaire.** The content of PBQ is composed of the items directed to determine one's basic beliefs about oneself, other people, and the world [17]. The original form is about to avoidant, dependent, passive-aggressive, obsessive-compulsive, antisocial, narcissistic, histrionic, schizoid, and paranoid attitudes and beliefs and consists of nine categories, each has 14 questions, and 126 items in total [17]. After reading each item, subjects mark the items between zero (I do not believe at all) and four (I believe completely) according to how much it is related to them. The scale is appropriate for evaluation and treatment of person with personality disorder. Turkish PBQ was adapted to the Turkish by Turkcapar and Kose, its validity and reliability were done by Turkcapar et al. [18].

### Statistical analysis

All variables were screened for the accuracy of data entry, missing values, and homoscedasticity using SPSS 24. The data had less than 5% of missing items and no pattern was detected. Descriptive statistic was reported using means and standard deviations for continuous variables and frequencies and percentages for categorical variables. Correlation analyses between the TCI-R scale and subscales were performed using Pearson's correlation coefficients. The internal consistency of the Turkish TCI-R scale and subscales was estimated using Cronbach's alpha coefficients. Based on the theoretical structure, two sets of exploratory factorial analyses were performed. Principal factor analyses with Promax rotations were used. The alpha level of 0.05 was set up to indicate statistical significance.

## Results

### Sociodemographic characteristics of sample

As it was shown in Table 1 in detail, the average age of 1026 participants in the study was 21.54 with a standard deviation of 3.30 and it ranged from 18 to 51. The sample consisted of 786 female (76.6%) and 240 male (23.4%) students. Most of the students participated in the study were single (95.6%) and 33 (3.2%) were married and 8 (0.8%) students were divorced. Of the participants, 53 (5.2%) had a suicide attempt history. The detailed demographic characteristics of participants were presented in Table 1.

According to the results of multivariate analysis, a statistically significant difference was found between male and female participants regarding HA, RD, C, and ST. The mean scores of HA, RD, C, and ST were significantly

higher in females than males. As it is demonstrated in Table 2, for the NS dimension, just one (NS4) subscale mean scores were significantly different between females and males. The mean scores of NS4 were lower in women. For dimension HA and C, except for one subscale for each (HA3 and C3, respectively) all the subscale scores were significantly higher in women. On the other hand; for dimension PS, men exhibited higher scores in PS2 and PS4 than women.

### Correlations of age with the TCI-R scales

The TCI-R temperament and character dimensions and age were found to be interrelated (Table 3). Novelty Seeking dimension was positively and significantly correlated with Reward Dependence and negatively and significantly correlated with Harm Avoidance, Persistence, Cooperativeness. Harm Avoidance was negatively and significantly correlated with all other dimensions. Reward Dependence was positively and significantly correlated with PS, C, and ST. Persistence was positively and significantly correlated with SD, C, and ST. Self-Directedness was positively and significantly correlated with C. Furthermore, age was found to be positively and significantly correlated with PS, SD, and C and negatively and significantly correlated with NS and HA.

### Internal consistency

The Cronbach  $\alpha$  coefficients for the Turkish TCI-R scales ranged from 0.73 and 0.92 for the temperament

**Table 1.** Demographic characteristics of the sample.

Age	21.54 $\pm$ 3.30	
	<i>n</i>	%
Gender		
Female	786	76.6
Male	240	23.4
Marital status		
Single	981	95.6
Married	33	3.2
Living together	3	0.3
Living separate	1	0.1
Divorced	8	0.8
Mother died or alive		
Alive	1015	98.9
Died	11	1.1
Father died or alive		
Alive	992	96.7
Died	34	3.3
Parent divorce		
No	977	95.2
Yes	49	4.8
Psychiatric disorders in parents		
No	882	86.0
Yes	144	14.0
Psychiatric disorder		
No	983	95.8
Yes	43	4.2
Therapy for psychiatric disorders		
No	939	91.5
Yes	87	8.5
Suicide attempt		
No	973	94.8
Yes	53	5.2

**Table 2.** TCI-R scale and subscale means, standard deviations, Cronbach alpha, and Cohen's d among the sample.

TCI-R Dimensions	Total (n = 1026)				Female (n = 786)		Male (n = 240)		P	d
	No of items	$\alpha$	Mean	SD	Mean	SD	Mean	SD		
<i>Novelty seeking (NS)</i>	35	0.73	104.04	11.31	103.80	11.31	104.84	11.31	0.213	−0.092
NS1 (exploratory excitability)	10	0.46	31.79	4.03	31.70	4.09	32.08	3.84	0.205	−0.096
NS2 (impulsiveness)	9	0.51	24.35	3.94	24.37	3.96	24.26	3.86	0.694	0.006
NS3 (extravagance)	9	0.78	27.94	6.03	27.95	6.15	27.92	5.63	0.949	0.005
NS4 (disorderliness)	7	0.45	19.97	3.52	19.78	3.35	20.58	3.99	<b>0.005</b>	−0.217
<i>Harm avoidance (HA)</i>	33	0.89	97.35	16.18	98.47	16.06	93.67	16.07	<b>&lt;0.001</b>	0.299
HA1 (anticipatory worry)	11	0.77	32.29	6.16	32.61	6.17	31.23	6.01	<b>0.002</b>	0.227
HA2 (fear of uncertain)	7	0.69	21.95	4.57	22.33	4.53	20.71	4.49	<b>&lt;0.001</b>	0.359
HA3 (shyness with strangers)	7	0.80	19.84	4.96	19.97	4.98	19.43	4.87	0.143	0.110
HA4 (fatigability)	8	0.76	23.26	5.12	23.56	5.12	22.29	5.02	<b>0.001</b>	0.250
<i>Reward dependence (RD)</i>	30	0.81	98.80	12.26	99.51	12.76	96.48	10.15	<b>&lt;0.001</b>	0.263
RD1 (sentimentality)	8	0.63	28.39	4.42	28.87	4.34	26.80	4.33	<b>&lt;0.001</b>	0.478
RD2 (open to warm communication)	10	0.74	34.61	5.64	34.66	5.73	34.44	5.33	0.572	0.040
RD3 (attachment)	6	0.72	18.87	4.32	18.94	4.48	18.62	3.74	0.262	0.078
RD4 (dependence)	6	0.47	16.94	3.13	17.03	3.09	16.63	3.23	0.079	0.127
<i>Persistence (PS)</i>	35	0.92	120.75	17.60	120.36	17.69	122.02	17.28	0.202	−0.095
PS1 (eagerness of effort)	9	0.73	31.15	4.88	31.21	4.90	30.95	4.81	0.463	0.054
PS2 (work hardened)	8	0.75	27.89	4.56	27.70	4.56	28.53	4.51	<b>0.013</b>	−0.183
PS3 (ambitious)	10	0.79	35.85	5.41	35.79	5.45	36.08	5.29	0.463	−0.054
PS4 (perfectionist)	8	0.78	25.86	5.12	25.67	5.18	26.47	4.85	<b>0.035</b>	−0.159
<i>Self-directedness (SD)</i>	40	0.85	132.29	15.30	132.52	15.21	131.55	15.60	0.392	0.063
SD1 (responsibility)	8	0.72	26.77	4.53	26.81	4.47	26.66	4.74	0.660	0.033
SD2 (purposefulness)	6	0.69	22.14	3.81	22.12	3.74	22.20	4.02	0.786	−0.021
SD3 (resourcefulness)	5	0.61	17.32	3.16	17.16	3.15	17.81	3.16	<b>0.005</b>	−0.206
SD4 (self-acceptance)	10	0.73	27.50	5.92	27.58	6.00	27.28	5.66	0.492	0.051
SD5 (congruent second nature)	11	0.63	38.57	4.87	38.86	4.79	37.61	5.02	<b>0.001</b>	0.255
<i>Cooperativeness (C)</i>	36	0.86	127.59	14.81	129.01	14.46	122.96	15.01	<b>&lt;0.001</b>	0.411
C1 (social acceptance)	8	0.75	29.05	4.44	29.32	4.42	28.19	4.42	<b>0.001</b>	0.256
C2 (empathy)	5	0.53	18.77	2.66	18.99	2.55	18.03	2.88	<b>&lt;0.001</b>	0.353
C3 (helpfulness)	8	0.39	25.44	3.18	25.53	3.23	25.13	3.00	0.087	0.128
C4 (compassion)	7	0.88	24.26	6.15	24.76	6.10	22.63	6.05	<b>&lt;0.001</b>	0.351
C5 (principled)	8	0.57	30.07	4.10	30.41	3.82	28.98	4.77	<b>&lt;0.001</b>	0.331
<i>Self-transcendence (ST)</i>	26	0.80	85.85	11.23	86.41	11.11	84.00	11.43	<b>0.004</b>	0.214
ST1 (self-forgetfulness)	10	0.65	32.22	4.92	32.48	4.93	31.35	4.83	<b>0.002</b>	0.232
ST2 (transpersonal identification)	8	0.66	26.18	4.45	26.12	4.47	26.37	4.42	0.448	−0.056
ST3 (spiritual acceptance)	8	0.78	27.46	5.59	27.81	5.46	26.29	5.84	<b>&lt;0.001</b>	0.290

Note: TCI-R = Temperament and Character Inventory-Revised.

scales and from 0.80 and 0.86 for the character scales (Table 2). The lowest  $\alpha$  values were observed for the NS (0.73) and the RD (0.81) scales.

The Cronbach  $\alpha$  coefficients for the Turkish TCI-R subscales were relatively consistent within each of the scales except for the NS and the C scale. In summary, 22 of the 29 subscales had  $\alpha$  values greater than 0.60.

### Test-retest reliability of the Turkish TCI-R

Test-retest correlations for the Turkish TCI-R scales and subscales after 1 month are presented in Table 4.

At the subscale level, the test-retest correlation coefficients ranged from 0.62 to 0.91. There were no significant differences between the mean scores of the TCI-R across the 1-month test-retest period.

### Convergent and discriminant validity

Convergent and discriminant validity were examined by the correlation between the Turkish TCI-R scales scores and BDI, BAI and PBQ scale and subscales scores (Table 5).

BDI was positively and significantly correlated with NS ( $r = 0.116$ ,  $p < 0.01$ ) and HA ( $r = 0.261$ ,

**Table 3.** Correlations between temperament and character scales and age

Scales	NS	HA	RD	PS	SD	C	ST	Age
NS								
HA	−0.226**							
RD	0.161**	−0.083**						
PS	−0.205**	<b>−0.432**</b>	0.067*					
SD	−0.176**	<b>−0.469**</b>	0.055	<b>0.443**</b>				
C	−0.155**	−0.206**	<b>0.387**</b>	0.269**	<b>0.456**</b>			
ST	0.015	−0.116**	0.105**	<b>0.329**</b>	0.036	0.203**		
Age	−0.089**	−0.141**	−0.003	0.095**	0.120**	0.078*	−0.094**	

NS = Novelty Seeking; HA = Harm Avoidance; RD = Reward Dependence; PS = Persistence; SD = Self-Directedness; ST = Self-Transcendence and C = Cooperativeness. Coefficients greater than or equal to 0.30 are shown in bold.

\* $p < 0.05$ . \*\* $p < 0.01$ .



**Table 4.** Test–retest correlations for the Turkish TCI-R after 4-weeks ( $n = 84$ ).

Temperament scale and subscale	$r_{tt}$	Character scale and subscale	$r_{tt}$
NS	0.831**	SD	0.871**
HA	0.906**	C	0.836**
RD	0.844**	ST	0.792**
PS	0.868**	SD1	0.792**
NS1	0.704**	SD2	0.761**
NS2	0.624**	SD3	0.776**
NS3	0.840**	SD4	0.821**
NS4	0.640**	SD5	0.768**
HA1	0.889**	C1	0.700**
HA2	0.846**	C2	0.739**
HA3	0.766**	C3	0.707**
HA4	0.848**	C4	0.876**
RD1	0.729**	C5	0.713**
RD2	0.824**	ST1	0.734**
RD3	0.861**	ST2	0.719**
RD4	0.663**	ST3	0.846**
PS1	0.775**		
PS2	0.789**		
PS3	0.793**		
PS4	0.798**		

Note: rtt: test–retest correlation coefficient.

\*\*Correlation is significant at the 0.01 level (two-tailed).

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

$p < 0.01$ ) and negatively and significantly correlated with PS ( $r = -0.140$ ,  $p < 0.01$ ) of temperament dimension. It was also positively and significantly correlated with ST ( $r = 0.079$ ,  $p < 0.05$ ) and negatively and significantly correlated with SD ( $r = -0.410$ ,  $p < 0.01$ ) and C ( $r = -0.181$ ,  $p < 0.01$ ) of character dimensions.

BAI was positively and significantly correlated with NS ( $r = 0.068$ ,  $p < 0.05$ ) and HA ( $r = 0.237$ ,  $p < 0.01$ ) and negatively and significantly correlated with PS ( $r = -0.083$ ,  $p < 0.01$ ) of temperament dimension and It was also positively and significantly correlated with ST ( $r = 0.143$ ,  $p < 0.01$ ) and negatively and significantly correlated with SD ( $r = -0.340$ ,  $p < 0.01$ ) and C ( $r = -0.176$ ,  $p < 0.01$ ) of character dimension.

PBQ was positively and significantly correlated with HA ( $r = 0.133$ ,  $p < 0.01$ ) and negatively and significantly correlated with RD ( $r = -0.220$ ,  $p < 0.01$ ) of temperament dimension. It was also positively and significantly correlated with ST ( $r = 0.133$ ,  $p < 0.01$ ) and negatively and significantly correlated with

SD ( $r = -0.379$ ,  $p < 0.01$ ) and C ( $r = -0.439$ ,  $p < 0.01$ ) of character dimension.

### Factor structure of the Turkish TCI-R

The factorial structure of the TCI-R was examined by the exploratory factor analysis for temperament and character dimensions separately. Kaiser–Meyer–Olkin Measure of Sampling Adequacy (KMO) and Barlett’s test of Sphericity was performed. In this study, KMO Sampling Adequacy was found to be 0.83, Barlett’s test of Sphericity  $X^2$  was found as 6398.710 for Temperament dimension, Sampling Adequacy was found to be 0.78, and Barlett’s test of Sphericity  $X^2$  was found as 3941.910 for Character dimension.

Factor structure of the Temperament dimension scales was explored with an exploratory factor analysis using a condition of Eigenvalues greater than 1 rule for retaining factors (Table 6). The initial results indicated a four-factor solution not providing a strong fit. On the other hand, following Promax rotation, a four-factor solution showed a better factor distribution. The four factors accounted for 27.71%, 15.80%, 12.30%, and 6.86% of the variances observed (62.67% cumulatively). The standardized factor loading following Promax rotation showed that in the four-factor solution, PS, HA, RD, and NS factors were robust. The subscale NS1 also loaded negatively on Factor 2 (HA) and positively on factor 3 (RD).

Factor structure of the Character dimension scales was explored with an exploratory factor analysis using a condition of Eigenvalues greater than 1 rule for retaining factors (Table 7). The results indicated a three-factor solution not providing a strong fit. On the other hand, following Promax rotation, a four-factor solution showed a better factor distribution. The three factors accounted for 29.57%, 14.25%, and 12.32% of the variance (56.14% cumulatively). The standardized factor loading following Promax rotation showed that in the four-factor solution, C and ST factors were robust. For SD, SD1, SD2, SD3, and SD5, subscales loaded consistently, whereas SD4 subscale did not load on factor 2 (SD) but loaded more strongly on Factor 1 (C) and factor 3 (ST).

**Table 5.** Correlation coefficients between TCI-R and BDI, BAI and PBQs.

Scales	NS	HA	RD	PS	SD	C	ST
BDI	0.116**	0.261**	NS	-0.140**	-0.410**	-0.181**	0.079*
BAI	0.068*	0.237**	NS	-0.083**	-0.340**	-0.176**	0.143**
PBQ	NS	0.133**	-0.220**	NS	-0.379**	-0.439**	0.156**
Avoidant	-0.065*	0.273**	-0.184**	-0.069*	-0.380**	-0.360**	0.130**
Dependent	NS	0.245**	NS	-0.135**	-0.459**	-0.291**	0.066*
Passive aggressive	0.128**	NS	-0.188**	NS	-0.258**	-0.331**	0.141**
Obsessive compulsive	-0.114**	NS	-0.157**	0.265**	-0.197**	-0.300**	0.186**
Antisocial	NS	NS	-0.174**	0.126**	-0.281**	-0.404**	0.170**
Narcissistic	0.096**	NS	-0.188**	0.100**	-0.251**	-0.449**	0.134**
Histrionic	0.103**	0.063*	NS	NS	-0.385**	-0.348**	0.082**
Schizoid	-0.068*	NS	-0.447**	0.085**	-0.108**	-0.291**	0.130**
Paranoid	NS	0.146**	-0.224**	0.065*	-0.299**	-0.385**	0.153**
Borderline	NS	0.337**	-0.159**	-0.174**	-0.485**	-0.378**	NS

**Table 6.** Factor structure of the Temperament Dimension of TCI-R.

Scale	Factor 1 (PS)	Factor 2 (HA)	Factor 3 (RD)	Factor 4 (NS)
Eigenvalues	4.434	2.528	1.968	1.098
Variation (%)	27.714	15.798	12.301	6.860
NS1	0.13	−0.33	0.34	0.27
NS2	−0.26	0.03	0.01	<b>0.61</b>
NS3	−0.13	0.14	0.15	<b>0.69</b>
NS4	−0.21	−0.26	−0.07	<b>0.57</b>
HA1	−0.05	<b>0.78</b>	0.04	0.13
HA2	−0.07	<b>0.70</b>	0.01	−0.23
HA3	−0.09	<b>0.61</b>	−0.35	−0.06
HA4	−0.14	<b>0.70</b>	−0.15	0.05
RD1	0.34	<b>0.62</b>	<b>0.51</b>	0.18
RD2	0.10	−0.09	<b>0.82</b>	0.07
RD3	−0.17	−0.19	<b>0.81</b>	−0.05
RD4	<b>−0.41</b>	0.04	<b>0.54</b>	<b>−0.50</b>
PS1	<b>0.83</b>	0.00	0.11	−0.07
PS2	<b>0.82</b>	−0.18	−0.04	−0.05
PS3	<b>0.86</b>	−0.02	0.04	−0.15
PS4	<b>0.84</b>	−0.07	−0.12	−0.20

Note: Promax with Kaiser normalization was performed. Loadings with absolute value  $\geq 0.40$  are shown in bold.

## Discussion

In this study, we aimed to examine the validity, reliability, and factor structure of the TCI-R scale in a Turkish sample. The main results of the study confirmed that the Turkish TCI-R was observed to have stable and reliable psychometric properties.

This study confirms that some of the Turkish TCI-R scales correlate with each other. The highest correlation was found between the SD scale and HA (negative correlation). This relationship may mean that anxious and pessimistic individuals are more challenged in choosing personal goals and values and they tend to see other people or situations as their cause of failure [3,4]. The second highest correlation was found between the C scale and SD (positive correlation). In addition, there was a moderate negative correlation between PS and HA, the moderate positive correlation between PS and SD. Other TCI-R scales showed weaker correlations among themselves and these results are consistent with the TCI-R validation studies in the literature [11,19,20]. In addition, similar to previous reports, there was a negative correlation between NS and age

because of the reduced relevance of new stimuli with age [3,11,21]. SD and C showed a positive correlation with age. Cloninger et al. [3] reported a strong association between age and SD and C scores.

When the effect of gender on the TCI-R scales was examined, it was determined that women's HA, RD, C and ST scores were significantly higher than men. The gender differences we found were similar to those of Giakoumaki et al. [20] and Jaksic et al. [21]. In particular, the high RD scores of female participants have been reported in many studies. Cloninger suggests that this gender difference in Reward Dependence is related to the noradrenergic system [22]. It has been suggested that High Reward Dependence (RD) in females is related to the fact that the female brain evolves with the interest and emotional intelligence reading mechanisms that enable women to have stronger maternal skills and parenting activities than men do [23].

The internal consistency of the Turkish TCI-R scale was found to be acceptable, except for some subscales with low Cronbach  $\alpha$  coefficients. For all dimensions except NS (0.73), Cronbach  $\alpha$  coefficients were 0.80 and above. The Cronbach  $\alpha$  coefficients were between 0.73 (NS) and 0.92 (PS). For NS dimension, the lowest Cronbach  $\alpha$  coefficient was obtained in almost all TCI-R validation studies. The PS dimension developed with TCI-R showed excellent internal consistency. In general, these internal consistency coefficients are similar to those obtained from studies conducted in healthy and patient samples [11,19,20]. The present study also confirmed that the Turkish TCI-R has good test-retest reliability due to the fact that similar correlations were observed across a one-month interval, indicating the stability of the measure over time.

In the present study, BDI and BAI scores were found to be positively correlated with Harm Avoidance (HA) and negative correlation with Self-Directedness (SD). That means depression and anxiety symptoms are associated with high HA and low SD scores. Indeed, Cloninger has reported depressive mood as an emotion due to an increase in Harm Avoidance (HA) [24]. Other studies have reported similar results [19,25]. In addition, significant correlations were found between Turkish TCI-R dimensions and PBQ scale. The highest correlation was found between the PBQ scores and Self-Directedness (SD) (negative) and Cooperativeness (C) (negative). This result supports the claim that low SD and C scores are significantly associated with the presence of personality disorders [26].

Factor analysis of Turkish TCI-R was performed by Principal Component Analysis with Kaiser normalization separately for temperament and character dimensions because temperament and character dimensions did not match with an orthogonal factor structure. According to the analysis results; the Turkish version of TCI-R has demonstrated a consistent and expected factor structure for the overall temperament and character dimensions.

**Table 7.** Factor structure of the Character Dimension of TCI-R.

Scale	Factor 1 (C)	Factor 2 (SD)	Factor 3 (ST)
Eigenvalues	3.844	1.853	1.602
Variation (%)	29.570	14.253	12.321
SD1	0.09	<b>0.76</b>	−0.29
SD2	0.03	<b>0.77</b>	0.14
SD3	−0.28	<b>0.92</b>	0.07
SD4	<b>0.47</b>	0.04	−0.39
SD5	0.12	<b>0.75</b>	−0.01
C1	<b>0.74</b>	0.04	0.00
C2	<b>0.54</b>	0.09	0.26
C3	<b>0.74</b>	−0.12	−0.03
C4	<b>0.83</b>	−0.14	−0.04
C5	<b>0.55</b>	0.15	0.21
ST1	−0.15	−0.15	<b>0.77</b>
ST2	0.12	0.07	<b>0.78</b>
ST3	0.14	0.08	<b>0.61</b>

Note: Promax with Kaiser normalization was performed. Loadings with absolute value  $\geq 0.40$  are shown in bold.

In this present study, the variances explained for temperament and character dimensions (62.67% and 56.14%) were similar to the Belgian [11] (60% and 57%), the French [25] (64.2% and 55.6%), the Greek [20] (66.61% and 59.29%), and the Czech [27] (65.1% and 59.6%) versions which used the same factor analysis method. It was determined that Harm Avoidance (HA) and Persistence (PS) scales of the temperament dimension were robust. However, the Reward Dependence (RD) factor was less robust because RD1 and RD4 showed lower factor loadings. Persistence was found to be the strongest factor with high factor loadings between 0.82 and 0.86. These results are also consistent with those found in other studies [11,20,25,27,28]. In the character dimension, except for the SD4 subscale, the others were loaded on the expected factors consistent with the character dimensions defined by Cloninger. The SD4 subscale loaded more strongly on Cooperativeness (C) instead of Self-Directedness. In the previous validity studies, the SD4 factor has also been reported as loaded on Cooperativeness (C) [11,19,20,27,28]. This finding indicates that there is a significant relationship between SD4 subscale and Cooperativeness (C). This relationship has been interpreted by Cloninger as the ability of one to accept his own limitations is related to his ability to accept and tolerate the boundaries of other people and this relationship has been discussed theoretically in depth [29].

The results reported in this study should be considered in light of certain limitations. The sample in this study was recruited from volunteer college students with a limited age range and mostly of women, which to some extent limits the generalization of the results to other samples.

In conclusion, the Turkish version of the TCI-R had sound psychometric properties in our sample of Turkish healthy volunteers, including its internal consistency, test-retest reliability, concurrent validity, and factorial structure. Finally, Cloninger's TCI-R will be useful for future studies in different countries to help better understand psychopathology and normalcy and to examine the biological, social, and psychological differences among people from different cultures.

## Disclosure statement

No potential conflict of interest was reported by the authors.

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