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The Norwegian Junior Temperament and Character Inventory (JTCI): An assessment of its psychometric properties

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Abstract

The role of adolescent personality concerning mental health, well-being, self development, and academic performance is an interesting aspect that needs more attention. The use of the JTCI (Junior Temperament and Character Inventory) can contribute to more knowledge and a better understanding of a possible influence of personality in this context. The aim of this study was to assess the psychometric properties of the Norwegian version of the JTCI among an adolescent sample in terms of factor analysis, reliability and validity. The sample included 2075 subjects in the age from 15–18 years. We analyzed the factor structure, internal consistency, and validity of the measure. The Norwegian version of the JTCI was found to have good psychometric properties in terms of internal consistency, a reasonable factor structure and significant correlations with depression, self-esteem, and self-efficacy. However, further research on its differentiation of Harm Avoidance and Self-directedness is needed. The JTCI appears as a useful tool in addressing issues ranging from scholastic performance to developmental issues, mental health and well-being.

1. Introduction

Personality traits are useful predictors of behavior and functioning across situations in a person's life. A large amount of research shows that individual differences in personality traits in adolescents are predictive on many levels concerning aspects ranging from psychiatric disorders [1–4] to academic achievement [5,6]. The development of a healthy personality and well-being among adolescents seems to be important for promoting academic achievement, in opposition to a narrow focus on teaching facts and skills [5,6]. The former focus will also support the assumption that developing social and emotional skills like self-concept, self-control, and decision-making is important considering the limitations in defining scholastic success exclusively by school achievement. These skills are central in developing protective mechanisms concerning mental health [7]. Mental health has been described as: "A state of well-being in which a person realizes and uses his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to contribute to his or her community" [8]. This definition is very similar to the description of the character traits of self-directedness, cooperativeness, and self-transcendence [7,9].

In order to describe the underlying psychobiological structures of personality, Cloninger developed the Temperament and Character Inventory (TCI) [10–12]. This is a battery of tests designed to assess differences between individuals in seven basic dimensions of temperament and character. Temperament refers to more or less automatic emotional responses to experience that are considered to be moderately heritable and stable throughout life. The four measured temperament dimensions are Novelty seeking (NS), Harm Avoidance (HA), Reward Dependence (RD), and Persistence (PS). These dimensions reflect the basic organization of varying brain systems responsible for activation, inhibition, and maintenance of behavior in response to stimuli. Character refers to self-concepts and individual differences in goals and values, which in turn

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affect voluntary choices, intentions, and the meaning of experiences done throughout life. According to Cloninger differences in character are moderately influenced by sociocultural learning and mature progressively throughout life in addition to be modified by the temperament traits [13]. The three measured character dimensions are Self-Directedness (SD), Cooperativeness (CO), and Self-Transcendence (ST). All of these aspects of personality interact with each other to allow for adaption to life experiences and also influence susceptibility to emotional and behavioral disorders.

The TCI is a family of tests with several versions devised for different aspects concerning age group, clinical details and type of informant [9]. The TCI accounts for individual differences in both normal and deviant behavior patterns.

The validity of the original TCI has been well documented and described in previous studies [14–16]. Studies to assess psychometric properties of the TCI have been conducted among various sociocultural and ethnical populations, including French [15,17], and Swedish [14,18], Korean versions [19]. A relatively consistent factor structure of the instrument has been found [14,15,19–21]. The adult TCI has been used in numerous studies and has become a well-established instrument for personality assessment. In a study on 528 healthy Japanese subjects, Otani et al. [22] found negative correlations between the three subscales (achievement, dependency and self-control) of the 24-item Dysfunctional attitude Scale and the TCI dimension of self directedness. Since the adult version of the TCI is unsuitable for use on an adolescent population [18], Luby et al. [23] developed the Junior Temperament and Character Inventory (JTCI) for use with children between 9 and 13 years old.

The JTCI is a self-administered questionnaire containing 105 items requiring a true or false response. The psychometric properties were tested in a sample of non-referred children (N = 322, mean age 12.0 years, SD 1.3). The fit of the model emerged as satisfactory and so did the internal consistency. Schmeck et al. [24] investigated the psychometric properties among a slightly older German adolescent sample (12–18 years old) and found very good support to Cloninger's model of personality and reported the psychometric properties of the German JTCI as good. The original English version of the JTCI had been translated into German and has been used for clinical purposes in adolescents [25]. From the item pool of the German JTCI [24] and the JTCI (age 12–18) a test-version of 173 items was developed together with Cloninger. By means of statistical methods such as item-analysis, item selection on criteria like item difficulty, item discrimination and scale reliability, a reliable scale was constructed (Cronbach alpha within the range of 0.79–0.85). The result was a 103-item German JTCI with test-retest reliability levels ranging from 0.65 to 0.82 (Pearson correlation). The Strengths and Difficulties Questionnaire (SDQ) is a questionnaire addressing positive and negative behavioral attributes of children or adolescents [26]. The correlation coefficients between dimensions of the German JTCI and SDQ [27] demonstrated the JTCI's validity by substantial correlations between HA and SD with the emotional problem score ($r = 0.62$, $r = -0.58$, respectively) and between NS and CO with the behavioral problem score ($r = 0.46$, $r = -0.43$, respectively) [24]. It is reasonable to assume that these domains would correlate to the corresponding factors of SDQ.

The purpose of the current study was to assess the psychometric properties of the Norwegian version of the JTCI among an adolescent sample in terms of factor analysis, reliability and validity.

2. Method

2.1. Measurement

The Junior Temperament and Character Inventory (JTCI) is a self-administered questionnaire containing 103 items scored on a five-point scale (1–5) ranging from "totally agree" to "totally disagree". The different domains of the German version contain the following number of items: NS = 15, HA = 13, RD = 18, PS = 14, SD = 15, CO = 18, and ST = 10. The Norwegian version of the JTCI was developed according to established guidelines [28] following several steps based on the German version of the JTCI [29]. This procedure included translation, back-translation by independent native speakers, and linguistic revision of items.

Severity of depression was measured using a Norwegian version of the Center for Epidemiologic Studies Depression Scale (CES-D) [30], developed to assess depressive symptomatology in the general population. This 20-item self-report scale yields scores ranging from 0 to 60 (scores given from 0 to 3), with a score of 16 or above indicating a clinical level of depression. The CES-D's Cronbach alpha in the current study was 0.88.

Self-efficacy was measured by means of the Norwegian version of the General Self-Efficacy Scale (GSES) [31]. The scale consists of 10 items and assesses the ability of an individual's beliefs in handling difficult situations in an appropriate way. Responses are reported on a four-point scale ranging from "not at all true" to "exactly true". Its Cronbach alpha in the current study was 0.88.

Self-esteem was assessed using the Norwegian version of The Rosenberg Self Esteem Scale (RSES) [32,33], as a measure of global self-esteem. The scale consists of 10 statements related to overall feelings of self-worth or self-acceptance. The items are answered on a four-point scale ranging from strongly agree to strongly disagree yielding a score between 10 and 40. Its Cronbach alpha in the current study was 0.82.

2.2. Sample

Participants in this study were 2075 (50.2% females and 49.8% males) high school students based on two separate data collection rounds. All students were recruited from 11

high schools in Troms County in Northern Norway in two bulks separated by approximately 9–11 months. Both samples were part of a larger study with a four-arm randomized controlled trial design on the use of an internet-based cognitive-behavioral program. Members of the research group visited the participating schools for recruitment of the participants. Students volunteering to participate signed a written consent form. Subjects with more than 2 items missing in the JTCI and those above the age of 18 years were excluded from the study (original sample size n = 2252). The mean age in the final sample was 16.7 (SD = 0.9, range = 15–18). Within this sample two types of educational direction were present: a generally orientated and an occupationally orientated educational program (Table 1).

Only a part of the sample (n = 1193) provided complete data sets of the Center for Epidemiologic Studies Depression Scale (CES-D) scores, General Self-Efficacy Scale (GSES), and Rosenberg Self Esteem Scale (RSES). This constituted the sample for validation of the JTCI (Table 1). The data collection was done in a classroom setting either by computer or a pen- and paper version.

The regional medical research Ethics committee approved the study.

2.3. Statistics

Descriptives on domain and subscale level of the JTCI were presented in terms of means and standard deviations. Multiple analyses of covariance were performed to test for gender differences controlled for age.

The internal consistency of the scales was determined calculating Cronbach's alpha coefficients, and the factor structure of the data was explored by exploratory factor analysis (EFA) using principal axis factoring with direct oblimin rotation. The structure of temperament and character was tested separately, and the empirically derived factor structure was then tested against the ideal factor matrices with a loading of 1.0 for the items on the factor they are supposed to belong to and loadings of 0.0 on all other factors by orthogonal Procrustes rotation [34]. In the Procrustes rotation analysis congruence coefficients above 0.80 were regarded as equivalent and are actually identical [34,35]. Furthermore, principal component analysis with Promax rotation was separately applied for temperament and character to analyze the factor structure on subscale level. All analyses were conducted with SPSS 19 for Macintosh and PC.

3. Results

3.1. Descriptive statistics and internal consistency of JTCI scales and subscales

Mean scores, standard deviations and Cronbach's alpha coefficients for the JCI scales and subscales, and gender differences are shown in Table 2. The Cronbach's alpha coefficients varied from 0.79 (NS and RD) to 0.85 (HA) for the temperament scales, and from 0.78 (ST) to 0.84 (SD) for character scales based on the total sample, which demonstrates good internal consistency. The Cronbach's alpha coefficients for the subscales varied from 0.50 (PS1) to 0.78 (HA2) for temperament and from 0.33 (SD3) to 0.82 (SD4) for character subscales. The relatively low Cronbach's alpha value (<0.7) is dependent not only on the magnitude of the correlation among the items but also on the number of items in the scale.

Multivariate analyses of covariance showed that girls exhibited significantly higher scores for HA, RD, CO, and ST scales, and lower scores for NS, PS, SD, than boys. But, the differences between the gender were only of some importance in terms of medium effect size for HA (d = 0.32), and of small effect size for CO (d = 0.24), and lower for other scales.

The correlation matrices for the four temperament and three character scales and age are shown in Table 3. The highest correlation was for HA with SD (−0.72), and moderate correlations were obtained for PS with SD (0.49), RD with CO (0.47), PS with CO (0.46), and HA with PS (−0.41). All other correlation coefficients showed weaker (<0.40) relationships. Age showed low correlations with JTCI scales (−0.04 < r < 0.09).

Table 1
Characteristics of the sample.

	Total sample			Subsample for validation		
	Males n = 1032 (%)	Females n = 1043 (%)	Total N = 2075 (%)	Males n = 581 (%)	Females n = 612 (%)	Total N = 1193 (%)
Age N (%)						
- 15 years	69 (6.7)	64 (6.2)	133 (6.4)	45 (7.7)	49 (8.0)	94 (7.9)
- 16 years	415 (40.2)	417 (40.0)	832 (40.1)	203 (34.9)	235 (38.4)	438 (36.7)
- 17 years	331 (32.1)	339 (32.4)	670 (32.3)	195 (33.6)	188 (30.7)	383 (32.1)
- 18 years	217 (21.0)	223 (21.4)	440 (21.2)	138 (23.8)	140 (22.9)	278 (23.3)
Type of upper secondary school						
General orientation		389−67.0		452−74.1		841−70.5
Occupation-focused orientation		192−33.0		160−35.9		352−29.5

Table 2
Internal consistency reliabilities (α), means, standard deviations (SD), and gender differences on the JTCI scales and subscales.

JTCI scales and subscales	Number of item	α	Girls		Boys		F	p value
			Mean	SD	Mean	SD		
Exploratory excitability (NS1)	4	0.68	14.78	2.90	14.76	2.76	0.96	.381
Impulsiveness (NS2)	4	0.61	11.88	2.78	12.22	2.79	7.50	.001
Extravagance (NS3)	3	0.62	9.37	2.70	9.11	2.78	2.55	.078
Disorderliness (NS4)	4	0.76	10.60	3.25	11.34	3.28	23.93	.000
Novelty Seeking (NS)	**15**	**0.79**	**46.63**	**8.09**	**47.42**	**8.13**	**4.72**	**.009**
Anticipatory worry (HA1)	3	0.71	9.91	2.79	8.91	2.78	34.44	.000
Fear of uncertainty (HA2)	4	0.78	11.75	3.50	10.96	3.47	14.35	.000
Shyness (HA3)	3	0.76	9.64	2.94	9.22	3.04	5.93	.003
Fatigability (HA4)	3	0.59	9.05	2.60	8.49	2.60	12.10	.000
Harm Avoidance (HA)	**13**	**0.85**	**40.35**	**8.92**	**37.58**	**8.98**	**25.90**	**.000**
Sentimentality (RD1)	5	0.69	17.74	3.51	16.31	3.64	41.09	.000
Openness to warm communication (RD2)	5	0.68	15.84	3.88	15.68	3.53	0.48	.620
Attachment (RD3)	3	0.60	10.11	2.55	10.25	2.54	0.81	.443
Dependence (RD4)	5	0.59	15.40	3.54	14.84	3.34	6.85	.001
Reward Dependence(RD)	**18**	**0.79**	**59.08**	**9.30**	**57.08**	**9.19**	**12.10**	**.000**
Eagerness of effort (PS1)	3	0.50	9.60	2.47	9.31	2.28	4.66	.010
Work Hardened (PS2)	4	0.63	12.84	2.77	13.72	2.77	31.33	.000
Ambitious (PS3)	4	0.71	12.23	3.16	12.30	3.21	6.34	.002
Perfectionist (PS4)	3	0.63	10.67	2.14	10.77	2.17	2.87	.057
Persistence (PS)	**14**	**0.80**	**45.33**	**7.86**	**46.09**	**7.66**	**6.36**	**.002**
Responsibility (SD1)	4	0.64	13.43	3.10	13.47	3.19	.671	.511
Purposefulness (SD2)	3	0.74	9.98	2.66	10.54	2.66	13.824	.000
Resourcefulness (SD3)	3	0.33	9.98	1.90	10.00	1.98	7.973	.000
Self-acceptance (SD4)	5	0.82	15.77	4.60	17.27	4.53	29.673	.000
Enlightened second nature (SD5)	-	-	-	-	-	-	-	-
Self-Directedness (SD)	**15**	**0.84**	**49.16**	**9.36**	**51.29**	**9.50**	**14.32**	**.000**
Social acceptance (CO1)	3	0.54	10.39	2.38	10.11	2.38	4.29	.014
Empathy (CO2)	4	0.68	14.45	2.68	14.07	2.69	9.35	.000
Helpfulness (CO3)	4	0.76	15.75	2.71	15.36	2.81	13.89	.000
Compassion (CO4)	3	0.53	10.00	2.31	9.70	2.38	7.98	.000
Pure-hearted conscience (CO5)	4	0.47	14.06	2.53	13.64	2.48	10.53	.000
Cooperativeness (CO)	**18**	**0.81**	**64.64**	**8.57**	**62.88**	**8.79**	**18.91**	**.000**
Self-forgetful (ST1)	3	0.62	9.10	2.82	9.00	2.70	0.43	.648
Transpersonal identification (ST2)	3	0.56	8.18	2.49	7.98	2.53	1.70	.183
Spiritual acceptance (ST3)	4	0.81	10.50	4.13	9.70	4.08	12.51	.000
Self-Transcendence (ST)	**10**	**0.78**	**27.80**	**7.18**	**26.69**	**7.13**	**7.35**	**.001**

Note. The F tests for multivariate analyses of covariance with gender as the grouping variable, and age included as a covariate to control for the influence of age (Girls n = 1043; Boys n = 1032).

3.2. Factor structure of the JTCI subscales and factor congruence

Principal component analysis with Promax rotation was separately run for temperament and character subscales (Tables 4 and 5). Several temperament and character subscales had their highest loadings on unexpected factors, e.g. HA4, RD1, PS3, SD3, CO2, ST1. Large secondary loadings also occurred for NS1, RD3, PS1 and CO3.

Table 3
Correlations between temperament and character scales and age (N = 2075).

	NS	HA	RD	PS	SD	CO	ST
HA	−0.05*						
RD	0.20**	−0.14**					
PS	−0.17**	−0.41**	0.24**				
SD	−0.09**	−0.72**	0.21**	0.49**			
CO	−0.21**	−0.10**	0.47**	0.46**	0.25**		
ST	0.21**	0.28**	0.19**	0.03	−0.21**	0.11**	
Age	−0.04*	−0.03	0.00	0.06**	0.03	0.09**	0.03

NS: Novelty Seeking; HA: Harm Avoidance; RD: Reward Dependence; PS: Persistence; SD: Self-Directedness; CO: Cooperativeness; ST: Self-Transcendence.
** $p \leq 0.01$.
* $p \leq 0.05$.

Table 4
Results of principal component analysis of temperament subscales.

Temperament subscales	Factor 1 (HA)	Factor 2 (PS)	Factor 3 (NS)	Factor 4 (RD)
NS1	0.00	**0.47**	**0.51**	0.23
NS2	0.01	0.06	**0.76**	−0.02
NS3	0.03	−0.17	**0.62**	0.14
NS4	−0.06	0.00	**0.78**	−0.28
HA1	**0.82**	−0.03	0.10	0.09
HA2	**0.83**	−0.06	−0.06	−0.03
HA3	**0.77**	0.06	−0.09	−0.28
HA4	0.24	**−0.65**	0.01	0.13
RD1	**0.57**	0.26	0.04	**0.49**
RD2	−0.06	−0.05	0.06	**0.80**
RD3	**−0.41**	0.05	0.22	**0.55**
RD4	−0.01	−0.23	−0.31	**0.87**
PS1	0.05	**0.56**	**−0.44**	0.10
PS2	0.04	**0.89**	0.20	−0.17
PS3	**−0.42**	**0.40**	**−0.41**	−0.01
PS4	0.10	**0.80**	−0.18	0.00
Explained variance (%)	23.50	15.96	13.46	9.10

Promax rotation including factors with eigenvalues >1.
Loadings with absolute values of 0.40 or more are shown in bold.
Theoretically expected loadings have a grey background.
NS: Novelty Seeking; HA: Harm Avoidance; RD: Reward Dependence; PS: Persistence.

The pattern matrices of the EFAs, principal axis factoring, on item level were compared with the ideal matrices (norm matrix: each item with a loading 1.0 for the factor to which the item should belong to and loading 0.0 for all the other factors) by means of Procrustes rotation method. Taking a factor congruence coefficient of 0.80 as an indicator for acceptable factorial congruence), this was found for all JTCI-dimensions (NS: 0.81; RD: 0.88; SD: 0.86; and CO: 0.84 except for HA (0.76), PS (0.77), and ST (0.76). The Procrustes rotation method and the defined criterion were originally developed for comparing results of factor analysis between different samples. When applying this method for comparing results of a factor analysis with an ideal matrix, this criterion is rather strict.

Table 5
Results of principal component analysis of character subscales.

Character subscales	Factor 1 (SD)	Factor 2 (ST)	Factor 3 (CO)
SD1	**0.79**	−0.16	0.05
SD2	**0.79**	0.34	−0.10
SD3	0.32	**0.54**	0.07
SD4	**0.91**	0.06	−0.14
CO1	0.25	−0.25	**0.65**
CO2	−0.07	**0.64**	0.35
CO3	0.01	**0.44**	**0.59**
CO4	−0.28	0.01	**0.80**
CO5	0.09	0.01	**0.75**
ST1	**−0.51**	0.30	−0.16
ST2	0.01	**0.78**	−0.09
ST3	−0.14	**0.73**	−0.15
Explained variance (%)	25.83	21.38	12.36

Promax rotation including factors with eigenvalues >1.
Loadings with absolute values of 0.40 or more are shown in bold.
Theoretically expected loadings have a grey background.
SD: Self-Directedness; CO: Cooperativeness; ST: Self-Transcendence.

3.3. Validity indicators (construct validity)

All JTCI dimensional scores were significantly correlated with the General Self-Efficacy Scale score, all JTCI dimensional scores were furthermore significantly related with the depression index (CES-D total score) except for dimension CO; and with the score of the Rosenberg Self-Esteem Scale except for NS and CO (see Table 6). However, only the correlation coefficients between the JTCI dimensions HA, PS, and SD with the three external criteria were of moderate to high effect size.

4. Discussion

The aim of the current study was to assess the psychometric properties of the Norwegian version of the JTCI among a Norwegian adolescent sample consisting of 2074 individuals in terms of Cronbach's alpha, factor analysis, and validity.

The Norwegian version of the JTCI was found to have good psychometric properties in students ranging in age between15–18 years in terms of internal consistency and validity indicated by significant correlations with depression, self-esteem and self-efficacy. Four temperament and three character factors were successfully extracted yielding good internal consistency ($\alpha = 0.79–0.85$). However, we also found an unexpected strong correlation between HA and SD, indicating that the distinction between these two dimensions has partly been lost in the Norwegian JTCI version. Correlations of this magnitude (over 0.7) have never been observed in any age group with any of the TCI family of tests before this. However, the correlation between HA and SD was also reported to be−0.59 in the German JTCI, which is higher than in the original American version (−0.45) and other translations based on it (usually less than−0.4) [6,23,29,36]. Hence there is a tendency to confound HA and SD in the German test, which appears to be further exaggerated in the Norwegian test. The confounding of HA and SD in the Norwegian JTCI is undesirable because the two dimensions have distinct biological and psychological correlates [13].

The derived factor structure was tested against an ideal model by means of orthogonal Procrustes rotation [34,35]. This represents a very strict criterion, and our findings yielded congruence coefficients of >0.76 for all factors supporting the derived structure. However, we plan to carry out further work on the Norwegian JTCI to improve its correspondence to the original English version of the JTCI, which has a well-differentiated seven-dimensional structure.

Despite our reservations about the fidelity of the Norwegian translation of the German version to the original American JTCI, the current Norwegian test does have

Table 6
Pearson correlation coefficients between the Norwegian JTCI domain scores and the CES-D score, the Rosenberg Self-Esteem Scale score, and the General Self-Efficacy Scale score (n = 1240).

	NS	HA	RD	PS	SD	CO	ST
CES-D	0.09*	0.56**	−0.14*	−0.37**	−0.64**	−0.09*	0.16**
Self-Esteem Scale	0.02	−0.61**	0.20**	0.41**	0.75**	0.10**	0.09*
General Self-efficacy Scale	0.07	−0.45**	0.22**	0.42**	0.52**	0.23**	−0.07

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

psychometric utility as indicated by its proven internal consistency and construct validity. For validation purposes, additional measures were correlated with the JTCI. When correlated with CES-D, Self-Esteem, and General Self-Efficacy, several JTCI domains emerged as significant. The strongest correlations concerning depression was a positive correlation with HA and a negative with SD, and is in line with previous studies [4,37,38]. Furthermore, self-esteem also correlated negatively with HA and positively with SD, which is reasonable given the nature of self-esteem. If an individual holds a low self-esteem, it would seem obvious to be harm avoidant by nature, showing pessimistic attitudes, is worrying a lot, or being shy. Furthermore, an individual would also most likely be perceived as mature, strong, self-accepting, and effective in a sense of high self-esteem, which positively corresponds with high SD. Additionally, the General Self-Efficacy Scale yielded a negative correlation with HA and a positive with SD as well as with PS. This is similar to the association with self-esteem and plausible, since self-efficacy is likely to decrease with harm avoidant emotional reactions and behaviors, and to increase with self-directed personality characteristics.

Based on the original German scoring, gender differences were found with higher scores for HA, RD, SD, and CO among girls than boys, whereas boys scored higher than girls on NS, PS, and ST. The differences were significant, but the relative small effect sizes indicated that the ecological importance is not strong. The gender differences found were the same as previously reported in an adult sample [19] and similar to those found by Luby et al. [23].

The use of the JTCI can contribute in the understanding of adolescent behavior concerning mental health, well-being, self-development and scholastic outcome. A large amount of data indicates that individual differences in personality are causal antecedents that may contribute within the full range of psychopathology [7] providing an argument for the use of JTCI in both mental health care and school settings.

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