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A Psychometric Evaluation of the Revised Temperament and Character Inventory (TCI-R) and the TCI-140

Richard F. Farmer and **Lewis R. Goldberg**
Oregon Research Institute

Abstract

The psychometric properties of the newest version of the Temperament and Character Inventory, the TCI-R, were evaluated in a large (n = 727) community sample, as was the TCI-140, a short inventory derivative. Facets-to-scale confirmatory and exploratory factor analyses of the TCI-R did not support the organization of temperament and character facet scales within their superordinate domains. Five of the 29 facet scales also displayed relatively low internal consistency ($\alpha < .70$). Factor analyses of the TCI-140 item set yielded only limited support for hypothesized item-to-scale memberships. Harm Avoidance, Novelty Seeking, and Self-directedness items, in particular, were not well differentiated. Although psychometrically comparable, the TCI-R and the TCI-140 demonstrate many of the limitations of earlier inventory versions. Implications associated with the use of the TCI-R and TCI-140 and Cloninger's theory of personality are discussed.

Keywords

Temperament and Character Inventory; TCI-R; TCI-140; psychometric evaluation

Cloninger's (1986, 1987a, 1998, 2003) "unified biosocial" model of personality has had considerable influence within psychiatry and psychology during the last 20 years. This model, for example, has served as a framework for investigations into the stability of personality over time (Sigvardsson, Bohman, & Cloninger, 1987), the cross-cultural commonality versus specificity of personality traits (Svrakic, Przybeck, & Cloninger, 1991), the continuity of normal and pathological personality attributes (Cloninger & Svrakic, 1992), and the differentiation among various forms of pathological personality traits (Svrakic, Whitehead, Przybeck, & Cloninger, 1993). Studies based on Cloninger's biosocial model have also examined individual differences in associative and instrumental learning (Corr, Pickering, & Gray, 1995; Farmer et al., 2003), personality variability within families of disorders (e.g., the eating disorders; Fassino et al., 2002), and the identification of distinct groups of persons within diagnostic classes (e.g., among alcoholics; Cannon, Clark, Leeka & Keefe, 1993; Cloninger, 1987b).

Other lines of research within this framework have explored the heritability (Ando et al., 2002; Heath, Cloninger, & Martin, 1994) and genetics (Cloninger, 1998; Herbst, Zonderman, McCrae, & Costa, 2000) of personality, as well as brain functions and processes associated with personality variations (Hansenne et al., 2000; Peirson et al., 1999). Applied research based on Cloninger's model has evaluated responses to therapies as a function of variations of temperament and character dimensions (Joyce, Mulder, McKenzie, Luty, & Cloninger, 2004; Sato et al., 1999). As illustrated by these examples, Cloninger's theory of personality has been

Please address editorial correspondence to: Richard F. Farmer, Oregon Research Institute, 1715 Franklin Blvd. Eugene, Oregon 97403, Tel: 541-484-2123, ext. 2124, Fax: 541-484-1108, rfarmer@ori.org.

highly influential and broadly applied to a number of important topics, with studies providing equivocal support for key assumptions of his model.

Centrally important assessment tools used in investigations of Cloninger's biosocial theory include the Tridimensional Personality Questionnaire (TPQ; Cloninger, Przybeck, & Svrakic, 1991), and its successors, the Temperament and Character Inventory (TCI; Cloninger, Przybeck, Svrakic, & Wetzel, 1994) and the revised Temperament and Character Inventory (TCI-R; Cloninger, 1999). The TPQ and the TCI have been found to have significant psychometric shortcomings (reviewed below), and the TCI-R has received only limited psychometric evaluation, with the only published studies to date based on non-English-language versions of the inventory, namely French (Hansenne, Delhez, & Cloninger, 2005; Pelissolo et al., 2005), Spanish (Gutierrez-Zotes et al., 2004), Italian (Fossati et al., 2007), and Swedish and German (Brändström, Richter, & Nylander, 2003). To our knowledge, there are no published reports that have investigated the properties of the English-language version of the TCI-R. The purpose of the present research is to conduct a psychometric evaluation of the English-language TCI-R as well as a shortened inventory proposed by Cloninger, the TCI-140.

Cloninger's Initial Model of Temperament and the TPQ

Cloninger's (1986, 1987a) initial elaborations of his biosocial model stressed three dimensions of "temperament": Novelty Seeking (NS), Harm Avoidance (HA), and Reward Dependence (RD). Formulations of these temperament dimensions included descriptions of their hypothesized associations with neuroanatomy, neurophysiological and neurochemical processes, behavioral tendencies (e.g., approach, avoidance, escape), and sensitivity and responsiveness to various environmental events (e.g., novelty, reward, punishment, discriminative stimuli, unconditioned stimuli). Temperament dimensions were viewed as genetically independent (Cloninger, 1987a), largely uninfluenced by environmental events or circumstances, and relatively stable over the lifespan (Cloninger, 2003).

Cloninger (1986, 1987a) has described central and associated features of his temperament constructs. Like other temperament dimensions, NS is regarded as heritable and associated with the experience of intense excitement in the presence of novel stimuli or cues that signal reward or relief from aversion. Individuals high in NS are hypothesized to engage in frequent exploratory behavior, seek rewarding events, and avoid or escape from monotonous or boring situations. HA is assumed to be associated with a tendency to be especially sensitive and responsive to cues that signal punishment or novelty. Individuals high on this dimension are also thought to be behaviorally inhibited, highly sensitive to the effects of behavioral extinction, and more likely to avoid situations experienced as aversive. Finally, RD is hypothesized to be associated with the tendency to respond strongly to conditioned signals for reward, particularly those social in nature. Individuals high in RD are also thought to be especially sensitive to relief from aversion and resistant to the effects of extinction. Cloninger (1987a) further differentiated these temperament dimensions according to associated neurochemical functions.

Until the early 1990s, the TPQ was the principal instrument used to assess Cloninger's temperament dimensions. The items for this inventory were rationally derived and intended to measure traits specified within the framework of Cloninger's (1986, 1987a) biosocial model. The TPQ, however, was subsequently discovered to suffer from a number of psychometric limitations. Several of the TPQ facet scales, for example, characteristically evidenced unacceptably low internal consistency coefficients (Cannon et al., 1993; Cloninger et al., 1991; Sher, Wood, Crews, & Vandiver, 1995), and the internal consistency estimates for several of the domain scales also tended to be relatively modest in various samples compared to other major personality inventories.

Factor analytic studies of the TPQ and subsequent revisions have largely been conducted on facet scale scores rather than at the item level. Exploratory and confirmatory factor analytic studies of the hypothesized three-factor structure of the TPQ facet scales have produced mixed results (Bagby, Parker, & Joffe, 1992; Cannon et al., 1993; Earleywine, Finn, Peterson, & Phil, 1992; Parker, Bagby, Joffe, 1996; Sher et al., 1995; Waller, Lilienfeld, Tellegen, & Lykken, 1991), thus challenging some of the structural assumptions underlying Cloninger's initial temperament model.

Cloninger's Model of Temperament and Character and the TCI

In the early 1990s, Cloninger's biosocial model underwent considerable revision and extension (Cloninger & Svrakic, 1992; Cloninger, Svrakic, & Przybeck, 1993). A fourth temperament dimension was recognized, Persistence (PS). In the TPQ, persistence was regarded as a facet of RD, specifically RD2. In multiple factor analytic studies, however, this facet scale was found to emerge on its own factor (Cloninger et al., 1993). In Cloninger's subsequent theoretical papers, PS was regarded as an independent dimension of temperament. In the TCI, the 8-item former facet RD2 was used to assess the PS domain.

Another significant change from the TPQ to the TCI was the introduction of three dimensions of "character": Self-directedness (SD), Cooperativeness (C), and Self-transcendence (ST). The inclusion of the character dimensions into the biosocial model of personality and corresponding scales in the TCI represented an effort to incorporate "the role of character and social learning in motivated behavior" (Cloninger & Svrakic, 1992, p. 84). Whereas temperament was thought to reflect genetic influences on personality, character was regarded as shaped by environmental and cultural learning. Cloninger has provided little background information on the theoretical or conceptual influences that gave rise to these character scales. One consideration was apparently based on the observation that the TPQ-assessed temperament scales did not explain variations in maturity among adults nor predict the presence of significant personality disorder pathology (Cloninger, 2003). Based on these considerations, plus influences derived from humanistic, transpersonal, and psychodynamic theories, Cloninger rationally developed new character scales to assess (a) the self-concept in isolation, (b) the self-concept in relation with others, and (c) the self-concept in relation to the world as a whole (Cloninger, 2003; Cloninger et al., 1993). Individuals high in SD are regarded as autonomous and able to regulate their actions and demonstrate goal- and value-directed behaviors. Persons high in C are assumed to identify with, accept, and be tolerant of others. Individuals high in ST regard themselves as integral parts of the universe, and TCI items related to this domain assess experiences associated with meditative practice, spirituality, and a sense of connectedness to all living things.

During the initial development of the TCI, five 15-item facet scales for each character domain were tested in a sample of university students. Items were subsequently discarded if there was little variability in responses (i.e., $\leq 20\%$ or $\geq 80\%$ endorsement) or if items evidenced low correlations with other items that conceptually belonged to the same scale. From this process, 13 facet scales for three character dimensions were retained (Cloninger et al., 1993), along with the original 107 temperament items from the TPQ. The resultant TCI item set consisted of 226 items (with subsequent versions of the TCI expanded to 240 items; e.g., Cloninger, 1992), and like the TPQ, used a dichotomous "true/false" response format.

Cloninger et al. (1993) reported internal consistency coefficients for the domain and facet scales of the TCI based on a convenience sample of community volunteers (shoppers at a mall; N = 300). Although there was some improvement in internal consistency coefficients for the four temperament domain scales (*range*: .65 to .87), facet scale internal consistencies tended to be modest (*range*: .54 to .76; *mdn* = .69). The internal consistency coefficients for the three

character domain scales were adequate (*range*: .84 to .89), but they were relatively modest for the associated facet scales (*range*: .47 to .86; *mdn* = .70). Svrakic et al. (1993) reported similar internal consistency coefficients based on responses from psychiatric inpatients.

Factor-analytic findings on the TCI are noteworthy as they frequently reveal sizable cross-loadings or result in factors defined by an admixture of temperament and character facet scales, findings that do not support Cloninger's conceptual distinctions among the temperament and character domains. In Cloninger et al. (1993), for example, the SD4 facet scale loaded more highly on a factor defined by C facet scales when the character facets were analyzed separately. When temperament and character facets were analyzed together, two of the RD temperament facet scales loaded more highly on a factor defined by C facets, and a third RD facet scale (RD2, or Persistence) loaded on a factor that was primarily defined by that facet. Overall, the hypothesized distinct and multi-faceted nature of RD was not supported.

Other researchers who have analyzed TCI facet scales with exploratory (Herbst et al., 2000), targeted or Procrustes (Ball, Tennen & Kranzler, 1999), and confirmatory (Gana & Trouillet, 2003) factor analytic methods have also reported findings that are inconsistent with hypothesized seven-factor structure. Item-to-facet scale and item-to-domain scale analyses also did not consistently support item membership with hypothesized facet and domain scales (Ball et al., 1999, Note [1]; Cannon et al., 1993; Gana & Trouillet, 2003; Parker et al., 1996; Tomita et al., 2000). Overall, these findings indicate that responses to the TCI do not conform to the theory that is the basis for the inventory, thus raising questions about the overall utility of theory.

The Revised TCI (the TCI-R)

The TCI-R (Cloninger, 1999) assesses the same temperament and character domains as the TCI. The most significant revisions in the TCI-R included the further development and refinement of the Persistence (PS) temperament domain. In the TCI-R, the PS is now assessed with 35 items that have been subdivided into four facets scales consisting of 8 to 10 items each. Another modification found in the TCI-R is a switch from a "true/false" response format to a 5-point Likert scale format (definitely false, mostly or probably false, neither true nor false or about equally true and false, mostly or probably true, definitely true). Overall, of the 240 items found in the TCI-R, 51 items (including 5 validity items) are either new or rewritten, with the remaining 189 items unmodified carryovers from the TCI (Fossati et al., 2007).

As noted earlier, the psychometric properties of the TCI-R have not been fully evaluated, and efforts to date have been limited to non-English language versions. These published studies suggest some psychometric advantages of the TCI-R over its predecessors. The internal consistency of the domain scales showed some improvement, although some of the facet scales continued to be relatively weak (Brändström et al., 2003; Fossati et al., 2007; Hansenne et al., 2005; Pelissolo et al., 2005). Although there is an indication of factor congruence between TCI and TCI-R domain scales and congruence in the TCI-R factor structures between German and Swedish samples (Brändström et al., 2003), some facet scales of the TCI-R continue to be more strongly associated with temperament or character dimensions that differ from their hypothesized domains (Fossati et al., 2007; Hansenne et al., 2005). Given previous reports of substantial cross-loadings among TCI temperament and character scales when factor analyzed within the same model (Ball et al., 1999; Herbst et al., 2000), it presently remains unclear if

[1]A website affiliated with Cloninger's research group, http://psychobiology.wustl.edu/research/inResearch.htm, describes a short inventory derived from the TCI-R item set, the TCI-140, which is suggested to be the "standard short form of the future." We have not, however, been able to locate any published studies on the English-language version of the TCI-140.

the hypothesized relative independence of character and temperament dimensions is evident in the English language version of the TCI-R.

The Present Research

Some of the failures to support central hypotheses of Cloninger's theory (e.g., Ando et al., 2004; Ball, Tennen, Poling, Kranzler, & Rounsaville, 1997; Comings, Gonzales, Saucier, Johnson, MacMurray, 2000; Chapman, Mayer, Specht, Farmer, & Field, 2003; Hansenne et al., 2000; Herbst et al., 2000; Mulder, Joyce, & Cloninger, 1994; Newman et al., 2000), including the structural features associated with responses to his inventories (e.g., Ball et al., 1999; Gana & Trouillet, 2003; Herbst et al., 2000), might be related to the psychometric problems that have plagued earlier versions of the TPQ and TCI, as outlined above. Because the TPQ and TCI were frequently used to operationalize personality dimensions of Cloninger's theory, and because these measures have known psychometric limitations, it is not always clear if failures to support the assumptions of Cloninger's unified biosocial theory are the result of problems with the theory, weaknesses in the measures used to test it, or a combination of both. In recognition of this dilemma, Ball et al. (1999) and Earleywine et al. (1992) have suggested that temperament and character constructs and items used to assess them might be considered for re-evaluation and revision in light of psychometric problems associated with the TPQ and TCI. Both construct revision and measurement modifications are evident in the TCI-R which, to date, has only been evaluated in non-English language samples. The main purpose of this research is to psychometrically evaluate Cloninger's TCI-R in a community-based English-speaking sample and to evaluate his proposed shortened inventory (i.e., the TCI-140).

METHOD

Participants

Beginning in 1993, homeowners in the Eugene-Springfield (Oregon) metropolitan area were recruited for participation in a series of assessments. The initial sample consisted of about 850 individuals (50% female) between the ages of 18 to 85. For this study, a total of 727 persons (57.2% female) provided usable TCI-R data. The mean age of this sample in 1993 was 51.3 years (*SD* = 12.8), with the TCI-R completed about three years later. A large majority of participants were Caucasian (96.4%), and received at least some college education (81.8%) or vocational training (6.2%). At the point of study entry, 42.1% of participants were fully employed, 15.1% were employed part time, 8.9% identified themselves as homemakers, 21.5% were retired, and 2.3% were unemployed. The remaining participants either did not report their employment status or indicated "other."

Measures

Temperament and Character Inventory–Revised (TCI-R) and TCI-140—The TCI-R (Cloninger, 1999) is a 240-item inventory that is the latest measure of Cloninger's theory of temperament and character, and reflects his most recent hypotheses concerning the higher-order dimensions of personality (Cloninger, 2003). Participants in the present sample were administered a longer predecessor of the TCI-R, the TCI-295, that contains additional items beyond those included in the TCI-R. The response option format of the TCI-295 ranged from 1 = *definitely false* to 5 = *definitely true*. These are the same response options used in the current version of the TCI-R. TCI-295 items that appear in TCI-R were used in the calculation of scale scores, with the remaining items not considered further. Table 1 lists the seven temperament and character domains, as well as hypothesized characteristics of low and high scorers on the TCI-R scales.

A shortened TCI-R inventory, the TCI-140, was developed by Cloninger (1999), and consists of 136 TCI-items related to his seven temperament and character domains plus four response accuracy/carelessness items. The first 140 items of the TCI-R constitute the TCI-140.

Analytic Approach for Evaluating Structural Features of the TCI-R Facet Scales and TCI-140 Item Sets—Structural features of the TCI-R, its predecessors, and related inventories (e.g., the Preschool TCI, Constantino, Cloninger, Clarke, Hashemi, & Przybeck, 2002; the Junior TCI, Luby, Svrakic, McCallum, Przybeck, & Cloninger, 1999), have been analyzed in a variety of ways. When consideration is restricted to reports authored or co-authored by Cloninger, there is no clear indication as to which methodological approach would be most theoretically consistent with the underlying model. Exploratory factor analyses of facet scales or items sets have, for example, been based on orthogonal (Constantino et al., 2002; de la Rie, Duijsens, Cloninger, 1998), oblique (Cloninger et al., 1993; Hansenne et al., 2005), or Procrustes (Fossati et al., 2007) rotation. Confirmatory factor analytic methods have also been employed (Luby et al., 1999).

With regard to the temperament scales, Cloninger et al. (1993) has suggested that the temperament dimensions are “independently heritable” (p. 975); however, shared environmental influences might result in relatively small intercorrelations among the four temperament domains (Cloninger, 1987a). With regard to the character scales, Cloninger et al. (1993; pp. 978–979) has reported that their development was informed by the absence of associations between important behaviors or personality attributes and the temperament scales. During the development of the TCI character scales, however, “[no] selection was made based on intercorrelations between factors (p. 983),” suggesting that orthogonality was not necessarily a structural goal for the character scales. Cloninger, Svrakic, and Svrakic (1997, p. 886) further suggested that “each [character facet scale] is moderately correlated with other components in the same dimension but weakly correlated with components in other dimensions.” Additionally, when relations among temperament and character domains are considered, Cloninger et al. (1997, p. 883) asserted that “[t]emperament constrains character development but does not fully determine it because of the systematic effects of social learning and the stochastic effects of experience.” This latter suggestion would imply some covariation among temperament and character domains. In the aggregate, these theoretical considerations suggest that oblique rotation methods would be the most theoretically consistent approach for evaluating the structural properties of the TCI-R.

In the determination of the number of factors to extract, the eigenvalue > 1.0 rule has usually (Cloninger et al., 1993; de la Rie et al., 1998; Fossati et al., 2007) but not always (Hansenne et al., 2005) been a primary selection consideration by Cloninger and his colleagues. This method of factor extraction, however, has been strongly criticized (e.g., Goldberg & Velicer, 2006). For the EFA analyses presented in subsequent sections, decisions concerning the numbers of factors to extract were based on scree plots of eigenvalues and the hypothesized theoretical structure of the TCI-R.

Finally, it remains unclear from Cloninger’s reports whether temperament and character items or facets should be included in the same analysis or be subject to separate analyses. In Cloninger et al. (1993), de la Rie et al, (1998), and Fossati et al. (2007), for example, facet scales or items belonging to all seven domains were included in the same analysis. In Constantino et al. (2002) and Hansenne et al. (2005), however, temperament and character facets scales or their corresponding item sets were analyzed in separate factor analyses. In the present study, the seven temperament and character dimensions of Cloninger’s model were evaluated simultaneously given (a) the different hypothesized etiological determinants of temperament and character (i.e., biology versus social learning; see Cloninger et al., 1993), (b) the suggestion that the “distinction between temperament and character appears to correspond to the

dissociation of two major brain systems for learning and memory that are present in humans: the procedural versus propositional systems" (Svrakic, Svrakic, & Cloninger, 1996, p. 251), and (c) the repeated description by Cloninger and colleagues of Cloninger's model of personality as a "seven factor model" (e.g., Cloninger, 1998; Cloninger & Svrakic, 1994; Svrakic et al., 1993).

In our analyses of the structural features of the TCI-R facet scales and TCI-140 item set, we also performed confirmatory factor analyses (CFA). The appropriateness of confirmatory factor analysis (CFA) for the evaluation of personality structure has been discussed and debated. McCrae, Zonderman, Costa, Bond, and Paunonen (1996), for example, have suggested that CFA approaches may not be appropriate because of the multi-factor nature of most personality items and scales. Consequently, we present the outcomes of these analyses with the caveat that this might constitute an overly conservative approach for testing the structural validity of the TCI-R facet organization and the TCI-140 item-to-scale membership.

Because the numbers of items that define the facet scales in the TCI-140 range between 2 to 6, no attempt was undertaken to evaluate the facet-level of analysis for this short version. Instead, for the TCI-140, data analyses are focused at the domain and item-levels. For the TCI-R, our analyses emphasized both the domain and facet-levels of analysis.

RESULTS

Internal Consistency of TCI-R Facet Scales

Consistent with research on the TCI and TPQ, alpha coefficients for the TCI-R facet scales varied markedly (Table 2). In only one instance (ST3) was $\alpha \geq .90$. Alpha coefficients for several facet scales ranged between .80 and .89 (NS3, HA1, HA3, HA4, RD2, RD3, PS1, SD4, SD5, and C4). A larger number of scales had coefficients that ranged between .70 and .79 (NS1, NS2, HA2, RD1, PS2, PS3, PS4, SD1, SD2, SD3, C1, ST1, and ST2). Alpha coefficients for the remaining facet scales were < .70: NS4 ($\alpha = .62$), RD4 ($\alpha = .58$), C2 ($\alpha = .67$), C3 ($\alpha = .64$), and C5 ($\alpha = .58$). Mean and median alphas for the 29 facet scales were both .77.

Whereas coefficient alpha is influenced by the number of items in a scale, the mean item correlation provides an index of internal consistency that is unaffected by scale length. As illustrated in Table 2, five facet scales had low internal consistency (mean item $r < .20$) when evaluated by this method: NS1, NS4, RD4, C3, and C5.

Structural Analyses of the TCI-R Facet Scales

When the 29 facet scales of the TCI-R were subjected to a CFA of its hypothesized seven-factor structure, a poor fit was observed: X^2 (356, N = 727) = 3393.92, $p < .0001$; CFI = .71, TLI = .67, RMSEA = .11, SRMR = .12. Consequently, the hypothesized structure of the TCI-R was not supported in this analysis.

The TCI-R facet scales were also subjected to an EFA analysis with oblique rotation, findings from which are presented in Table 3. Coefficients from the factor structure and pattern matrices are presented, as they provide different perspectives on the association of factors to domains. The factor structure matrix consists of bivariate correlations between facet scales and the factors. Values in the factor pattern matrix are adjusted for all other facets in the model, and indicate the importance of a given facet to the factor with variance shared with other facets removed.

Values for the first 10 eigenvalues were: 7.00, 3.71, 2.93, 2.39, 1.58, 1.08, .94, .76, .72, and .67. A scree plot suggested that no more than 7 or 8 factors should be extracted. A seven-factor solution was subsequently rotated based on its correspondence with the underlying theory of

the TCI-R. This solution accounted for 68% of the cumulative variance, with most of this accounted for by Factor 1 (24%), which was a blend of all of the HA facet scales and four of the five SD facet scales. Factor 2 was primarily defined by the PS facet scales, while Factor 3 included four of the five C facet scales and two of the four RD facet scales. Factor 4 was primarily defined by ST facets, and Factor 5 was largely defined by three of RD facet scales (RD1 was split between Factors 3 and 5). Factor 7 was mainly defined by three of the four NS facet scales. Factor 6 was not interpretable as it included a mix of facet scales associated with several temperament and character domains.

Structural Evaluations of the TCI-140 Item Set

The 136 temperament and character items of the TCI-140 were subjected to CFA analyses to evaluate the hypothesized membership of items to the seven domains. This analysis indicated a poor fit in relation to the hypothesized seven-factor model, X^2 (9023, N = 727) = 26,837.01, $p < .0001$; CFI = .56, TLI = .55, RMSEA = .05, SRMR = .09.

These 136 TCI-140 items were also subjected to an EFA analysis with oblique rotation. Values for the first 10 eigenvalues were: 16.12, 9.52, 8.60, 6.10, 4.49, 3.46, 2.62, 2.40, 2.10, and 2.03. A scree plot suggested that no more than 7 factors should be extracted. The seven-factor solution accounted for 37% of the cumulative variance. The rotated pattern and structure matrices generally revealed modest to moderate primary loadings and frequent cross-loadings.[2] An examination of the structure matrix revealed that only 29% (40 of 136) of the highest item loadings were ≥ −.60 or ≤ .60. Factor 1 was largely defined by items from SD and HA (−) domains. Of the HA items, 65% (13 of 20) loaded highest on this first factor, whereas 90% (18 of 20) of SD items had the highest loadings on this factor. All PS items (20 of 20) loaded highest on Factor 2. RD items primarily defined Factor 3, where 16 of 20 (80%) loaded highest on this factor. Factor 4 was largely defined by ST items, with 14 of 16 items (88%) loading highest on this factor, and items from the C domain tended to load highest on Factor 5 (14 of 20 items, or 70%). Factor 6 was largely a blend of NS (−) and HA items. Nine of 20 NS items (45%) and 6 of 20 HA items (30%) loaded highest on this factor. Factor 7 was largely defined by a majority of the remaining NS items, with 9 of 20 items (45%) loading highest on this factor. Overall, NS, HA and SD items were poorly differentiated in this analysis.

Descriptive Data for TCI-R and TCI-140 Domain Scales

Distribution characteristics and internal consistencies—Table 4 presents descriptive statistics for the TCI-R and TCI-140 domain scales. Included in the table are two indices of internal consistency (i.e., coefficient alpha and the mean item intercorrelation). The TCI-R domain scales demonstrate good internal consistency when indexed by coefficient alpha (range of α = .84 to .92). Alpha coefficients for the TCI-140 domain scales were often comparable to the original TCI-R domain scales, and in each instance were ≥ .80 with but one exception (for the NS domain scale, α = .78). The mean item intercorrelations for the domain scale items, however, suggest some variability in internal consistency among scales. Particularly noteworthy were the low mean item correlations for the NS domain scales of the TCI-R and TCI-140 (.14 and .15, respectively).

Similarity of domain scales across inventory versions—TCI-140 domain scales correlated highly with their corresponding TCI-R counterparts. These seven correlations ranged from .93 to .98 domain scales (*mean r* = .96; *median r* = .98), and indicated that the TCI-140 domain scales assess constructs very similar to those measured in the TCI-R.

[2]Output from this analysis is available from the first author.

Table 5 presents the intercorrelations among the domain scales, separately for the TCI-R and TCI-140. As revealed in the table, the patterns of intercorrelations are similar for both versions of the inventory, and are similar to those previously reported for the TCI (Cloninger et al., 1993). Noteworthy is the observation that 6 of 21 (29%) of the intercorrelations among the domain scales for both the TCI-R and TCI-140 exceeded or equaled an absolute value of .30, suggesting a moderate degree of overlap among several of the scales. The degree of overlap between HA/SD and SD/C for both inventory versions is particularly high.

DISCUSSION

Cloninger's (1987a, 2003) unified psychobiological model of personality and psychopathology has had considerable influence in framing research questions in psychiatry and, to a lesser but growing degree, in psychology. Cloninger's inventories that measure the temperament and character dimensions of his model have now been used in hundreds of published reports. Although empirical support for the fundamental theoretical assumptions and predictions arising from Cloninger's theory has been mixed, it is frequently difficult to disentangle the limitations of the theory from limitations of the measures that serve as the primary tools to assess central concepts of the theory. The TCI-R (Cloninger, 1999) has been presented as "a big break in terms of content" (Sansone Family Center for Wellbeing, 2007) over previous versions of the TCI and the TPQ. The English-language version of the TCI-R and the short inventory proposed by Cloninger (TCI-140), however, currently suffer from an absence of published research on their psychometric properties. To our knowledge, the present research represents the first published work on this topic.

In a large community sample, the hypothesized associations of the TCI-R facet scales to domains were not supported by confirmatory or exploratory factor analyses. In the exploratory factor analysis (EFA), and consistent with findings reported by others with the TCI (e.g., Herbst et al., 2000), Harm Avoidance (HA) and Self-directedness (SD) facets were not clearly distinguishable, with four facet scales from each domain primarily defining the first factor. Also consistent with past research with the TCI, Conscientiousness (C) and Reward Dependence (RD) facets were also not well differentiated. Similar to these past studies (Cloninger & Svrakic, 1992; Herbst et al., 2000), RD1 loaded higher on a factor largely defined by C facet scales, and RD4 was split equally between two factors largely defined by RD and C facet scales. Furthermore, and consistent with findings reported Hansenne et al. (2005) with the French version of the TCI-R, SD4 had several cross-loadings and did not predominantly load on a factor defined by other SD facet scales.

An item-to-scale confirmatory factor analysis (CFA) and EFA of the TCI-140 also failed to support the hypothesized designation of items to domain scales. HA/SD and HA/NS items, in particular, were poorly differentiated. These findings, coupled with the factors derived from analyses of the TCI-R facet scales, suggest that responses to the TCI-R and TCI-140 by community participants do not correspond to the underlying theory of these inventories. Overall, these findings coupled with those that suggest marginal internal consistencies of several facet scales imply modest utility associated with the facet-level of analysis for elucidating characteristics of the TCI-R dimensions.

The findings summarized above suggest that the TCI-R suffers many of the same psychometric difficulties of its predecessors and is far from being the "big break" that it has been characterized to be in the evolution of Cloninger's measures of temperament and character. Rather, the present research suggests that the TCI-R offers little in the way of psychometric improvements over previous versions. Such an outcome might have been expected given that large majority of TCI-R items (79%) were taken directly from the TCI without modification (Fossati et al., 2007).

Findings from this study and others that demonstrate psychometric weaknesses of the TCI-R and its predecessors not only raise questions about how personality is operationalized in Cloninger's theory, but also present a significant challenge to the theory itself. Several of the central assumptions underlying Cloninger's theory have not received much support. Although it is not possible to completely disentangle limitations of the theory from limitations of the measure used to test the theory, a growing body of research suggests, at best, only weak support for the basic assumptions of his model. Cloninger et al. (1993), for example, suggested that each dimension of temperament is independently heritable, while character dimensions are largely the product of social learning and other environmental influences. There is, however, an indication that the temperament and character dimensions of his model do not greatly differ in heritability, and that shared environmental influences do not contribute to familial aggregation of the three character dimensions (Gillespie, Cloninger, Heath, Martin, 2003; see Ando et al., 2002, Ando et al., 2004, and Comings et al., 2000, for related findings). Furthermore, there is some evidence that nonshared environmental influences rather than genetic factors maximally discriminate temperament from character domains (Ando et al., 2004). These observations call into question Cloninger's assertion that temperament and character dimensions are primarily distinguished by genetic etiology. In a further challenge to the operationalization of personality in his inventories, there is also a suggestion of differences in genetic influences among some facets within the domains. That is, some domains consist of genetically heterogeneous traits that, in some instances, demonstrate stronger genetic associations with facets from other domains (Ando et al., 2004).

Cloninger's (1987a) theory of neurochemical processes associated with extremes in temperament further suggests that individuals would maximally benefit from medications that target specific neurotransmitters hypothesized to be associated with temperament extremes (e.g., dopaminergic drugs might be more effective than other medications for treating problems associated with extreme NS, serotonergic drugs might be most helpful for persons high in HA, and noradrenergic drugs most effective among those with extreme elevations in RD; see Cloninger, 1987a, and Svrakic et al., 2002). Cloninger and his colleagues (e.g., Svrakic et al., 2002) have further suggested that psychotropic medications should not alter character domain scores. Data relevant to these assumptions are, at best, mixed. Although serotonergic activity has been theoretically linked to HA in Cloninger's theory, for example, studies provide equivocal support for this assertion (Hansenne et al., 1997; Peirson, et al., 1999; Pfohl, Black, Noyes, Kelley, & Blum, 1990). Serotonergic activity has also been associated with the SD character dimension (Peirson, et al., 1999).

Pharmacological studies that examined the associations between extremes in temperament types and classes of antidepressants that primarily act on certain neurotransmitters or prevent their breakdown have produced highly inconsistent findings (Joyce, Mulder & Cloninger, 1994; Joyce et al., 2004; Nelson & Cloninger, 1995, 1997; Newman et al., 2000; Sato et al., 1999; Tome, Cloninger, Watson & Isaac, 1997). These mixed findings challenge assertions concerning simple one-to-one associations between temperament extremes and neurotramitter functions, as well as the utility of temperament profiles in informing choices among pharmacological interventions. Additionally, in some research, there is an indication that character rather than temperament dimensions better predict response to antidepressant treatment (Sato et al., 1999), which is also inconsistent with Cloninger's model (Svrakic et al., 2002).

Tests of Cloninger's (1987a) hypotheses concerning the association of temperament with sensitivity to environmental cues (e.g., to novelty, reward and punishment cues) and responsiveness to such cues (e.g., exploratory pursuit, appetitive approach, passive avoidance) have also yielded mixed findings (Chapman et al., 2003; Corr et al., 1995; Farmer et al., 2003). There are further indications that the associations between TCI temperament dimensions

and prototypical stimulus-response profiles are not as simple and straightforward as Cloninger originally proposed (Farmer, Whitehead, & Woolcock, 2007).

Finally, Cloninger's theory asserts that temperament and character development occur sequentially, with temperament development preceding that of character (Cloninger & Gilligan, 1987). Findings from Constantino et al. (2002), however, indicate that temperament and character dimensions among preschoolers are about equally stable between 30 months to 65 months of age, and that character dimension scores do not significantly correlate with age.

Overall, there is not strong support for the main assumptions of Cloninger's theory, nor is their solid support for the hypothesized structure of personality traits as measured in several versions of his inventory. Perhaps because of its appealing simplicity and readily testable hypotheses, Cloninger's theory has frequently served as the foundation for research investigations into personality and psychopathology. Although such investigations have produced many useful findings, it is becoming increasingly clear that the model and the measures used to operationalize its main elements have several significant flaws, and have limited utility in exploring and explaining important processes related to personality and psychopathology.

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Table 1

Domain scales of the TCI-R and hypothesized characteristics of low and high scorers on personality dimensions.

Personality dimensions	Characteristics of persons low and high on TCI-R dimensions[a]
Temperament Dimensions	
Novelty Seeking (NS)	*Low*: Reserved, rigid, frugal, stoical.
	High: Exploratory, impulsive, extravagant, irritable.
Harm Avoidance (HA)	*Low*: Optimistic, daring, outgoing, vigorous
	High: Pessimistic, fearful, shy, fatigable.
Reward Dependence (RD)	*Low*: Critical, aloof, detached, independent.
	High: Sentimental, open, warm, sympathetic.
Persistence (PS)	*Low*: Apathetic, spoiled, underachiever, pragmatist.
	High: Industrious, determined, ambitious, perfectionist.
Character Dimensions	
Self-Directedness (SD)	*Low*: Blaming, aimless, inept, vain.
	High: Responsible, purposeful, resourceful, self-accepting.
Cooperativeness (C)	*Low*: Prejudiced, insensitive, hostile, revengeful.
	High: Reasonable, empathic, helpful, compassionate.
Self-Transcendence (ST)	*Low*: Undiscerning, empirical, unimaginative, dualistic, practical.
	High: Judicious, intuitive, inventive, transpersonal, spiritual.

[a] From Cloninger (2003).

Table 2

Descriptive statistics for the TCI-R facet scales

TCI-R facet scales	Number of items in scale	Skew	Kurtosis	Internal consistency	
				Mean item *r*	Coefficient alpha
NS1: Exploratory excitability	10	−.24	.11	.19	.70
NS2: Impulsiveness	9	.27	.14	.24	.74
NS3: Extravagance	9	.43	.00	.33	.82
NS4: Disorderliness	7	.36	−.18	.19	.62
HA1: Anticipatory worry	11	.60	.63	.27	.80
HA2: Fear of uncertainty	7	−.15	−.07	.30	.75
HA3: Shyness	7	.18	−.62	.49	.87
HA4: Fatigability	8	.52	.10	.42	.85
RD1: Sentimentality	8	−.24	.25	.23	.71
RD2: Openness to warm communication	10	−.38	−.26	.38	.86
RD3: Attachment	6	−.23	−.64	.46	.84
RD4: Dependence	6	−.32	.01	.18	.58
PS1: Eagerness of effort	9	−.27	.28	.35	.83
PS2: Work hardened	8	−.24	.14	.28	.75
PS3: Ambitious	10	−.09	−.02	.28	.79
PS4: Perfectionist	8	−.08	−.26	.28	.76
SD1: Responsibility	8	−.52	.26	.31	.78
SD2: Purposefulness	6	−.82	.91	.34	.76
SD3: Resourcefulness	5	−.62	.60	.34	.72
SD4: Self-acceptance	10	−.39	−.02	.32	.82
SD5: Enlightened second nature	11	−.65	.78	.32	.84
C1: Social acceptance	8	−.58	.65	.30	.77
C2: Empathy	5	−.42	.55	.29	.67
C3: Helpfulness	8	−.12	−.26	.18	.64
C4: Compassion	7	−1.14	1.25	.53	.88
C5: Pure-hearted conscience	8	−.51	−.07	.16	.58
ST1: Self-forgetfulness	10	.30	−.11	.27	.79

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TCI-R facet scales	Number of items in scale	Skew	Kurtosis	Internal consistency: Mean item *r*	Internal consistency: Coefficient alpha
ST2: Transpersonal identification	8	.13	−.28	.29	.77
ST3: Spiritual acceptance	8	−.30	−.88	.52	.90

Table 3

EFA analysis of the TCI-R facet scales (promax rotation; n = 727)

TCI-R Facet Scale	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
HA1	**−.83/−.83**	.07/−.20	−.14/−.26	−.07/−.19	.11/−.08	.02/−.15	−.01/−.07
HA2	**−.70/−.66**	−.11/−.33	.11/.15	−.06/−.17	.13/.05	.34/.32	−.08/−.21
HA3	**−.69/−.68**	.10/−.23	.15/−.12	−.02/−.20	**−.42/−.42**	.11/.00	.06/−.10
SD1	**.67/.70**	−.11/.10	.25/.44	−.15/.02	.10/.27	.16/.36	.09/.09
SD3	**.66/.78**	.32/.50	−.02/.17	−.05/.13	.01/.19	.13/.17	.13/.10
HA4	**−.64/−.66**	−.22/−.43	−.11/−.12	.16/−.02	.01/−.10	.26/.09	.10/.03
SD5	**.52/.59**	.13/.33	.02/.31	−.13/−.03	.14/.20	.29/.49	−.36/−.42
SD2	**.47/.61**	.14/.34	−.11/.29	.12/.23	.20/.33	**.44/.50**	−.08/−.14
PS4	.00/.28	**.86/.86**	−.02/.06	.05/.20	−.06/.15	.08/.03	−.07/−.19
PS3	.04/.32	**.85/.87**	−.20/−.05	.01/.18	.08/.22	.10/−.01	.00/−.10
PS2	.14/.41	**.80/.80**	.15/.14	.08/.23	−.28/.02	.03/.02	.02/−.10
PS1	.15/.41	**.71/.74**	.23/.27	−.09/.13	−.04/.23	.01/.07	.05/−.05
SD4	.35/.28	−.47/−.38	.36/.43	−.06/−.08	−.13/−.03	.25/.48	−.04/−.08
C1	.23/.35	−.03/.12	**.84/.79**	.09/.26	−.11/.28	−.17/.20	−.05/−.05
C4	.10/.24	−.09/−.06	**.67/.71**	.19/.23	−.27/.10	.28/.51	.08/−.04
C3	.06/.27	.15/.20	**.66/.77**	−.14/.09	.13/.46	.17/.42	.13/.02
RD4	−.30/−.16	.05/−.05	**.63/.64**	−.34/−.18	.23/.39	.11/.33	.09/−.02
C2	.09/.25	.04/.27	**.51/.65**	.32/.50	.24/.54	−.16/.13	−.22/−.14
RD1	−.40/−.20	.11/.16	**.47/.54**	.18/.36	**.40/.60**	−.17/.00	−.04/.00
ST1	.00/.13	.07/.24	−.07/.06	**.89/.88**	−.05/.20	−.08/−.18	.04/.15
ST2	−.03/.12	−.01/.20	.08/.28	**.83/.86**	.10/.36	−.01/−.01	−.06/.04
ST3	−.14/.06	−.03/.05	−.02/.31	**.72/.68**	.04/.28	**.50/.40**	.10/.05
RD3	.09/.18	−.13/.09	−.10/.31	−.03/.22	**.90/.86**	.07/.11	.13/.25
RD2	.18/.31	−.08/.20	.07/.47	.09/.36	**.83/.90**	−.01/.12	.02/.16
NS4	.23/.10	−.12/.02	.02/−.21	.05/.15	.10/.06	**−.77/−.74**	.10/.37
C5	.03/.20	.05/.06	.07/.43	.10/.12	.10/.25	**.70/.73**	.03/−.16
NS3	−.18/−.05	.09/−.04	.10/.07	−.03/.10	.09/.23	.04/−.17	**.80/.73**
NS2	.18/.14	−.17/−.18	−.06/−.11	.01/.08	.03/.07	−.11/−.29	**.69/.76**

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TCI-R Facet Scale	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
NS1	.34/.46	.16/.30	.04/.13	.12/.33	.17/.36	−.14/−.21	**.50/.58**

Note: For each pair of loadings, coefficients from the pattern matrix are displayed to the left of the coefficients from the structure matrix. When loadings from both the factor structure and pattern matrices are ≤ −.40 or ≥ .40 for a given facet scale, those loadings are bolded.

Table 4

Descriptive statistics for the TCI-R and TCI-140 Domain Scales.

	TCI Version	
	TCI-R	**TCI-140**
Novelty Seeking (NS)		
Number of items in scale	35	20
Skew	.13	.24
Kurtosis	.28	.11
Mean item *r*	.14	.15
Coefficient alpha	.84	.78
Harm Avoidance (HA)		
Number of items in scale	33	20
Skew	.27	.26
Kurtosis	.07	.02
Mean item *r*	.24	.29
Coefficient alpha	.91	.89
Reward Dependence (RD)		
Number of items in scale	30	20
Skew	−.31	−.27
Kurtosis	−.09	−.20
Mean item *r*	.22	.22
Coefficient alpha	.89	.85
Persistence (PS)		
Number of items in scale	35	20
Skew	−.09	−.04
Kurtosis	.29	.19
Mean item *r*	.25	.30
Coefficient alpha	.92	.89
Self-Directedness (SD)		
Number of items in scale	40	20
Skew	−.39	−.64
Kurtosis	.29	.85
Mean item *r*	.19	.26
Coefficient alpha	.90	.88
Cooperativeness (C)		
Number of items in scale	36	20
Skew	−.46	−.55
Kurtosis	.21	.21
Mean item *r*	.19	.21
Coefficient alpha	.89	.84
Self-Transcendence (ST)		
Number of items in scale	26	16
Skew	.06	.04

	TCI Version	
	TCI-R	**TCI-140**
Kurtosis	−.45	−.60
Mean item *r*	.26	.32
Coefficient alpha	.90	.89

Table 5

Intercorrelations among the TCI-R and TCI-140 domain scales.

	TCI domain scales					
TCI Scales	**NS**	**HA**	**RD**	**PS**	**SD**	**C**
TCI-R						
HA	−.28[a]					
RD	.24[a]	−.14[a]				
PS	.00	**−.43**[a]	.14[a]			
SD	−.08[c]	**−.53**[a]	.26[a]	.27[a]		
C	−.07[c]	−.24[a]	**.52**[a]	.20[a]	**.57**[a]	
ST	.16[a]	−.13[a]	**.34**[a]	.19[a]	.10[b]	**.36**[a]
TCI-140						
HA	−.22[a]					
RD	.16[a]	−.12[b]				
PS	−.01	**−.41**[a]	.09[c]			
SD	−.10[b]	**−.58**[a]	.24[a]	.28[a]		
C	−.11[b]	−.22[a]	**.48**[a]	.13[a]	**.50**[a]	
ST	.18[a]	−.12[b]	**.30**[a]	.16[a]	.06	**.31**[a]

Notes: Correlations ≤ −.30 or ≥ .30 are bolded.

[a] $p < .001$

[b] $p < .01$

[c] $p < .05$.