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ORIGINAL RESEARCH

Development of a Self-Administrated Transdiagnostic Measurement for Compulsivity in Addictive Behaviors: The Chinese Compulsivity Trait Scale

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Objectives: Compulsivity signifies a tendency towards repetitive and persistent actions in spite of negative consequences. Compulsive symptoms are at the core of different addictive disorders, such as substance use disorders, gambling disorder, and Internet gaming disorder. This study aims to develop a brief self-administrated scale for measuring trait compulsivity across various addictive behaviors in the context of Chinese culture.

Methods: The 20-item Chinese Compulsivity Trait Scale (CCTS) was developed based on a theoretical conceptualization of compulsivity. A total of 2315 young adults were then recruited to complete the CCTS along with a series of other scales, including the Obsessive-Compulsive Inventory-Revised (OCI-R), Fagerström Test for Nicotine Dependence (FTND), Alcohol Use Disorders Identification Test (AUDIT), South Oaks Gambling Screen (SOGS), Internet Gaming Disorder Scale (IGDS), Generalized Anxiety Disorder Scale (GAD-7), and Zung Self-Rating Depression Scale (SDS). Validity and reliability of the CCTS were assessed with multiple analyses.

Results: The CCTS exhibited excellent reliability and validity. The Cronbach's α was 0.872, and the one-month test–retest reliability was 0.863. Exploratory factor analysis extracted four first-order factors with an eigenvalue over 1, explaining 50.23% of the total variance. Confirmatory factor analysis confirmed the four-factor model, showing a reasonable model fit. The CCTS score significantly correlated with the OCI-R, FTND, AUDIT, SOGS, and IGDS scores (r=0.383–0.682, p<0.001), showing good concurrent and criterion-related validity. The correlations of the CCTS score with the SDS and GAD-7 scores were not significant (r=0.014–0.020, p>0.05), indicating reasonable discriminant validity.

Conclusion: The CCTS demonstrated sound psychometric properties among these non-clinical young adults. This scale might serve as a validated tool for evaluating transdiagnostic trait compulsivity across diverse addictive problems, including both substance use disorders and behavioral addictions. Further investigations should be conducted in clinical patient populations to verify the adaptability of the CCTS.

Keywords: compulsivity, addiction, self-report scale, validation, young adults

Introduction

Compulsivity represents a tendency towards persistent and repetitive actions despite the negative consequences.[1] Traditionally, obsessive-compulsive disorder (OCD) is considered the classic archetype of compulsivity. Individuals with OCD might spend a large amount of time repeatedly checking, ordering, or washing, though they actually realize the nonsensical nature of these compulsions and their negative effects.[2] Compulsive features could also be observed in other psychiatric conditions, including substance use disorders,[3] behavioral addictions,[4] and eating disorders.[5] During the

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coronavirus disease 2019 (COVID-19) pandemic, compulsivity in different addictive behaviors can be related to pandemic awareness,[6] virus panic and anxiety,[7] and contagious fear.[8] In the general population, approximately 10% may display sub-threshold compulsive symptoms.[9] As a result, compulsivity is increasingly recognized as a transdiagnostic domain or trait.[10]

In theoretical models of drug addiction, compulsivity is conceptualized as an acquired feature linked to repeated seeking and taking of certain drugs, which persist in spite of severe punishment.[11] The critical transition from a goal-driven behavior towards a compulsive behavior is the hallmark of addiction, which has been well elucidated by different etiological models, such as habit-formation hypothesis and incentive-sensitization hypothesis.[12] Nonetheless, compulsivity is deemed as a transdiagnostic trait that may predate the emergence and development of addictive disorders as a vulnerability marker.[13] In this respect, compulsivity as a trait could be evaluated by employing lab-based neuropsychological tasks and self-report scales. Currently, neurocognitive tasks are the most frequently used tools for evaluating trait compulsivity or, more precisely, compulsivity-related neurocognitive performance.[14] However, compulsivity is a multidimensional concept that is commonly linked to behavioral inflexibility and top-down cognitive control impairments.[15,16] In addition to inhibitory control aspects, compulsivity might be underpinned by four other neurocognitive domains, namely contingency-related cognitive flexibility, attentional set-shifting, attentional bias, and habit learning.[14] These domains can be measured each by using at least one neurocognitive task, such as the Probabilistic Reversal Learning Task for the first domain, the Intra-Extra Dimensional Set Shift Task for the second domain, the Trail Making Task for the third domain, and the Two-Step Task for the fourth domain, respectively.[4] Systematic reviews revealed that deficits in compulsivity-related neurocognitive function could be a fundamental vulnerability for both alcohol use and gambling disorders.[3] More interestingly, individuals with heroin addiction and their unaffected siblings showed similar heightened compulsive traits on neurocognitive tasks of compulsivity, which were inferred as potential familial vulnerability markers implicated in heroin dependence.[17] Increasing evidence over the last decade has led to a broad consensus that compulsivity is a key construct that needs to be investigated across disorders.[18]

Relative to neurocognitive tasks, self-report scales are cost-effective and quick to administer, making them widely used for measuring psychological and behavioral traits (eg, as a means of dimensional measurement for compulsivity). Indeed, the idea that compulsivity can be conceptualized as a trait-like tendency makes it useful for identifying subclinical levels of compulsivity within the general population, so as to identify at-risk individuals for early intervention and prevention.[19] Although there are numerous self-report tools available for assessing the severity of OCD, self-report scales specifically designed to quantify trait compulsivity itself are scarce.[13] Nevertheless, recent efforts have been made to fill this gap, including the development of the Brief Assessment Tool of Compulsivity Associated Problems (BATCAP) and the Cambridge-Chicago Compulsivity Trait Scale (CHI-T).[19,20] The BATCAP was designed to quantify various types of compulsivity-related behaviors within a single questionnaire, while the CHI-T involves broader aspects of compulsive traits. Particularly, the CHI-T has attracted significant attention from researchers since its development. The CHI-T is a 15-item scale that addresses the issue of assessing compulsivity as a transdiagnostic trait. It was validated initially in community samples and online samples with problematic behaviors, symptoms of OCD, and familial risk of addictions.[10,19] Recently, the CHI-T has undergone more strict validation within large-scale samples.[21,22] Factor analysis using structural equation modeling detected two factors for the CHI-T, namely perfectionism and reward drive;[21] however, network analysis indicated three interrelated factors: perfectionism, reward drive, and cognitive rigidity.[22] The CHI-T has contributed greatly to the development of self-report tools for compulsivity as a personality trait. Unfortunately, its full scale has not been available for public access to date. As a newly developed scale, the CHI-T would benefit from additional validation in clinical and general populations from diverse cultures.[13]

In addition to the CHI-T, researchers from other cultures have also attempted to develop new measurements for evaluating compulsivity, such as the Granada Assessment for Cross-domain Compulsivity (GRACC), a self-report scale designed to measure domain-specific compulsivity in behavioral addictions.[23] The GRACC is worded in Spanish, with both a complete 90-item version and a shorter 18-item version. Developed based on a framework of six operationalizations of compulsivity, this scale comprised a proposed conceptual synthesis of compulsivity-sensitive items, such as cognitive/attentional hijacking, insuperable urges, inability to interrupt, and inflexible behaviors or rituals.[23,24] Factor analysis using structural equation modeling suggested a one-dimensional factor structure for the GRACC.[23] While the

GRACC was validated among individuals with specific behavioral addictions (video gaming and gambling), its transdiagnostic design may make it applicable to multiple addictive domains with proper adjustments by changing the target activity.

From recent years, an increasing research interest and publication regarding the investigation of compulsivity in addictive behaviors can be seen in China.[17,25] However, although the assessment tools of OCD symptoms are not unusual, such as the Obsessive-Compulsive Inventory[26,27] and Obsessive Beliefs Questionnaire,[28] validated tools for measuring trait compulsivity using self-report scales are lacking. Meanwhile, the prevalence of diverse addictive behaviors, including substance use disorders and Internet gaming disorder, has been on the rise in the general population, especially among the young people.[29,30] Therefore, it is important to develop a culturally adaptive tool for evaluating compulsivity across various types of addictive behaviors in the Chinese culture. It would be of great help in identifying at-risk individuals for developing addiction-related problems across a wide range of compulsive traits. Besides, current definitions and conceptualizations of compulsivity have mostly originated from the Western samples; thus, a novel tool designed for Chinese samples is expected to provide additional insights in this field.

In this study, our aim was to develop and validate a self-administered transdiagnostic scale tool for trait compulsivity in addiction, namely the Chinese Compulsivity Trait Scale (CCTS), within a non-clinical sample of Chinese young adults. The CCTS was first designed based on a theoretical conceptualization of compulsivity, and then conducted among 2315 young adult college students, along with the Obsessive-Compulsive Inventory-Revised (OCI-R), Alcohol Use Disorders Identification Test (AUDIT), Fagerström Test for Nicotine Dependence (FTND), South Oaks Gambling Screen (SOGS), Internet Gaming Disorder Scale (IGDS), Generalized Anxiety Disorder Scale (GAD-7), and Zung Self-Rating Depression Scale (SDS). Psychometric properties of the CCTS were assessed and tested.

Methods

Subjects and Procedure

A total of 2315 young adult students were included. All of them were recruited from the local universities in Guiyang, the capital city of Guizhou Province, China. First, a comprehensive list of all the universities located in the city was created, and eight universities (50%) were randomly selected from that list. At each university, 350 undergraduate students (approximately 5%) were selected randomly according to their student card numbers. Subsequently, all students selected were invited via email, telephone, and WeChat to complete self-report scales online. The inclusion criteria for eligible participants were:[1] aged 18 years or higher; and[2] willing to participate in our study. The exclusion criteria were:[1] current or past neurological diseases, serious psychiatric conditions (eg, major depressive disorder, bipolar disorder, schizophrenia), or other mental disorders;[2] having a history of brain trauma;[3] current or past use of illegal psychoactive drugs (eg, amphetamine, heroin, cocaine, ketamine); and[4] severe physical diseases. These conditions were all evaluated by self-reports. Among the 2800 students, 156 students did not respond to the invitation in due course. Of the remaining 2644 students who voluntarily agreed to participate in this study, 187 were excluded because of being under 18 years old. Additionally, 142 students were excluded due to meeting at least one of the exclusion criteria, failure to complete the online survey, providing invalid responses, or having a lot of omissions (> 5%) on the scale items. Finally, 2315 subjects (mean age: 20.88 ± 2.25 years, from 18 to 25 years; 1251 women and 1064 men, accounting for 54.0% and 46.0%, respectively) were included in data analysis.

Measurements

Chinese Compulsivity Trait Scale (CCTS)

To develop the CCTS, we conducted a comprehensive literature review to formulate a theoretical conceptualization of trait compulsivity. Together, six different operationalizations of compulsivity were adopted based on the proposed conceptual synthesis of compulsivity,[24] including automatic/habitual behavior, overwhelming urge/desire, attentional capture and cognitive hijacking, inability to stop or interrupt the activity once initiated, attentional capture and cognitive hijacking, and inflexible rules, stereotyped behaviors and rituals.[24] Additionally, the three dimensions of compulsivity encompassed in the CHI-T, namely, perfectionism, cognitive rigidity, and reward drive,[22] were also incorporated. Next,

an expert consensus procedure was employed to refine these operationalizations. Three senior psychological experts specializing in OCD, addiction, and compulsivity research were invited. The core concepts of compulsivity were introduced and discussed by the experts, followed by a detailed discussion on the aforementioned operationalizations, in order to identify the fundamental dimensions of compulsivity. After several rounds of simplification, consolidation, and integration of the proposed dimensions, seven key dimensions of compulsivity were identified: (a) cognitive inflexibility and rigidity; (b) propensity of perfectionism; (c) automatic inappropriate habits; (d) cognitive capture and hijacking; (e) insensitivity to negative consequences; (f) inability to stop; and (g) reward-driven urge. For the purpose of evaluating the inter-rater reliability, we collected the rating scores of the three experts for each of the dimensions on a 7-point Likert scale from 1 "not at all important" to 7 "extremely important". Kendall's concordance coefficient (*W*) was then calculated, with a value of 0.976, which indicates high inter-rater agreement. All of the authors participated in these discussions and agreed with the expert consensus. Then, an initial version of the CCTS was designed by the authors. It consisted of 35 items, with five items for each dimension. The items were mostly selected and revised from well-established scales (Chinese versions) related to the assessment of compulsive beliefs or behaviors, such as the OCI-R,[26,27] the Obsessive Beliefs Questionnaire-44,[28] the Frost Multidimensional Perfectionism Scale,[31] the obsessive-compulsive subscale of the Symptom Checklist 90,[32] and the Yale-Brown Obsessive-Compulsive Scale.[33] To avoid that the items were designed as a tool for evaluating OCD symptoms, we revised them to the greatest extent into analogous expressions as a measurement of trait compulsivity according to the CHI-T and the GRACC. Each item was rated on a 4-point Likert scale (0=strongly disagree, 1=disagree, 2=agree, and 3=strongly agree). A higher total score indicates a higher level of compulsivity. Content analysis on the scale items were conducted by the experts. The rating scores of the experts on each of the items were collected by using a 7-point Likert scale (1=not at all suitable for the dimension, 7=extremely suitable for the dimension). Accordingly, five items that were not suitable for the dimensions (ie, with an average rating score of 4 or less) were removed. After a trial test of the revised version of the CCTS among 150 randomly selected college students in one local university, 10 additional items were removed due to low item-total correlations (<0.30) or factor loading coefficients (<0.35). As a result, 20 items were retained from the earlier versions to form the final CCTS. The original items were all worded in simplified Chinese. For the purpose of cross-cultural communication, we translated them into English with the help of a native English-speaker who teaches English at the university (Supplementary Table S1).

Obsessive-Compulsive Inventory-Revised (OCI-R)

We used the OCI-R to investigate convergent validity for the CCTS. The OCI-R is an 18-item inventory that is rated on a 5-point Likert scale from 0 "not at all" to 4 "extremely". It is widely used to assess obsessive and compulsive symptoms.[34] Participants reported their subjective feelings on the items (eg, "I find it difficult to control my own thoughts"). The total score ranges from 0 to 72. Higher total scores indicate more obsessive-compulsive symptoms. Cronbach's α was 0.905 in this study.

Fagerström Test for Nicotine Dependence (FTND)

The FTND is a 6-item scale used to measure the severity of nicotine dependence.[35] The maximum possible score on the FTND is 10. A total score of 4 or higher indicates probable nicotine dependence.[36] The FTND was adopted as an indicator for assessing criterion validity. Cronbach's α was 0.817 in this study.

Alcohol Use Disorders Identification Test (AUDIT)

The AUDIT is a self-rated scale used for screening alcohol use disorders.[37] There are 10 items on the AUDIT, with items 1–8 being scored from 0 to 4 points, while items 9–10 being scored with 0, 2, or 4 points. The total score ranges from 0 to 40, with a score of 8 or higher indicating harmful alcohol consumption.[37] The AUDIT was also employed as an indicator to assess criterion validity. Cronbach's α was 0.836 in this study.

South Oaks Gambling Screen (SOGS)

The SOGS is a self-report instrument used to screen for pathological gambling.[38] There are 20 questions counted in the SOGS, each scored with either 0 or 1 point. The total score ranges from 0 to 20, with a score of 5 or higher indicating

probable pathological gambling.[38] The SOGS was used as an indicator to assess criterion validity. Cronbach's α was 0.871 in this study.

Internet Gaming Disorder Scale (IGDS)

The IGDS is a 9-item self-rated scale designed for screening Internet gaming disorder according to the nine DSM-5 diagnostic criteria.[39] There are nine items rated with a yes/no response, each scored with 1 or 0 points accordingly. The total score ranges from 0 to 9, with a score of 5 or higher indicating probable Internet gaming disorder.[39] The IGDS was also used as an indicator to evaluate criterion validity. Cronbach's α was 0.799 in this study.

Zung Self-Rating Depression Scale (SDS)

The SDS measures depression symptoms in the last month.[40] There are 20 items rated on a 4-point Likert scale. A higher total score indicates more severe depressive symptoms. The SDS was used as an indicator to evaluate discriminant validity for the CCTS. Cronbach's α was 0.890 in this study.

Generalized Anxiety Disorder Scale (GAD-7)

The GAD-7 detects anxiety symptoms over the past four weeks.[41] There are seven items rated on a 4-point Likert scale. A higher total score reflects heavier anxiety symptoms. The GAD-7 was also used as an indicator to assess discriminant validity. Cronbach's α was 0.794 in this study.

Statistical Analysis

Data analysis was processed with the SPSS version 22.0 and AMOS version 24.0 (SPSS Inc., Chicago, IL, USA). The factor structure of the CCTS was detected with exploratory factor analysis (EFA) using one random half of the total sample (n=1158), and then confirmatory factor analysis (CFA) was performed to confirm the factor model using another half of the total sample (n=1157). Based on Bartlett test of sphericity (χ^2=6282.16, df=190, p<0.001) and Kaiser–Meyer–Olkin (KMO) value (0.912), EFA was conducted, with principal component analysis as the extraction method and varimax as the rotation method. By using structural equation modeling nested within the AMOS, we performed CFA to test the fitting of proposed factor models detected from EFA. Concurrent and criterion-related validity were assessed using Pearson correlations, conducted between the CCTS and OCI-R scores as well as between the CCTS and FTND, AUDIT, SOGS, and IGDS scores. Discriminant validity was tested with correlations between the CCTS, SDS, and GAD-7 scores. Cronbach's α coefficient was used to test the reliability of internal consistency for the CCTS. Test–retest reliability was used to evaluate temporal stability of the scale with the intraclass correlation coefficients. Out of the total sample (n=2315), 230 random participants (about 10%) were chosen to complete the CCTS again (one month after initial test). Furthermore, receiver operating characteristic (ROC) curves were employed for discrimination evaluation of the CCTS in predicting different addictive behaviors (ie, nicotine dependence, alcohol use disorder, pathological gambling, and Internet gaming disorder). Measurement invariance testing was conducted by using the multigroup CFA to investigate whether group (ie, gender) differences might be caused by the measurement tool itself. Three models were examined, including the configural model, the metric model, and the scalar model, as suggested in previous studies.[42]

Results

Demographics

The demographics and scale scores are described in Table 1. All of the scale scores exhibited a normal distribution according to the kurtosis and skewness values.

Item Analysis

The top 27% and bottom 27% of the CCTS total scores were grouped into the high-score (n=625) and low-score (n=625) groups, respectively. For each item, the mean scores in each group were compared with t-tests. Table 2 shows that all 20 items showed significant between-group differences (ps<0.001). Moreover, item-total score correlations were all higher than 0.30 (r=0.427–0.678, ps<0.001), see Table 2.

Table 1 Demographics and Scale Scores (n=2315)

Variables	Mean or Number	SD or %	Range	Skewness	Kurtosis
Age, years	20.88	2.25	18–25	0.416	−1.066
Gender, Female	1251	54.04	–	–	–
Years of education	14.33	1.08	13–16	0.255	−1.172
Ethnicity, Hans	1448	62.55	–	–	–
Home locality, Urban	1523	65.79	–	–	–
Body Mass Index, kg/m^2	20.65	2.76	16.61–38.70	1.940	1.608
CCTS scores	14.82	9.42	1–46	0.942	0.066
OCI-R scores	15.91	9.98	4–50	0.858	0.239
FTND scores	1.41	2.16	0–10	1.786	1.884
Non-ND (< 4)	2081	89.89	–	–	–
Probable ND (≧4)	234	10.11	–	–	–
AUDIT scores	4.77	4.48	0–26	0.734	0.141
Non-AUD (< 8)	1976	85.36	–	–	–
Probable AUD (≧8)	339	14.64	–	–	–
SOGS scores	1.93	2.17	0–13	1.889	2.231
Non-PG (< 5)	2144	92.61	–	–	–
Probable PG (≧5)	171	7.39	–	–	–
IGDS scores	2.85	1.79	0–9	0.393	0.056
Non-IGD (< 5)	1996	86.22	–	–	–
Probable IGD (≧5)	319	13.78	–	–	–
SDS scores	30.18	8.83	20–64	1.156	0.697
GAD-7 scores	10.09	4.14	0–21	0.348	0.526

Abbreviations: CCTS, The Chinese Compulsivity Trait Scale; OCI-R, The Obsessive-Compulsive Inventory-Revised; FTND, The Fagerström Test for Nicotine Dependence; AUDIT, The Alcohol Use Disorders Identification Test; SOGS, The South Oaks Gambling Screen; IGDS, The Internet Gaming Disorder Scale; SDS, The Zung Self-Rating Depression Scale; GAD-7, The Generalized Anxiety Disorder Scale; ND, Nicotine Dependence; AUD, Alcohol Use Disorders; PG, Pathological Gambling; IGD, Internet Gaming Disorder.

Table 2 Item Analysis (M±SD) and Item-Total Score Correlations (r) of the CCTS

Items	High-Score Group (n=625)	Low-Score Group (n=625)	*t* value	Item-Total Correlations (n=2315)
CCTS 1	1.29±0.99	0.49±0.58	17.555***	0.446***
CCTS 2	1.31±0.97	0.35±0.57	21.420***	0.438***
CCTS 3	1.73±1.23	0.08±0.32	32.382***	0.649***
CCTS 4	1.49±1.29	0.12±0.31	25.964***	0.631***
CCTS 5	1.61±0.95	0.68±0.59	20.611***	0.459***
CCTS 6	1.19±0.97	0.16±0.38	24.691***	0.534***
CCTS 7	0.95±1.16	0.04±0.29	19.151***	0.495***
CCTS 8	1.65±0.91	0.22±0.51	34.372***	0.582***
CCTS 9	0.92±0.78	0.07±0.28	25.559***	0.545***
CCTS 10	1.48±0.85	0.36±0.70	25.619***	0.481***
CCTS 11	1.15±0.63	0.18±0.39	29.287***	0.562***
CCTS 12	1.29±0.85	0.31±0.51	24.783***	0.499***
CCTS 13	1.76±1.10	0.08±0.35	36.496***	0.678***
CCTS 14	1.03±0.76	0.18±0.40	24.798***	0.488***
CCTS 15	1.12±0.84	0.33±0.48	20.589***	0.468***
CCTS 16	1.01±0.68	0.24±0.49	23.164***	0.463***
CCTS 17	1.74±0.95	0.29±0.53	33.301***	0.643***
CCTS 18	1.55±1.02	0.58±0.76	19.059***	0.427***
CCTS 19	1.89±0.88	0.52±0.55	32.923***	0.615***
CCTS 20	2.13±0.99	0.19±0.55	42.822***	0.676***

Note: ***$p<0.001$.
Abbreviation: CCTS, The Chinese Compulsivity Trait Scale.

Scale Reliability

As seen in Table 3, the Cronbach's α of the CCTS was 0.872, indicating good internal consistency. Evaluated with ICC, the one-month test–retest reliability was 0.863. For the four factors in the CCTS (see Table 4), the Cronbach's α ranged from 0.765 to 0.824, and the one-month test–retest reliability ranged from 0.753 to 0.816.

Table 3 Cronbach's α and Test–Retest Reliability of the CCTS

Items	Cronbach's α Coefficient if the Item Deleted (n=2315)	Test–Retest Reliability, Intraclass Correlation Coefficient (n=230)
CCTS 1	0.869	0.854***
CCTS 2	0.870	0.861***
CCTS 3	0.862	0.857***
CCTS 4	0.863	0.856***
CCTS 5	0.869	0.860***
CCTS 6	0.866	0.847***
CCTS 7	0.868	0.859***
CCTS 8	0.865	0.842***
CCTS 9	0.866	0.839***
CCTS 10	0.868	0.857***
CCTS 11	0.866	0.850***
CCTS 12	0.867	0.855***
CCTS 13	0.860	0.843***
CCTS 14	0.868	0.861***
CCTS 15	0.868	0.857***
CCTS 16	0.868	0.855***
CCTS 17	0.862	0.851***
CCTS 18	0.871	0.869***
CCTS 19	0.863	0.850***
CCTS 20	0.861	0.846***
CCTS total	**0.872**	**0.863****
Factor 1	0.824	0.816***
Factor 2	0.790	0.778***
Factor 3	0.813	0.805***
Factor 4	0.765	0.753***

Notes: Factor 1, cognitive inflexibility and behavioral rigidity; Factor 2, propensity of perfectionism; Factor 3, uncontrollable reward-driven urges; Factor 4, insensitivity to negative consequences. ***$p<0.001$.
Abbreviation: CCTS, The Chinese Compulsivity Trait Scale.

Table 4 Varimax Rotated Factor Loadings of the CCTS (n=1158)

Items	Communalities	Factor 1	Factor 2	Factor 3	Factor 4	Total
CCTS 16	0.599	0.740				
CCTS 11	0.537	0.665				
CCTS 15	0.419	0.565				
CCTS 8	0.413	0.497				
CCTS 10	0.357	0.443				
CCTS 6	0.364	0.421				
CCTS 14	0.372	0.405				
CCTS 1	0.721		0.834			
CCTS 12	0.708		0.814			
CCTS 4	0.528		0.529			

(*Continued*)

Table 4 (Continued).

Items	Communalities	Factor 1	Factor 2	Factor 3	Factor 4	Total
CCTS 19	0.529		0.489			
CCTS 18	0.562			0.740		
CCTS 17	0.581			0.684		
CCTS 20	0.559			0.654		
CCTS 13	0.481			0.460		
CCTS 3	0.428			0.447		
CCTS 5	0.534				0.673	
CCTS 7	0.455				0.630	
CCTS 2	0.361				0.539	
CCTS 9	0.410				0.469	
Variance explained		**13.79%**	**12.20%**	**13.18%**	**11.06%**	**50.23%**

Notes: Factor 1, cognitive inflexibility and behavioral rigidity; Factor 2, propensity of perfectionism; Factor 3, uncontrollable reward-driven urges; Factor 4, insensitivity to negative consequences.
Abbreviation: CCTS, The Chinese Compulsivity Trait Scale.

Construct Validity

In EFA, there were four factors extracted with an eigenvalue over 1, explaining 50.23% of the total variance (Table 4). Subsequently, CFA was conducted to confirm the proposed four-factor model detected in EFA. As suggested in other studies,[43] we adopted several model fit indices to examine the model fitting, including (a) χ^2/df with an acceptable value below 3, (b) RMSEA or SRMR with a value below 0.05, (c) GFI or AGFI with a value over 0.90, and (d) CFI or NNFI with an ideal value over 0.95. Table 5 shows that the four-factor model of the CCTS has ideal model fitting (χ^2/df = 2.746, SRMR = 0.033, RMSEA = 0.039, GFI/AGFI > 0.95, CFI/NNFI > 0.95). Moreover, we tested a unidimensional one-factor model for the CCTS, and found that model fitting of the four-factor model was better than that of the one-factor model.

As displayed in Figure 1, the four first-order factors correlated significantly with each other in the four-factor model, showing a reasonable construct validity. The first factor contains items 6, 8, 10, 11, 14, 15, and 16, thus named as "cognitive inflexibility and behavioral rigidity"; the second factor includes items 1, 4, 12, and 19, named as "propensity of perfectionism"; the third factor consists of items 3, 13, 17, 18, and 20, named as "uncontrollable reward-driven urges"; and the fourth factor includes items 2, 5, 7, and 9, named as "insensitivity to negative consequences".

Concurrent, Criterion, and Discriminant Validity

We employed Pearson correlations to examine concurrent validity between the CCTS and OCI-R, criterion validity between the CCTS and FTND, AUDIT, SOGS, and IGDS, as well as discriminant validity between the CCTS, SDS, and GAD-7, respectively. Table 6 reveals middle to high correlations of the CCTS scores with OCI-R, FTND, AUDIT, SOGS, and IGDS scores (r=0.383–0.682, ps<0.001), while the correlations of the CCTS with SDS and GAD-7 scores were not significant (r=0.014–0.020, ps>0.05).

Measurements of addictive behaviors (ie, FTND, AUDIT, SOGS, and IGDS) were further employed for discrimination evaluation of the CCTS. Cut-off scores of 4 for the FTND, 8 for the AUDIT, 5 for the SOGS, and 5 for the IGDS

Table 5 Model Fit of the Four-Factor and One-Factor Models for the CCTS (n=1157)

Model Fit Indices	χ^2/df	RMSEA	SRMR	GFI	AGFI	CFI	NNFI
Four-factor model	2.746	0.039	0.033	0.984	0.965	0.980	0.968
One-factor model	3.467	0.065	0.054	0.911	0.890	0.873	0.895

Abbreviation: CCTS, The Chinese Compulsivity Trait Scale.

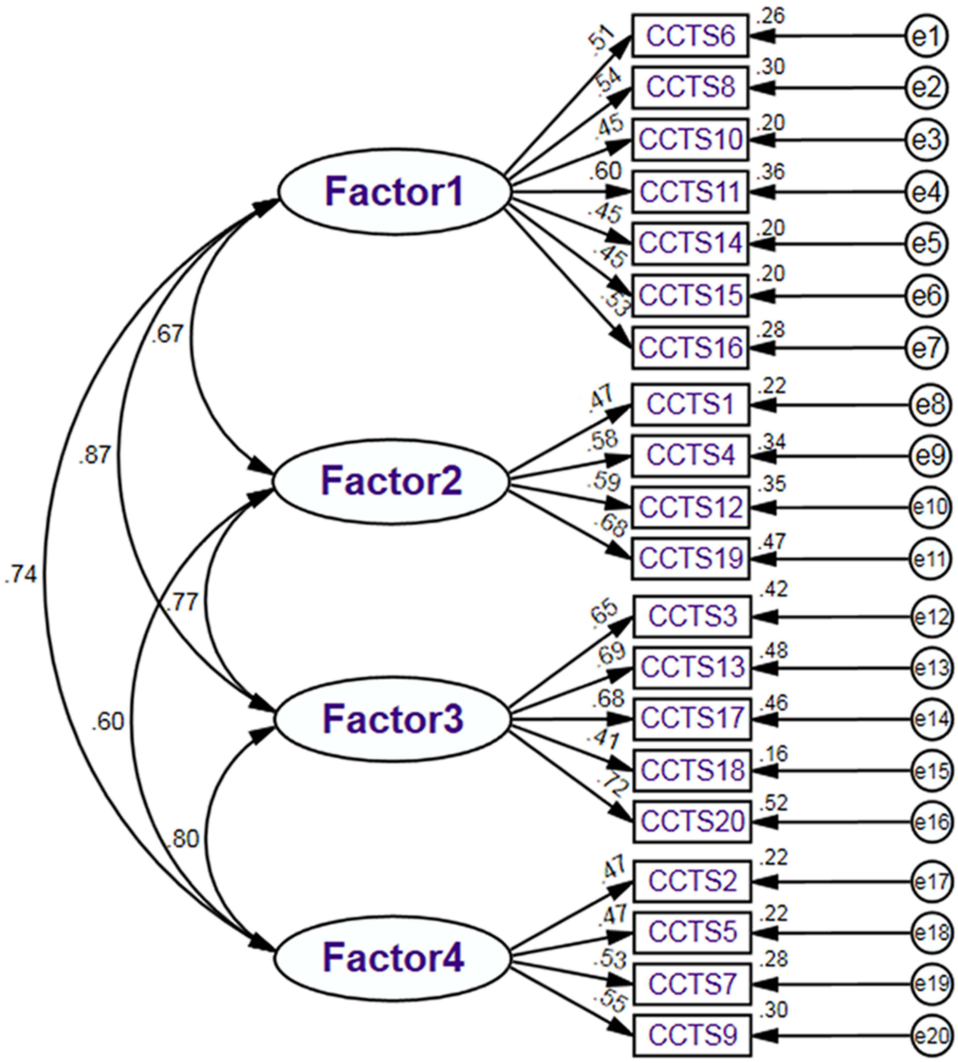

Figure 1 Factorial structure of the Chinese Compulsivity Trait Scale (CCTS). Factor 1, cognitive inflexibility and behavioral rigidity; Factor 2, propensity of perfectionism; Factor 3, uncontrollable reward-driven urges; Factor 4, insensitivity to negative consequences.

were utilized. The ROC curves are depicted in Figure 2. The area under the curve (AUC) was 0.814 for FTND, 0.720 for AUDIT, 0.810 for SOGS, and 0.810 for IGDS, indicating a significant effect of the CCTS in predicting the severity of addictive behaviors.

Table 6 Pearson Correlations (r) Between the CCTS and Other Scale Scores (n=2315)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) CCTS score	–						
(2) OCI-R score	0.682***	–					
(3) FTND score	0.428***	0.407***	–				
(4) AUDIT score	0.456***	0.359***	0.248***	–			
(5) SOGS score	0.383***	0.320***	0.367***	0.318***	–		
(6) IGDS score	0.405***	0.338***	0.150***	0.195***	0.081***	–	
(7) SDS score	0.020	0.017	0.208***	0.248***	0.025	0.116***	–
(8) GAD-7 score	0.014	0.018	0.170***	0.149***	0.001	0.125***	0.467***

Note: ***p<0.001.

Abbreviations: CCTS, The Chinese Compulsivity Trait Scale; OCI-R, The Obsessive-Compulsive Inventory-Revised; FTND, The Fagerström Test for Nicotine Dependence; AUDIT, The Alcohol Use Disorders Identification Test; SOGS, The South Oaks Gambling Screen; IGDS, The Internet Gaming Disorder Scale; SDS, The Zung Self-Rating Depression Scale; GAD-7, The Generalized Anxiety Disorder Scale.

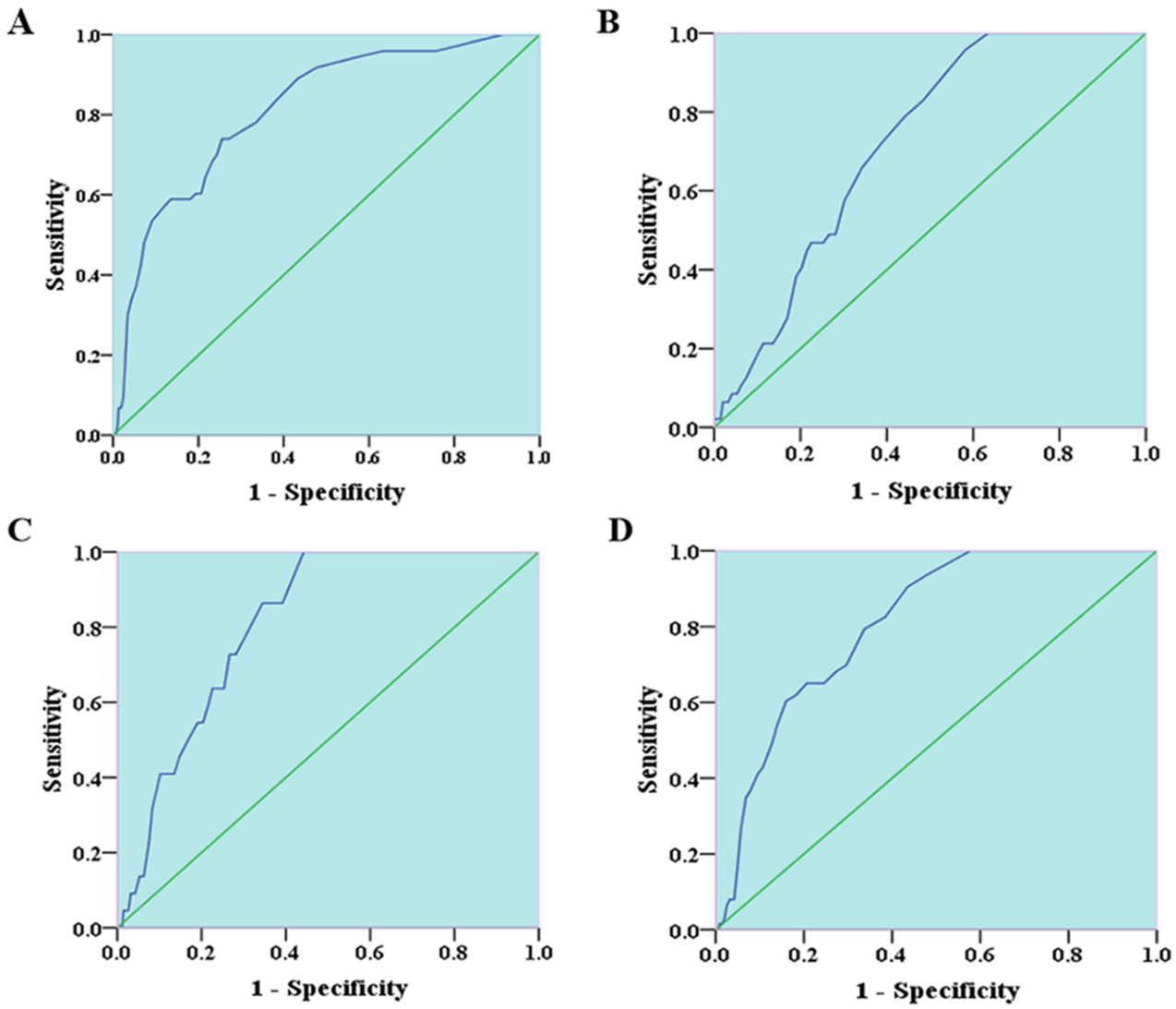

Figure 2 Receiver operating characteristic (ROC) curves that display the predictive accuracy of the CCTS as a discrimination evaluation measurement for (**A**) ND, (**B**) AUD, (**C**) PG, and (**D**) IGD, with an area under the curve (AUC) of 0.814 (95% CI=0.766–0.862), 0.720 (95% CI=0.669–0.771), 0.810 (95% CI=0.754–0.865), and 0.810 (95% CI=0.769–0.850), respectively.
Abbreviations: CCTS, The Chinese Compulsivity Trait Scale; ND, Nicotine Dependence; AUD, Alcohol Use; Disorder; PG, Pathological Gambling; IGD, Internet Gaming Disorder.

Measurement Invariance Testing

As shown in Table 7, the configural model, metric model, and scalar model were examined across two gender groups. As suggested, a decrease of ≤ 0.01 in CFI, or an increase of ≤ 0.015 in RMSEA between these models, indicates acceptable measurement invariance.[40] The data showed that the change in CFI ranged from 0.007 to 0.009, and the change in

Table 7 Test of Measurement Invariance Across Groups by Gender for the CCTS (n=2315)

Model Fit Indices	χ^2/df	RMSEA	CFI	RMSEA Change	CFI Change
Configural model	2.983	0.042	0.968	–	–
Metric model	2.897	0.050	0.961	+0.008	−0.007
Scalar model	2.715	0.061	0.952	+0.011	−0.009

Notes: Difference tests are displayed for configural model vs metric model, and for metric model vs scalar model, respectively.
Abbreviation: CCTS, The Chinese Compulsivity Trait Scale.

RMSEA ranged from 0.008 to 0.011. As a result, the measurement invariance for the CCTS was established across males and females.

Discussion

This study is the first attempt to develop and preliminarily validate a convenient self-report scale for measuring trait compulsivity across various addictive behaviors in the context of Chinese culture. The CCTS showed reasonable item effectiveness, reliability, and validity. Particularly, the CCTS total score was closely correlated with several typical categories of addictive behaviors (ie, nicotine dependence, alcohol use disorder, gambling disorder, and Internet gaming disorder), indicating pretty good criterion-related validity. Factor analysis with EFA and CFA confirmed a four-factor model, namely cognitive inflexibility and behavioral rigidity, propensity of perfectionism, uncontrollable reward-driven urges, and insensitivity to negative consequences, which may represent the central dimensions of compulsivity.

Compulsive features have been consistently found in various mental disorders, including substance use disorders,[3] gambling disorder,[4] eating disorders,[5] Internet gaming disorder,[44] and OCD.[45] In addictive disorders, compulsivity lies at the core of pathology, as one of the most important mechanisms. For instance, as the drive for drug seeking and taking moves from positive to negative reinforcement, there is a transition in addiction mechanisms from impulsivity to compulsivity in the frontostriatal circuits.[46] Compared with impulsivity, however, compulsivity has been studied less frequently in addiction.[3] Yet, research interest in compulsivity has been flourishing over the last decade. Particularly, the idea that compulsivity can be conceptualized as a trait-like tendency has inspired the development of tools for measuring trait compulsivity, such as the CHI-T.[19] This is helpful in identifying individuals at risk of compulsivity-related disorders with sub-clinical levels of compulsivity for early intervention and prevention.[13,22]

Given the substantial lack of validated self-report instruments for assessing trait compulsivity in China, we endeavored to create a new scale (ie, the CCTS). This scale was primarily designed based on a concept-driven framework of compulsivity. First, a conceptualization of compulsivity was theoretically formulated through a comprehensive literature review. Considering the limited literature about self-report scales for trait compulsivity, we incorporated a conceptual synthesis of compulsivity and three dimensions suggested in previous studies.[22,24] However, it is worth noting that although the three dimensions encompassed in the CHI-T (perfectionism, reward drive, cognitive rigidity) may represent typical domains of trait compulsivity, the conceptual synthesis of compulsivity we adopted here were actually generated from item analysis of 90 items,[23,24] which were intended to assess an acquired, domain-specific characteristic of a particular activity that has already been exhibited by individuals such as video gamers and gamblers.[23] Nevertheless, in view of the important fact that these operational manifestations may represent to some degree a consensus definition of compulsivity and largely overlap with definitions identified using theory-driven top-down approaches,[44] we still incorporated these elements into our study as potential dimensions of compulsivity. This open inclusive concept- driven approach may help us to maximize the potential conceptualization of trait compulsivity from the existing literature. Subsequently, after intensive consolidation and refining processes using an expert consensus procedure, we identified seven key dimensions of compulsivity (see Section 2.2.1). An initial version of the CCTS with 35 items was created based on these dimensions. These items were designed with analogous expressions as a tool for evaluating trait compulsivity similar to the CHI-T.[19] For the purpose of ensuring the brief, high-quality nature of the scale, content analysis was conducted by experts and a trial test was carried out among 150 young adult students. Finally, 20 items with good content validity and high factor loading coefficients (>0.35) were retained from the initial version, constituting the final version of the CCTS. However, during EFA in a large-scale sample (n=1158), four interrelated first-order factors were extracted, which were confirmed via CFA. Therein, for Factor 2 "propensity of perfectionism" and Factor 4 "insensitivity to negative consequences", four items in each remained unchanged and were reserved; Factor 3 was renamed as "uncontrollable reward-driven urges", consisting of four items of the prior (g) reward-driven urge and one item of prior (f) inability to stop; Factor 1 was renamed as "cognitive inflexibility and behavioral rigidity", comprising three items of prior (a) cognitive inflexibility and rigidity, one item of prior (c) automatic inappropriate habits, and three items of prior (d) cognitive capture and hijacking (see Supplementary Table S2 for more details of the factors and domains for the items). Therefore, although the number of dimensions in the CCTS decreased from seven (in the initial version) to four (in the final version) through the EFA and CFA, these four factors extracted may probably represent the

most significant traits of compulsivity. Particularly, the Factor 1 integrated several central domains of compulsivity, including the manifestations of cognitive inflexibility (eg, cognitive hijacking, attentional capture) and behavioral rigidity (eg, rituals, automatic habits). In theoretical models of addiction such as the incentive-sensitization hypothesis,[47] cognitive hijacking and attentional capture are crucial mechanisms in the transition to addiction, with the former associated with impaired attentional control (and/or amplified craving) towards addiction-related cues and the latter primarily reflecting preoccupation and intrusive thoughts related to addictive activities.[48] Similarly, cognitive rigidity has also been proven to be one of the central dimensions in the CHI-T.[22] On the other hand, behavioral rigidity (or behavioral inflexibility), together with cognitive inflexibility, is shared by different types of addictive disorders.[49] Considering the characteristic features of addicted individuals, which are often described as behaviorally inflexible and rigid, Factor 1 in the CCTS represents potentially a key trait of compulsivity that may emerge as a predisposing factor among at-risk individuals prone to developing addiction-related problems. However, future empirical evidence from longitudinal studies is warranted in this aspect. Relatively speaking, Factor 2 and Factor 3 are similar to the two dimensions (ie, perfectionism, reward drive) included in the CHI-T, respectively. Research in non-clinical samples suggests that perfectionism, as one maladaptive personality trait, has a strong association with alcohol-related problems,[50] gambling disorders,[51] and symptoms of eating disorders.[52] Actually, perfectionism is identified as a core component of the internal conceptual framework of compulsivity traits.[21,22] Uncontrollable reward-driven urges, often referred to as craving in addiction models, have been considered a driving force behind compulsive behaviors.[22] Given that craving is an essential component of addictive disorders and a significant indicator of addiction severity,[53] theoretical models have attributed a key role to it in the aetiology of addiction. However, because craving does not appear to be a preexisting condition prior to engaging in addictive behaviors, it is generally measured using non-specific scales in the form of an overwhelming urge or desire.[24] In this sense, our Factor 3 is comparable to the dimension of "reward drive" in the CHI-T.[22] By comparison, the Factor 4 (ie, insensitivity to negative consequences) is a new factor that has not been seen in the CHI-T. The tendency to continue behaviors that are insensitive to negative consequences (even though having conscious awareness of them) is a brief, explicit definition of compulsivity.[54] Insensitivity to (or ignoring) the negative consequences associated with repeated addictive activities is nearly universal across various types of addictions.[55] Thus, it is plausible that Factor 4 may indicate a possible trait linked to addiction susceptibility. However, it remains highly speculative due to our cross-sectional design, and further research is needed.

Item analysis indicated reasonable item effectiveness in the CCTS. Each of the 20 items showed a significant between-group difference ($p<0.001$), and the item-total score correlations were significantly moderate to high, ranging from 0.427 to 0.678 ($p<0.001$), surpassing the threshold value of 0.30.[56] The CCTS also demonstrated excellent scale reliability. The Cronbach's α is 0.872, indicating reasonable internal consistency reliability, similar to the existing peer scales such as the CHI-T.[19] After removing any single item, Cronbach's α ranged from 0.860 to 0.871 for the scale, indicating excellent internal consistency. Additionally, evaluated with ICC, the CCTS had a one-month test–retest reliability of 0.863, higher than a suggested reference value of 0.80.[57] Thus, the CCTS showed excellent reliability and stability as a cost-effective measurement, probably making it useful for further large-scale surveys.

Factor analysis of the CCTS using EFA and CFA revealed reasonable construct validity for this scale. The EFA extracted four first-order factors using the principal component analysis (PCA) with a varimax rotation method. These factors collectively explained 50.23% of the total variance. Subsequently, the four-factor model of the CCTS was further confirmed by conducting CFA, with all of the indices good for ideal model fit. Furthermore, a comparison between the four-factor model and the one-factor model for the CCTS indicated that the former outperformed the latter, fitting better with the data. The factorial structure of the four-factor model is concise and clear (Figure 1). The four first-order factors were interconnected, with correlation coefficients ranging from 0.60 to 0.87, showing a reasonable construct validity. Factor loading of the 20 items all had a greater value than standard 0.35 (Figure 1 and Table 4). The construct validity of the CCTS is partially comparable to that of the CHI-T.[19]

Concurrent and criterion validity were assessed using Pearson correlations. Data revealed a strong correlation of the CCTS with the OCI-R scores ($r=0.682$, $p<0.001$), and moderate to high correlations of the CCTS score with nicotine dependence (ie, FTND), alcohol use disorders (ie, AUDIT), pathological gambling (ie, SOGS), and Internet gaming disorder (ie, IGDS) scores ($r=0.383$–0.456, $p<0.001$). These data suggest that the CCTS has good concurrent and

criterion-related validity. The OCI-R is a standard tool for evaluating typical compulsive symptoms associated with OCD, and is widely used for measuring compulsivity in clinical practice and research.[34] Like other similar studies,[19,20] we employed the OCI-R and indicated reasonable concurrent validity for the CCTS in this study. Moreover, correlations between the CCTS total score and four classical categories of addictive behaviors, including both SUD (ie, nicotine dependence and alcohol use disorder) and non-substance-related behavioral addictions (ie, Internet gaming disorder and pathological gambling), were significantly positive. Due to the core role of compulsivity implicated in addictive disorders,[15,16] our data regarding the close relationships between the CCTS and the FTND, AUDIT, SOGS, and IGDS scores suggested that this new scale could serve as an effective tool for measuring compulsivity traits related to addiction. More importantly, we also utilized the measurements of the addictive behaviors (ie, FTND, AUDIT, SOGS, IGDS) to evaluate the discrimination accuracy of the CCTS. The cut-off scores for these scales were used to establish a dichotomy of categories (eg, non-nicotine dependence vs probable nicotine dependence). ROC curves were obtained for each of the addictive behaviors (Figure 2). The AUC for discrimination evaluation was reasonable, with a large value ranging from 0.720 to 0.814, indicating a significant effect of the CCTS in predicting the severity of addictive disorders. This further supports the excellent criterion validity of the CCTS. Moreover, a discriminant validity examination was conducted between the CCTS with the SDS and the GAD-7. The correlations of the CCTS score with the SDS and GAD-7 scores were not significant (r=0.014–0.020, ps>0.05), indicating that the constructs measured by the CCTS as a tool for assessing trait compulsivity are distinct from depression and anxiety symptoms evaluated with the SDS and GAD-7.[40,41]

Finally, measurement invariance of the CCTS was examined across males and females by using a multigroup CFA. We tested and compared the configural model, metric model, and scalar model. The data indicated an acceptable measurement invariance based on the change in CFI and RMSEA between these models, and thus the measurement invariance of the CCTS was well verified for gender.[42]

Conclusions and Limitations

On the whole, the 20-item Chinese Compulsivity Trait Scale (CCTS) demonstrated sound psychometric properties among the non-clinical young adults. This scale might probably serve as a convenient and validated tool for measuring transdiagnostic trait compulsivity across diverse addictive disorders, including both substance use disorders and behavioral addictions, at least in four central domains (ie, cognitive inflexibility and behavioral rigidity, propensity of perfectionism, uncontrollable reward-driven urges, and insensitivity to negative consequences).

However, several limitations in the current study should be noted. First, the participants were mainly young adult university students. Although we developed and validated the CCTS with a large sample, this specific non-clinical sample could not be properly representative of the general and common population. The CCTS should be examined among community samples and clinical populations so as to verify its effectiveness in future studies. Second, self-report scales were primarily utilized in this study. It is thus possible that a subjective bias cannot be completely avoided. More objective measurements such as neurocognitive tasks on compulsivity should be employed to test the validity of the CCTS in further research. Actually, neurocognitive tasks used to evaluate compulsivity always cover the domains of contingency-related cognitive flexibility, attentional set-shifting, attentional bias, and habit learning.[4] In the CCTS, although certain factors (eg, cognitive inflexibility and behavioral rigidity) might represent similar concepts with the domains taxed in neurocognitive tasks (eg, contingency-related cognitive flexibility), our self-report methodology could not be comparable to that of the neurocognitive tasks, such as in terms of robustness. Therefore, objective neurocognitive tasks should be included in similar studies that are aimed to assess trait compulsivity by using self-report scales. Third, although factor analysis of the CCTS using EFA and CFA models revealed a concise four-factor structure, some items from different domains that might be distinct from each other were classified into the same factor. For instance, the Item 11 pertaining to automatic habits was included in Factor 1 (ie, cognitive inflexibility and behavioral rigidity). Although we have conceptualized the domain of automatic habits under the category of behavioral rigidity (and ultimately falling into Factor 1), whether habits are necessary for the development of addictive behaviors is controversial.[24] Thus, the domain of automatic habits in the CCTS should be considered more carefully in the practice of measuring compulsivity as a trait. Similarly, more attention should be paid to the domain of inability to stop (ie, Item 18), which was categorized

into Factor 3 (uncontrollable reward-driven urges). These limitations, although likely derived from the factor analysis processes, should be addressed with a larger representative sample as well as clinical samples in future.

Data Sharing Statement

Data could be obtained by contacting the corresponding author.

Ethics Approval and Informed Consent

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Human Research Ethics Committee of the Guizhou Medical University (GMU/2020LS05, 07/04/2020). Written informed consent to participate in this study was provided by the participants. All participants were compensated with RMB ¥20 each.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare no conflict of interest.

References

1. Dalley JW, Everitt BJ, Robbins TW. Impulsivity, compulsivity, and top-down cognitive control. *Neuron*. 2011;69(4):680–694. doi:10.1016/j.neuron.2011.01.020
2. Denys D. Obsessionality & compulsivity: a phenomenology of obsessive-compulsive disorder. *Philos Ethics Humanit Med*. 2011;6(1):3. doi:10.1186/1747-5341-6-3
3. Lee RSC, Hoppenbrouwers S, Franken I. A systematic meta-review of impulsivity and compulsivity in addictive behaviors. *Neuropsychol Rev*. 2019;29(1):14–26. doi:10.1007/s11065-019-09402-x
4. van Timmeren T, Daams JG, van Holst RJ, Goudriaan AE. Compulsivity-related neurocognitive performance deficits in gambling disorder: a systematic review and meta-analysis. *Neurosci Biobehav Rev*. 2018;84:204–217. doi:10.1016/j.neubiorev.2017.11.022
5. Carr MM, Wiedemann AA, Macdonald-Gagnon G, Potenza MN. Impulsivity and compulsivity in binge eating disorder: a systematic review of behavioral studies. *Prog Neuro Psychopharmacol Biol Psychiatry*. 2021;110(110):110318. doi:10.1016/j.pnpbp.2021.110318
6. Lăzăroiu G, Gedeon T, Rogalska E, et al. The economics of deep and machine learning-based algorithms for COVID-19 prediction, detection, and diagnosis shaping the organizational management of hospitals. *Oecon Copernic*. 2024;15(1):27–58. doi:10.24136/oc.2984
7. Lăzăroiu G, Adams C. Viral panic and contagious fear in scary times: the proliferation of COVID-19 misinformation and fake news. *Analy Metaphy*. 2020;19:80–86. doi:10.22381/AM1920209
8. Lăzăroiu G, Horak J, Valaskova K. Scaring ourselves to death in the time of COVID-19: pandemic awareness, virus anxiety, and contagious fear. *Linguist Philos Investig*. 2020;19:114–120. doi:10.22381/LPI1920208
9. Denys D. Compulsivity and free will. *CNS Spectrums*. 2014;19(1):8–9. doi:10.1017/S1092852913000412
10. Albertella L, Chamberlain SR, Le Pelley ME, et al. Compulsivity is measurable across distinct psychiatric symptom domains and is associated with familial risk and reward-related attentional capture. *CNS Spectrums*. 2020;25(4):519–526. doi:10.1017/S1092852919001330
11. Lüscher C, Robbins TW, Everitt BJ. The transition to compulsion in addiction. *Nat Rev Neurosci*. 2020;21(5):247–263. doi:10.1038/s41583-020-0289-z
12. Perales JC, King DL, Navas JF, et al. Learning to lose control: a process-based account of behavioral addiction. *Neurosci Biobehav Rev*. 2020;108:771–780. doi:10.1016/j.neubiorev.2019.12.025
13. Hook RW, Grant JE, Ioannidis K, et al. Trans-diagnostic measurement of impulsivity and compulsivity: a review of self-report tools. *Neurosci Biobehav Rev*. 2021;120:455–469. doi:10.1016/j.neubiorev.2020.10.007

14. Fineberg NA, Chamberlain SR, Goudriaan AE, et al. New developments in human neurocognition: clinical, genetic, and brain imaging correlates of impulsivity and compulsivity. *CNS Spectrums*. 2014;19(1):69–89. doi:10.1017/S1092852913000801
15. Robbins TW, Gillan CM, Smith DG, de Wit S, Ersche KD. Neurocognitive endophenotypes of impulsivity and compulsivity: towards dimensional psychiatry. *Trends Cogn Sci*. 2012;16(1):81–91. doi:10.1016/j.tics.2011.11.009
16. Robbins TW, Banca P, Belin D. From compulsivity to compulsion: the neural basis of compulsive disorders. *Nat Rev Neurosci*. 2024;25 (5):313–333. doi:10.1038/s41583-024-00807-z
17. Yan WS, Liu SJ, Zheng DH. Compulsivity and inhibitory control deficits in abstinent individuals with heroin addiction and their biological siblings compared with unrelated healthy control participants. *Biolog Psych Cognit Neurosci Neuroimaging*. 2024;9(2):196–206. doi:10.1016/j.bpsc.2023.11.002
18. Yücel M, Oldenhof E, Ahmed SH, et al. A Transdiagnostic Dimensional Approach Towards a Neuropsychological Assessment for Addiction: An International Delphi Consensus Study. *Addiction*. 2019;114(6):1095–1109. doi:10.1111/add.14424
19. Chamberlain SR, Grant JE. Initial validation of a transdiagnostic compulsivity questionnaire: the Cambridge–Chicago Compulsivity Trait Scale. *CNS Spectrums*. 2018;23(5):340–346. doi:10.1017/S1092852918000810
20. Albertella L, Le Pelley ME, Chamberlain SR, et al. Reward-related attentional capture is associated with severity of addictive and obsessive–compulsive behaviors. *Psychol Add Bhav*. 2019;33(5):495–502. doi:10.1037/adb0000484
21. Tiego J, Trender W, Hellyer PJ, Grant JE, Hampshire A, Chamberlain SR. Measuring compulsivity as a self-reported multidimensional transdiagnostic construct: large-scale (N = 182,000) validation of the Cambridge–Chicago compulsivity trait scale. *Assessment*. 2023;30 (8):2433–2448. doi:10.1177/10731911221149083
22. Liu C, Albertella L, Lochner C, et al. Conceptualising compulsivity through network analysis: a two-sample study. *Comprehen Psych*. 2023;127 (152429):152429. doi:10.1016/j.comppsych.2023.152429
23. Muela I, Navas JF, Barrada JR, et al. Operationalization and measurement of compulsivity across video gaming and gambling behavioral domains. *BMC Psychol*. 2023;11(1):407. doi:10.1186/s40359-023-01439-1
24. Muela I, Navas JF, Ventura-Lucena JM, Perales JC. How to pin a compulsive behavior down: a systematic review and conceptual synthesis of compulsivity-sensitive items in measures of behavioral addiction. *Addict Behav*. 2022;134(107410):107410. doi:10.1016/j.addbeh.2022.107410
25. Wu L, Xu J, Song K, et al. Emotional bias modification weakens game-related compulsivity and reshapes frontostriatal pathways. *Brain*. 2022;145 (12):4210–4221. doi:10.1093/brain/awac267
26. Peng Z-W, Yang W-H, Miao G-D, Jing J, Chan RC. The Chinese version of the obsessive-compulsive inventory-revised scale: replication and extension to non-clinical and clinical individuals with OCD symptoms. *BMC Psychiatry*. 2011;11(1). doi:10.1186/1471-244X-11-129
27. Chasson GS, Tang S, Gray B, Sun H, Wang J. Further validation of a Chinese version of the obsessive-compulsive inventory-revised. *Behav Cogn Psychotherap*. 2013;41(2):249–254. doi:10.1017/S1352465812000379
28. Wang J, Wei Z, Wang H, Jiang Z, Peng Z. Psychometric properties of the Chinese version of the obsessive beliefs questionnaire-44 (OBQ-44). *BMC Psychiatry*. 2015;15(1):188. doi:10.1186/s12888-015-0579-6
29. Wang X, Ma Z, Wang C. A longitudinal study on the addictive behaviors of general population before and during the COVID-19 pandemic in China. *Inter J EnvironRes Public*. 2022;19(10):5979. doi:10.3390/ijerph19105979
30. Chen QQ, Chen MT, Zhu YH, Chan KL, Ip P. Health correlates, addictive behaviors, and peer victimization among adolescents in. *China World J Pedia*. 2018;14(5):454–460. doi:10.1007/s12519-018-0158-2
31. Cheng SK, Chong GH, Wong CW. Chinese frost multidimensional perfectionism scale: a validation and prediction of self-esteem and psychological distress. *J Clin Psychol*. 1999;55(9):1051–1061. doi:10.1002/(sici)1097-4679(199909)55:9<1051::aid-jclp3>3.0.co;2-1
32. Dang W, Xu Y, Ji J, et al. Study of the SCL-90 scale and changes in the Chinese norms. *Front Psych*. 2021;11:524395. doi:10.3389/fpsyt.2020.524395
33. Zhang CC, Gong H, Zhang Y, et al. Development and psychometric evaluation of the Mandarin Chinese version of the yale-brown obsessive-compulsive scale - second edition. *Brazilian J Psych*. 2019;41(6):494–498. doi:10.1590/1516-4446-2018-0126
34. Foa EB, Huppert JD, Leiberg S, et al. The obsessive-compulsive inventory: development and validation of a short version. *Psycholog Assess*. 2002;14(4):485–496. doi:10.1037/1040-3590.14.4.485
35. Heatherton TF, Kozlowski LT, Frecker RC, Fagerström KO. The Fagerström test for nicotine dependence: a revision of the Fagerström tolerance questionnaire. *Br J Addict*. 1991;86(9):1119–1127. doi:10.1111/j.1360-0443.1991.tb01879.x
36. Fagerström KO, Kunze M, Schoberberger R, et al. Nicotine dependence versus smoking prevalence: comparisons among countries and categories of smokers. *Tobacco Control*. 1996;5(1):52–56. doi:10.1136/tc.5.1.52
37. Saunders JB, Aasland OG, Babor TF, de la Fuente JR, Grant M. Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption--II. *Addiction*. 1993;88(6):791–804. doi:10.1111/j.1360-0443.1993.tb02093.x
38. Lesieur HR, Blume SB. The South Oaks gambling screen (SOGS): a new instrument for the identification of pathological gamblers. *Am J Psychiatry*. 1987;144(9):1184–1188. doi:10.1176/ajp.144.9.1184
39. Sigerson L, Li AY, Cheung MW, Luk JW, Cheng C. Psychometric properties of the Chinese internet gaming disorder scale. *Addict Behav*. 2017;74 (74):20–26. doi:10.1016/j.addbeh.2017.05.031
40. Zung WW. A self-rating depression scale. *Arch Gen Psych*. 1965;12(12):63–70. doi:10.1001/archpsyc.1965.01720310065008
41. Spitzer RL, Kroenke K, Williams JB, Löwe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med*. 2006;166 (10):1092–1097. doi:10.1001/archinte.166.10.1092
42. Chen FF. Sensitivity of goodness of fit indexes to lack of measurement invariance. *Struct Equ Model*. 2007;14(3):464–504. doi:10.1080/10705510701301834
43. Gonzalez R, Griffin D. Testing parameters in structural equation modeling: every "one" matters. *Psychological Methods*. 2001;6(3):258–269. doi:10.1037/1082-989x.6.3.258
44. Brooks SJ, Lochner C, Shoptaw S, Stein DJ. Using the research domain criteria (RDoC) to conceptualize impulsivity and compulsivity in relation to addiction. *Prog Brain Res*. 2017;(235):177–218. doi:10.1016/bs.pbr.2017.08.002
45. Pazuniak M, Pekrul SR. Obsessive-compulsive disorder in autism spectrum disorder across the lifespan. *Child Adolesc Psychiatr Clin N Am*. 2020;29(2):419–432. doi:10.1016/j.chc.2019.12.003

46. Koob GF, Volkow ND. Neurobiology of addiction: a neurocircuitry analysis. *Lancet Psych*. 2016;3(8):760–773. doi:10.1016/S2215-0366(16)00104-8
47. Berridge KC, Robinson TE. Liking, wanting, and the incentive-sensitization theory of addiction. *Amer Psycholog*. 2016;71(8):670–679. doi:10.1037/amp0000059
48. Robinson TE, Berridge KC. The incentive-sensitization theory of addiction 30 years on. *Ann Rev Psychol*. 2025;76(1):29–58. doi:10.1146/annurev-psych-011624-024031
49. Lim TV, Ersche KD. Differential profiles of cognitive and behavioral inflexibility in addictive disorders. *Curr Opin Behav Sci*. 2024;58:101402. doi:10.1016/j.cobeha.2024.101402
50. Canning JR, Patock-Peckham JA, Walters KJ, Bauman DC, Frohe T, Leeman RF. Perfectionism Discrepancy and Falling Short of the Ideal Self: Investigating Drinking Motives and Impaired Control on the Road to Alcohol-Related Problems. *Personal Indivi Differe*. 2020;159. doi:10.1016/j.paid.2020.109909
51. Tabri N, Werner KM, Milyavskaya M, Wohl MJA. Perfectionism predicts disordered eating and gambling via focused self-concept among those high in erroneous beliefs about their disordered behavior. *J Behav Addict*. 2021;10(3):524–533. doi:10.1556/2006.2021.00068
52. Cresswell C, Watson HJ, Jones E, Howell JA, Egan SJ. The role of compulsive exercise in the relationship between perfectionism and eating disorder pathology in underweight adolescents with eating disorders. *Eating Behav*. 2022;47(101683):101683. doi:10.1016/j.eatbeh.2022.101683
53. Franken IH. Drug craving and addiction: integrating psychological and neuropsychopharmacological approaches. *Prog Neuro Psychopharmacol Biol Psychiatry*. 2003;27(4):563–579. doi:10.1016/S0278-5846(03)00081-2
54. Luigjes J, Lorenzetti V, de Haan S, et al. Defining compulsive behavior. *Neuropsychol Rev*. 2019;29(1):4–13. doi:10.1007/s11065-019-09404-9
55. Crews FT, Boettiger CA. Impulsivity, frontal lobes and risk for addiction. *Pharmacol Biochem Behav*. 2009;93(3):237–247. doi:10.1016/j.pbb.2009.04.018
56. Bollen K, Lennox R. Conventional wisdom on measurement: a structural equation perspective. *Psychol Bull*. 1991;110(2):305–314. doi:10.1037/0033-2909.110.2.305
57. Koo TK, Li MY. A guideline of selecting and reporting intraclass correlation coefficients for reliability research. *J chiropra Med*. 2016;15(2):155–163. doi:10.1016/j.jcm.2016.02.012