Research article

Development and validation of Chinese form Short Dark Tetrad (C-SD4)

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ARTICLE INFO

ABSTRACT

The Short Dark Tetrad (SD4) was developed as a brief measure of the Dark Tetrad, which comprises narcissism, Machiavellianism, psychopathy, and sadism. Previous research suggests the possibility of cultural differences in these traits in Western and Eastern cultures. We developed and validated the Chinese form of SD4 (C-SD4) cross four studies in a large sample (total N = 3181) to assist in solving problems caused by these differences. In study 1, we adjusted the item pool on the basis of the original form of SD4. In Study 2, we trimmed the scale to generate a 28-item version of C-SD4 and examined correlations with Big-5. In study 3, we examined the internal structure, measurement invariance, and criterion validity of the C-SD4. In study 4 we examined C-SD4 test-retest reliability and compared item content to standard measures. This package of studies suggests that the C-SD4 is a reliable and valid measure of the Dark Tetrad in Chinese participants.

1. Introduction

Paulhus and Willams [1] coined the term "Dark Personality" to describe variation in maladaptive personality traits that predispose antisocial behavior. This model initially consisted of three interrelated variables: narcissism, Machiavellianism, and psychopathy. Despite some controversy and criticism [2–4], this model has been the basis for a large number of reviews and empirical studies [1, 5–7].

This research has led to questions about the structure of dark personality traits. Some researchers have advised broadening the membership of dark personality [8-10]. A recent study showed that the dark personality could contain up to nine variables [11]. Among these variables, sadism shares the characteristic of callous [12], but differs from the other three traits in that it also involves an intrinsic pleasure in hurting others [13,14]. Consequently, many researchers interested in dark personality now include sadism in a "Dark Tetrad" [8,10,15–20].

1.1. Justification of the Dark-Tetrad

Since variables in dark personality overlap with each other, Paulhus and Willams [1] advised studying these variables together to

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clarify their distinctiveness. However, the excessive questionnaire length dampen the enthusiasm of researchers, the addition of sadism further exacerbated the problem. Two instruments, the Short Dark Triad (SD3, [6]) and the Dirty Dozen (DD12, [21]) have been used to measure the Dark Triad together with relatively few items, so as to reduce participant burden and increase researcher convenience. They provide good instruments to assess Dark Triad but not Dark Tetrad. The addition of sadism and the theory of dark tetrad raised new requirements for measurement.

Some researchers have used standard measures directly to assess the Dark Tetrad [12,22]. As an alternative, some researchers added existing measures of sadism to SD3 to assess the Dark Tetrad, which can reduce participant burden [23,24]. However, both two approaches face the problem of overlapping between constructs. A meta-analysis showed that the correlations between members of Dark Triad are quite high, especially between Machiavellianism and psychopathy (r = 0.58) [25]. Some researchers even suggested that Machiavellianism is a secondary literature of psychopathy because they have similar nomological networks [26]. And this issue can be compounded by the addition of sadism. The correlations between psychopathy and sadism often close to Nickisch et al. [23] or over 0.6 [12] and even 0.7 [24]. In summary, the addition of sadism made the demand for the short measure stronger, and enlarged the problem of overlap in the field of dark traits. Thus, it is ideal to generate a new short-form measure for dark tetrad that maximize discriminant validity.

Paulhus et al. [14] added the sadism subscale based on the SD3 to form the Short Dark Tetrad (SD4), which solved above problems. The SD4 broadened the overall constellation of dark traits by increasing the distinctiveness of other subscales, especially between psychopathy and Machiavellianism while also adding sadism as an independent factor. All the four variables in the Dark Tetrad share callousness as a core feature [6,27,28]. They are thought to be distinguished by unique features: ego-reinforcement for narcissism [29], manipulation for Machiavellianism [30,31], low self-control and impulsivity for psychopathy [6,32], and enjoying from others' suffering for sadism [13,14]. In previous measures, not only above core and unique features but also some related but less important content were included, resulting in some unnecessary overlap. For example, to get the pleasure from others' suffering, sadists may hurt others directly. Therefore, some standard measures of sadism included items like "I enjoy physically hurting people", namely physical sadism, which reflects the tendency of sadism. However, it is not the core or indispensable content of sadism but makes sadism overlap with psychopathy. Therefore, more vicarious sadism items, which also reflect the feature of sadism but distinct with psychopathy, were selected in the SD4. Similarly, Machiavellianism subscale focused on manipulation and removed aggressive items to reduce overlap with psychopathy. In these ways, the SD4 reduced the overlap while preserving the essence of each construct as much as possible. Moreover, as a brief, 28 item measure, it is relatively easy to use. Subsequent studies suggest that the SD4 has good psychometric properties and measurement invariance across demographic groups [14,33,34] in western samples. In summary, SD4, a validated instrument, reduced participant burden and distinct four variables more clearly.

1.2. Culture differences and Dark Traits in China

Meanwhile, the SD4 has not been well validated in eastern samples, which limits its applicability in eastern culture. The East Asian culture, and Chinese culture specifically, is different in a number of respects from western culture. These differences may be especially important with regard to dark personality. Previous research is mixed with regard to how well measures of dark traits developed in western populations are invariant in samples of other cultures, with some studies suggesting measurement equivalence [35], but more studies finding non-equivalence [36–38]. Recent research suggests that cultural differences could explain 6%–16% variance in the dark traits [39]. Variation in the content and structure of dark personality may have to do with specific features of western and eastern cultural traditions.

For example, studies in culturally similar western countries, such as the United States, the United Kingdom, and Germany, has identified measurement noninvariance in measures of narcissism [38], issues with using directly translated measures in Chinese cultures seem likely. In addition, as an important member of personality disorders in the Diagnostic and Statistical Manual of Mental Disorders–Fifth Edition (DSM-5; [40]), narcissistic personality disorder was not included in the Chinese Classifications of Mental Disorders–Third Edition [41]. This indicated a cultural difference in the understanding of narcissism.

The concept of Machiavellianism originated within an Italian political and philosophical context. Although there are analogues in other cultures, such as the philosophy of Chinese military strategist Sun Tzu [31], there are also some differences cross cultures [42]. It is possible that the general idea of using strategic, Machiavellian tactics to get ahead in life manifests differently in a Chinese context, even if the underlying trait is similar.

A number of studies indicate cross-cultural generalizability issues with regard to psychopathy. Studies of the most common measure of psychopathy, the Psychopathy Checklist-Revised (PCL-R), indicate measurement noninvariance between the North American and German offenders [37]. Response thresholds of the Levenson Self-Report Psychopathy Scale (LSRP) are also different between Chinese and U.S. samples and the model fit in Chinese sample is not ideal [43]. The original three-factor model of Psychopathic Personality Inventory-Revised (PPI-R) was not applicable in Japan [44]. In one study, researchers removed East Asian participants when conducting confirmatory factor analysis (CFA) as the factor structure of East Asian students is unique [45].

Sadism is a relatively new variable, and relevant research in China is limited [46]. As such, the content of sadism in Chinese needs further clarification.

These problems seem to persist when the dark traits are considered collectively. For instance, the SD3 is widely used in western countries [6,7]. However, some research showed it has measurement noninvariance cross culture [36], and other studies further suggest diminished model fit in eastern samples [47,48]. Likewise, a recent study of the SD4 indicated the need to shorten it from 28 to 16 items to get obtain satisfactory psychometric properties in Chinese context [49]. The resulting Super-Short Dark Tetrad (SSD4) suffers from somewhat low reliability estimates, and possibly content coverage issues, as a result of having very brief scales (see Refs.

[21,50–52]). In summary, above results lead us to expect cultural differences to affect measurement in dark tetrad traits, making English form of the SD4 has limited applicability in Chinese context. We thus aimed to develop a Chinese form of the SD4 (C-SD4) that was brief enough to be practical, long enough to be reliable and content-valid, and which measured the same latent constructs with standard instruments used in western samples.

1.3. The present study

There usually be four steps when developing a scale, item development, factor analysis, reliability and validity [53]. Therefore, we conducted four studies (total N = 3181) to generate the Chinese form of Short Dark Tetrad (C-SD4) and examine its psychometric properties. Considering the cultural differences of dark personality [36,39], we expected that some items may need to be dropped or replaced. In study 1, we developed the 38-item Version 1 based on the item pool of the SD4 and conducted an exploratory factor analysis (EFA) on the 38 items. According to the results of the EFA, 29 items were remained as the Version 2. Then we adjusted and added some items to form the Version 3 with 37 items. In study 2, we turned to EFA again to trim the 37-item Version 3 to the 28-item final version of C-SD4, and examined associations with Big Five traits. In Study 3, we examined the structure and measurement invariance cross gender of C-SD4 in a new sample using CFA. Then we tested the criterion validity with dominance, the behavioral activation system (BAS), sensation seeking, trait anger, forgiveness, self-control, proactive aggression, reactive aggression, and appetitive aggression. In study 4, we examined the correlations of C-SD4 subscales with standard measures of the dark tetrad and their facets to test whether the C-SD4 captured the content of the original concepts comprehensively. In addition, as an alternative to the C-SD4, we conducted a preliminary comparison of C-SD4 and SSD4 [49] to examine the value of the extra items. Also, we examined the 4-week test-retest reliability of C-SD4. Supplements are available on https://osf.io/ezwgf/. All data are available by request from the corresponding author.

2. Study 1 development of item pool

2.1. Method

2.1.1. Participants and procedure

A total of 1252 community participants in China (*Mean* age = 41.34, *SD* = 9.07, 60.1% were female) completed the online questionnaire of study 1. We posted the advertisement with the Q.R. code of the questionnaire in three communities, and participants received an electronic gift as a reward. We also included three validity items (such as "I am an alien") to exclude randomly responding participants. We used a similar method in all samples of the present study.

All the samples participated in the present study signed the informed consent form. The study has been approved by ethic committee at China University of Political Science and Law and all procedures were in accordance with the Declaration of Helsinki.

Step 1: Item generation

We generated the item pool based on the research of Paulhus et al. [14]; and made some adjustments according to Chinese culture. Because of page limitations, we details are relegated to Supplement. Briefly, a total of 38 items composed the first version of C-SD4, namely Version 1.

Step 2: Item reduction

An EFA was conducted on the 38 items in Version 1. Consistent with Paulhus et al. [14]; we also chose the Principal Axis Factor extraction method and Promax rotation. The SD4, as well as C-SD4, were instruments for dark tetrad, a mature personality framework. Therefore, consistent with Paulhus et al. [14]; we fixed the number of factors to four. First, four items were removed because they showed no clear loading (>0.3) on any factor. Second, we removed five items that load to mismatched factor. (See details in Table S1). After doing that, there were seven items in Machiavellianism and narcissism, respectively, with no cross loading. However, items on sadism and psychopathy had a serious cross-loaded. The four eigenvalues were as follows: 6.02, 2.65, 1.73, 1.28, and explained 20.74%, 9.14%, 5.98%, 4.41% variance. In step 2, we got satisfactory narcissism and Machiavellianism subscales but a failure of separation between psychopathy and sadism, namely Version 2 of C-SD4 with 29 items. We aimed to solve the overlap between psychopathy and sadism in the next step. The EFA Pattern Matrix of retained items is shown in Table S2.

Step 3: Item adjustment and supplement

The overlap between psychopathy and sadism is quite common, to the degree that some items in existing measures of psychopathy refer to sadistic behavior [6,54,55]. Paulhus et al. [14] addressed this issue by reducing physical sadism items (such as "I like to hurt people") and adding vicarious items (such as "I enjoy watching violent sports") as the former is too close to psychopathy (also see Ref. [19]). Although we have taken this method, some vicarious items were removed in step 2 for the overlap with Machiavellianism (such as "I know how to hurt someone with words alone"), so we added four new vicarious sadism items in step 3. Besides, the core feature of sadism is the pleasure of hurting others [8], so we adjusted sadism items according to Chinese language habits to highlight the "pleasure". For example, we adapted "Watching a fist-fight excites me" to "I enjoy watching a fist-fight". This is because in the

Chinese context, "excite" just means an "arousal", but "enjoy" could better reflect "pleasure". Meanwhile, we added four psychopathy items that do not include "hurting others" as alternatives.

In summary, a total of 37 items formed the Version 3 of the C-SD4, including 29 items of the Version 2 and eight sadism and psychopathy items (four each) added in step 3. (See details in Fig. 1 and Table S1)

3. Study 2 creation of the final version

After the reduction, adjustment and supplement of the item pool based on the results from study 1, we aimed in study 2 to create the final version of the C-SD4. We also calculated the association between the C-SD4 scales and Big Five personality traits to examine external validity.

3.1. Method

3.1.1. Participants and procedure

We recruited 789 undergraduates in public elective psychology courses (*Mean* age = 20.07, *SD* = 1.73, 63.0% were female) to create the final version of C-SD4. All participants completed the SD4, and 320 participants (*Mean* age = 19.98, *SD* = 1.43, 61.8% were female) also completed a measure of the big five.

3.2. Measures

Dark Tetrad. The 37-item version of the C-SD4 developed in study 1 was used to measure the dark tetrad traits.

Big Five. We used the Big Five Inventory–10 (BFI-10, [56]) to measure the Big Five traits with 2 items per scale. Considering the small number of items in each subscales, we followed the recommendation of Clark and Watson [57]. Besides alphas, we also calculated the mean interitem correlation (r_{mi}) to describe the reliability of subscales: agreeableness ($\alpha = 0.44$, $r_{mi} = 0.28$), extraversion ($\alpha = 0.79$, $r_{mi} = 0.65$), conscientiousness ($\alpha = 0.66$, $r_{mi} = 0.51$), neuroticism ($\alpha = 0.75$, $r_{mi} = 0.59$), and openness ($\alpha = 0.69$, $r_{mi} = 0.54$). The alphas, especially for agreeableness, were not quite high, but in a normal range of BFI-10 [58]. And the rs_{mi} are acceptable [57], indicating a satisfactory internal consistency reliability of BFI-10.

3.3. Results and discussion

We conducted an EFA on the 37 items of the Version 3 of the C-SD4 in the same way as Study 1. We removed 2 items for low loaded (<0.30), and 2 items for cross-loaded. After doing that, each subscale remained with seven items except the sadism subscale, remained eleven items with good factor loadings. We removed four sadism items that are redundant with other items in content to keep a balance of four subscales. (See details in Fig. 1 and Table S1). The four eigenvalues were as follows: 6.42, 2.54, 2.10, 1.30, and explained 22.92%, 9.06%, 7.50%, 4.66% variance. This resulted in the 28-item final version of the C-SD4. All the 28 items loaded on the hypothesized factors (at least 0.32). Except for M4, all the items had no cross-loading (>0.30) (Table S3). As shown in Table 1, the correlations between subscales was moderate ($rs = 0.25$–0.57, $r_{mean} = 0.37$). Internal consistency values were as follows: Machiavellianism = 0.77, narcissism = 0.76, psychopathy = 0.81, sadism = 0.80.

As shown in Table 2, the pattern of correlation between C-SD4 and Big Five scales is similar to the pattern observed in western
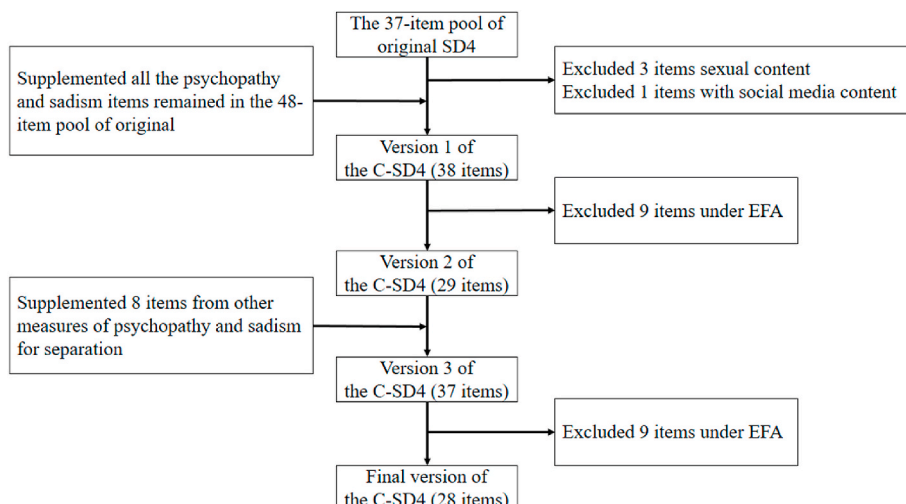

Fig. 1. Flowchart of the development of the C-SD4.

Table 1
Inter-correlations of SD4 subscales in study 2.

	Mean ± SD	M	N	P	S
M	17.61 ± 5.62	(0.77)			
N	15.71 ± 4.93	0.31	(0.76)		
P	10.98 ± 3.65	0.40	0.32	(0.81)	
S	8.50 ± 2.97	0.35	0.25	0.57	(0.80)

Note. N = 789. All inter-correlations were significant at $p < 0.01$, two-tailed; Cronbach alpha coefficients are on the diagonal, in parentheses. M = Machiavellianism, N = narcissism, P = psychopathy, S = sadism, the same below.

samples [14]. Machiavellianism, psychopathy and sadism were negatively related to agreeableness and conscientiousness. Narcissism was positively related to openness and extraversion, and had weaker negative or even positive correlations with agreeableness and conscientiousness. This is consistent with the view that narcissism also has a bright side [29,59,60].

4. Study 3 further confirmation of internal structure and criterion validity

We conducted a CFA to cross-validated the structure of C-SD4 in a new sample and examined the measurement invariance cross gender. On this basis, we measured more variables to examine the criterion validity of C-SD4 and further clarify the characteristics of 4 concepts in the dark tetrad.

Sadism is the new member of the dark tetrad, dominance, BAS and sensation seeking were measured to clarify the essence of sadism. Whether dominance is the core feature of sadism is controversial [13,14,61,62] and needs further clarification. BAS and sensation seeking shares a common feature of seeking reward and pleasure with sadism, we expect to distinguish their differences with sadism. On this basis, forgiveness is strongly associated with revenge, a deviate but premeditated behavior; trait anger and (low) self-control were associated with impulsive behavior; aggression is one of the most typical antisocial behaviors, they were measured as criteria and further distinguish dark constructs.

4.1. Method

4.1.1. Participants and procedure

We recruited 725 undergraduates (*Mean* age = 20.30, *SD* = 1.41, 67.9% were females) in public elective psychology courses. All participants completed the C-SD4. There were 252 participants also completed the measure of dominance, BAS, trait anger, forgiveness and self-control. Another 302 participants also completed the measures of proactive aggression, reactive aggression, appetitive aggression and sensation seeking.

4.2. Measures

Dark Tetrad. The 28-item final version C-SD4 was used to measure the dark tetrad.
Dominance. We used the 4-item dominance octant of International Personality Item Pool—Interpersonal Circumplex (IPIP-IPC) to measure dominance (Markey & Markey [63]; α = 0.76).
Behavioral Activation System (BAS). BAS was assessed with the 13-item BAS dimension of BIS/BAS scales (Carver & White [64]; α = 0.90).
Sensation seeking. We measured sensation seeking with the 8-item Brief Sensation Seeking Scale (B-SSS, Hoyle et al. [65]; α = 0.85).
Trait Anger. We assessed trait anger with the 10-item Trait Anger Scale (TAS, [66]; α = 0.91).
Forgiveness. We assessed forgiveness with 6-item Heartland Forgiveness Scale (Thompson et al. [67]; α = 0.63).
Self-control. Self-control was assessed with the 7-item Brief Self-Control Scale (BSCS, Morean et al. [68]; α = 0.65).
Proactive and Reactive Aggression. We used the Reactive-Proactive Aggression Questionnaire (RPQ) to measure reactive and proactive aggression [69]. Cronbach alpha coefficient of RPQ and two facets were 0.91, 0.90 and 0.87.
Appetitive Aggression. We used Appetitive Aggression Scale (AAS) to measure another type of aggression, namely appetitive aggression (Weierstall & Elbert [70]; α = 0.85).

Table 2
Correlations of SD4 subscales with the Big Five.

	Machiavellianism	Narcissism	Psychopathy	Sadism
Extraversion	−0.16**	0.32**	−0.22**	−0.15**
Agreeableness	−0.31**	−0.12*	−0.37**	−0.36**
Conscientiousness	−0.20**	0.06	−0.23**	−0.15**
Neuroticism	0.11	−0.23**	0.16**	0.09
Openness	0.05	0.38**	−0.03	−0.02

Note. *N* = 320. *$p < 0.05$, **$p < 0.01$ (two-tailed tests).

4.3. Analyses

We used Mplus [71], robust weighted least squares estimation to conduct CFA. We further examined the measurement invariance cross gender (male and female). The configural, metric, and scalar models were compared by multiple group model analyses. The ΔCFI ≤ 0.01 and ΔRMSEA ≤ 0.015 indicated no statistical differences between models.

Then, we calculated the Pearson correlation coefficients between subscales of C-SD4 and criteria. Then, to address the overlap among dark tetrad, we carried out a regression analysis of four variables of dark tetrad on criteria.

4.4. Results and discussion

4.4.1. Internal structure

The fit indices of CFA model are shown in Table 3 and factor loadings are shown in Fig. 2 (results from female and male are shown in Figures S1 and S2, respectively). Chi-square = 1475.32, $p < 0.001$. It is not fatal in the field of personality assessment because the sample size will excessively increases the power of chi-square and produce false positive [72]. The results of CFA were not perfect but good enough, and basically consistent with the original SD4 and much higher than that of the German form [33]. More importantly, these values were within a normal range in the instruments of personality, including some classic instruments such as the Big Five and HEXACO [73]. Besides, all the loading values were higher than 0.43.

As shown in Table 3, C-SD4 was proved to have measurement invariance, indicating a congruence of factor structure, factor loadings, and indicator intercepts cross gender.

As shown in Table 4, the correlations between subscales in Study 3 were also moderate ($rs = 0.20$–0.55, $r_{mean} = 0.35$). Internal consistency values were as follows: Machiavellianism = 0.81, narcissism = 0.86, psychopathy = 0.84, sadism = 0.91.

4.4.2. Criterion validity

Pearson correlation coefficients with criterion measures are shown in Table 5(left values). For three criteria to distinguish with sadism, dominance had a significant but low correlation with sadism and the highest correlation with narcissism. Sadism has a medium correlation with sensation seeking but no significant correlation with BAS. Except narcissism, the other three subscales were significantly positively correlated with trait anger and negatively correlated with self-control and forgiveness. All the 4 subscales showed positive correlations with reactive, proactive and appetite aggression. The results of regression analysis could reflect the unique features of four variables. Therefore, in the following section, we focus on the results of regression analysis (shown in Table 5, right values).

Sadism is the new member of the dark tetrad, so we chose three related variables to understand sadism better. Some researchers believed that dominance motivates sadism and is the core component of sadism [13,61,62]. Paulhus et al. [14] has expressed disagreement with this view, and our results confirmed that sadism had no significant contribution on dominance, and narcissism had the highest contribution on dominance, indicating that dominance is closely related to narcissism but not sadism.

Sadism is not passively taking but actively seeking pleasure from harming others [16,61]. Similarly, BAS and sensation seeking are also related to seeking pleasure and stimulation, so we compared sadism with these constructs. As shown in Table 5, sadism was the only variable that did not contribute significantly to BAS and sensation seeking. Although BAS and sensation seeking both share features of pursuing reward and pleasure, they are still different from sadism, even though sensation seeking is also accompanied by antisocial behaviors [65]. The pleasure of sadism is based on hurting others [8,16] instead of getting rewards through achievement, novelty, or risky behaviors.

To further clarify the unique pattern of dark tetrad traits correlates, we tested the association of some adaptive and maladaptive variables with the dark tetrad. Trait anger and low self-control had similar patterns, in which psychopathy had the highest correlation, Machiavellianism was lower and narcissism had negative correlations. The difference was that sadism significantly predicted low self-control, but not trait anger. Forgiveness had the highest negative correlation with Machiavellianism, followed by a lower association with psychopathy, a positive association narcissism and no significant association with sadism.

All four subscales showed positive correlations with three types of aggression, and regression models helped distinguish these patterns. Machiavellianism and psychopathy significantly predicted reactive aggression, while narcissism and sadism did not. The effect of sadism on proactive aggression was much higher than the other three, that of psychopathy also reached a significant level, while that of Machiavellianism and narcissism were not significant. Similarly, sadism had a much higher effect on appetitive aggression. Machiavellianism also had a significant effect, but psychopathy and narcissism did not.

Table 3
Model testing and invariance testing for CFA.

Model	χ^2	df	χ^2/df	CFI	SRMR	RMSEA [90%CI]
Model fit	1475.32	344	4.29	0.882	0.062	0.067 [0.064, 0.071]
Configural invariance model	1587.27	688	2.31	0.868	0.069	0.060 [0.056,0.064]
Metric invariance model	1609.90	712	2.26	0.868 (0.000)	0.071 (0.002)	0.059 [0.055,0.063]
Scalar invariance model	1678.24	736	2.28	0.861 (0.007)	0.071 (0.000)	0.059 [0.056,0.063]

Values in parentheses are variability for each level of invariance model.
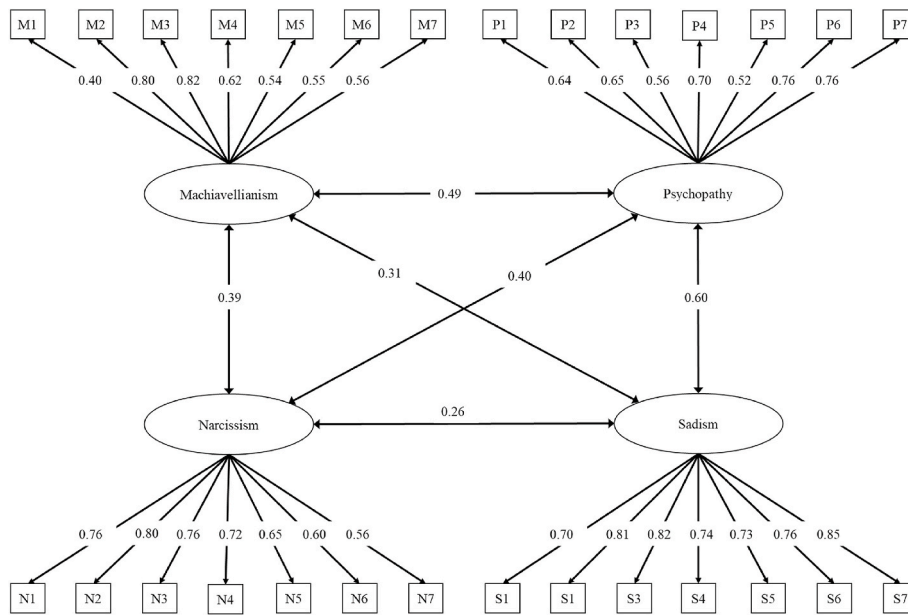
Fig. 2. CFA results from Study 3. Note. All the values were significant at $p < 0.01$.

Table 4
Inter-correlations of SD4 subscales in study 3.

	Mean ± SD	M	N	P	S
M	20.20 ± 6.00	(0.81)			
N	17.63 ± 5.56	0.34	(0.86)		
P	13.09 ± 4.85	0.42	0.32	(0.84)	
S	8.82 ± 3.50	0.28	0.20	0.55	(0.91)

Note. $N = 725$. All inter-correlations were significant at $p < 0.01$, two-tailed; Cronbach alpha coefficients are on the diagonal, in parentheses.

Table 5
Correlated and regression coefficients of SD4 subscales with criterions.

	Machiavellianism	Narcissism	Psychopathy	Sadism	R^2
Dominance	0.19**/0.01	0.50**/0.45**	0.29**/0.15**	0.14*/0.03	0.27
BAS	0.30**/0.17**	0.34**/0.24**	0.32**/0.22**	0.10/−0.06	0.20
Sensation Seeking	0.43**/0.23**	0.39**/0.21**	0.44**/0.27**	0.31**/0.03	0.31
Trait anger	0.28**/0.16**	−0.01/−0.16**	0.45**/0.39	0.31**/0.09	0.25
Self-control	−0.25**/-0.13*	0.09/0.25**	−0.47**/−0.42**	−0.36**/−0.14*	0.30
Forgiveness	−0.24**/−0.21**	0.11/0.22**	−0.25**/−0.17**	−0.24**/−0.12	0.15
Appetite aggression	0.35**/0.12*	0.29**/0.09	0.45**/0.11	0.60**/0.48**	0.40
Proactive aggression	0.24**/0.05	0.16**/-0.01	0.39**/0.15*	0.51**/0.40**	0.28
Reactive aggression	0.46**/0.31**	0.31**/0.11	0.41**/0.21**	0.32**/0.08	0.29

Note. For dominance, BAS, trait anger, forgiveness, self-control, $N = 252$; for proactive aggression, reactive aggression, appetite aggression and sensation seeking, $N = 302$; *$p < 0.05$, **$p < 0.01$. The left values are Pearson correlation coefficients, and the right values are regression coefficients.

4.5. Study 4 stability and correlation with standard measures

The goal of study 4 was to examine the retest stability of the C-SD4 and correlate it with standard measures of the dark tetrad.

4.6. Method

4.6.1. Participants and procedure

We used a community sample ($n = 214$, *Mean* age $= 39.60$, $SD = 9.16$, 70.1% were females) to examine the correlation with standard measures. The procedure was similar to that in Study 1.

Meanwhile, 195 undergraduates (*Mean* age $= 19.99$, $SD = 1.17$, 67.7% were females) completed the C-SD4 twice at an interval of 4 weeks.

4.6.2. Measures

Dark Tetrad. The C-SD4 was used to measure dark tetrad. In addition, we scored the subscales with the method of SSD4 [49] to compare the C-SD4 and SSD4. One item in psychopathy and sadism subscales of SSD4 respectively was not remained in C-SD4, making them incomparable. So we only compare their Machiavellianism and narcissism subscales as a preliminary comparison.

Machiavellianism. We used the 20-item Mach IV as the standard measure of Machiavellianism [30]. We partitioned Mach IV into manipulative tactics (10 items) and cynical worldview (10 items) [6]. The Alpha of Mach-IV is 0.76, and those of the two facets are 0.65 and 0.62.

Psychopathy. We used the 29-item Self-Report Psychopathy Scale-Short Form (SRP-SF) as the standard measure of psychopathy [74]. In the present study, we partitioned psychopathy into Interpersonal/Affective (14 items) and Social Deviance (15 items) factors [75].

Narcissism. We used the Narcissistic Personality Inventory–13 (NPI-13), as the standard measure of narcissism [58]. The NPI-13 has 3 facets: leadership/authority (LA, 4 items), grandiose exhibitionism (GE, 5 items) and entitlement/exploitativeness (EE, 4 items). The alpha and mean interitem correlations (r_{mi}) were NPI-13 ($\alpha = 0.72$, $r_{mi} = 0.18$), LA ($\alpha = 0.59$, $r_{mi} = 0.25$), GE ($\alpha = 0.48$, $r_{mi} = 0.18$), EE ($\alpha = 0.49$, $r_{mi} = 0.19$), which were within an acceptable range [57,58].

Sadism. We used Varieties of Sadistic Tendencies (VAST) as the standard measure of sadism [76]. VAST consists of 16 items and contains two facets: direct sadism (9 items) and vicarious sadism (7 items). Alpha of VAST was 0.78, those of the two facets were 0.68 (direct sadism) and 0.63 (vicarious sadism).

4.6.3. Analyses

We calculated the zero-order correlations between C-SD4 subscales and standard measures and disattenuated for measurement error by the formula $R_{xy} = r_{xy}/\sqrt{(r_{xx} \times r_{yy})}$ [77] to disattenuate measurement error. On this basis, to address the cross-correlations, we calculated the partial correlations between the C-SD4 subscales and the standard measures. The other six variables were included as covariates when calculating correlations between two variables. Further, we broke the standard measures into facets to check if C-SD4 captured the content of standard measures in a balanced way. In addition, we compared the C-SD4 with an alternative, SSD4. One item each in the sadism and psychopathy subscales of SSD4 is not included in C-SD4, making sadism and psychopathy cannot be directly compared. We scored the Machiavellianism and narcissism subscales as SSD4 [49] and compared the correlations of SD4 and SSD4 against standard measures and their facets. All the correlation coefficient differences were tested with the method Pearson and Filon's Z [78].

4.7. Results and discussion

Note from Table 6, the correlations between four C-SD4 subscales and their corresponding standard measures were above medium before disattenuation and they were much higher after disattenuation. It is higher than DD12 [6,7,21] and roughly equal to the German form of SD4 [33]. Meanwhile, each subscale showed the strongest correlation with its corresponding standard measure. However, there were still some cross-correlations, especially between psychopathy and sadism. Fortunately, the results of partial correlations solved the confusion clearly. Unavoidable, the effect size of partial correlations was smaller than that of zero-order correlations. Nonetheless, four subscales showed a clearer correspondence with their corresponding standard measures with no cross-correlation, indicating that C-SD4 retained the content of original concepts and has a good distinction between each other. Notable, as shown in Table 7, the mean correlation between subscales of C-SD4 is $r = 0.35$, while that of standard measures is $r = 0.45$, indicating that C-SD4 separated four variables better than standard measures.

As shown in Table 8, each C-SD4 subscale had comparable correlations with all facets of its corresponding scale (no significant Z-scores differences). In addition, the results of regression showed that two Mach-IV facets both made positive contribution on Machiavellianism subscale (Manipulative $\beta = 0.30$, $p < 0.001$; Cynical $\beta = 0.35$, $p < 0.001$); and so do three narcissism facets (LA $\beta = 0.29$, $p < 0.001$; GE $\beta = 0.30$, $p < 0.001$; EE $\beta = 0.16$, $p = 0.015$); two psychopathy facets (Interpersonal/Affective factor $\beta = 0.27$, $p = 0.027$; Social Deviance factor $\beta = 0.37$, $p < 0.001$) and two sadism facets (Vicarious sadism $\beta = 0.27$, $p < 0.001$; physical sadism $\beta = 0.33$, $p < 0.001$).

Table 6
Correlations of SD4 subscales with standard measures.

	C-SD4 subscales			
	Machiavellianism	Narcissism	Psychopathy	Sadism
Mach-IV	**0.57******(0.50******)**	0.17**(-0.15*)	0.24**(-0.11)	0.22**(-0.01)
NPI-13	0.41**(0.03)	**0.59******(0.43******)**	0.51**(0.06)	0.37**(0.11)
SRP-SF	0.41**(0.02)	0.40**(0.05)	**0.64******(0.31)**	0.53**(0.13)
VAST	0.29**(0.02)	0.20**(-0.07)	0.47**(0.05)	**0.55******(0.29******)**

Note. NPI=Narcissism Personality Inventory; SRP-SF= Self-Report Psychopathy Scale- Short Form; VAST= Varieties of Sadistic Tendencies. $N = 214$. All tests are two-tailed. The first value in each cell is zero-order correlations, the second value in parentheses is partial correlations. Boldfaced values are those between subscales and their corresponding standard measures.

* $p < 0.05$,

** $p < 0.01$.

We calculated the subscale-standard measure correlations of Machiavellianism and narcissism subscales of SSD4. As shown in Table 8 (values in parentheses), correlations of the Machiavellianism subscale of SSD4 with Mach IV and two facets were much weaker than those of C-SD4 (Mach IV: $Z = 6.69$, $p < 0.001$; Cynical Worldview: $Z = 4.90$, $p < 0.001$; Machiavellian Tactics: $Z = 6.76$, $p < 0.001$). The differences in the narcissism subscale were relatively small, and only the GE facet reached a nearly significant level ($Z = 1.94$, $p = 0.052$). This indicated that C-SD4 captured the content of standard measures better than SSD4, at least in the subscales of Machiavellianism and narcissism.

The retest stability coefficients for C-SD4 was relatively high (Machiavellianism = 0.74, narcissism = 0.79, psychopathy = 0.80, sadism = 0.78, overall = 0.85).

5. General discussion

Paulhus et al. [14] added sadism into the constellation of dark personality and developed the SD4 as a brief measure for western samples. The SD4 is an efficient and effective measure capable of distinguishing the four dark tetrad variables. However, like other dark personality measures, the items of the SD4 are based on how dark personality traits manifest in Western culture, and its applicability to Chinese culture is questionable [43,48]. Simply translating without adjusting, deleting and replacing items may lead to poor reliability and validity [47]. Meng et al. [49] revised a Chinese version of SD4 and reduced it from 28 items to 16 items for better psychometric properties, namely the SSD4. However, its extreme brevity lead to low reliability, gaps in core content, and weak correspondence with standard measures [6,50]. The present study developed the C-SD4, a measure of equivalent length as the original version.

Evidence from this series of studies suggest that the C-SD4 is reliable both in terms of internal consistency and retest stability which is especially desirable for short measures (see Ref. [79]), and its scales are distinguishable in terms of internal structure and external correlates, and that its pattern of external correlates is similar to that observed in western samples. Besides, the C-SD4 showed measurement invariance cross gender. Above results suggest that the C-SD4 provides an effective short measure of dark tetrad personality traits in Chinese culture.

5.1. Reduction of overlap

On this basis, the C-SD4 reduced the correlations between subscales to a reasonable level. Members of Dark Tetrad have inevitable overlap as they share callous exploitation as a common component [6,27,28], and a large amount of empirical and theory evidence proved that dark traits are interrelated but distinguished variables [1,5–7]. However, the overlap sometimes is too high, which has caused concerns and doubts of the theory of dark traits and hampers independent measurement of the Dark Tetrad constructs [4,25, 26]. For example, Vize et al. [26] pointed out that the nomological networks of psychopathy and Machiavellianism are highly overlapped, and Machiavellianism is a secondary psychopathy literature. The addition of sadism may exacerbated the problem as sadism overlaps substantially with psychopathy [14,19]. Therefore, measures on dark traits should control the overlap of subscales to a moderate and reasonable level.

We succeeded in obtaining four correlated but well-separated subscales after adjusting and replacing some items. Besides, consistent with the original form of SD4, the correlation between Machiavellianism and psychopathy in C-SD4 decreased compared with SD3 and standard measures [25,26]. The correlation between psychopathy and sadism, although still the highest in the present study, was much weaker than that of standard measures (SRP-SF and VAST). On the whole, compared with the standard measures, the average correlation coefficients between subscales were much lower, which indicated that the C-SD4 reduced the overlap of the Dark Tetrad.

5.2. Integrity of content

The correlations with standard measures further clarified that, despite fewer items and some deletions, the C-SD4 still retained the core content of the four constructs in a relatively complete and balanced manner. Consistent with the German SD4 [33], the C-SD4 showed strong correlations with standard measures, indicating a good convergent validity of the C-SD4. Besides, we further examined the correlations of subscales of the C-SD4 with facets of standard measures, as we adjusted scale content to maximize discriminant validity between subscales. For example, we minimized physical sadism items to reduce the overlap between sadism and psychopathy. This may reduce correlations with certain facets of established measures, making the content somewhat biased. Fortunately, in the

Table 7
Inter-correlations of dark tetrad with C-SD4 and standard measures in study 4.

	M	N	P	S
M	(0.83/0.76)			
N	0.39/0.34	(0.88/0.73)		
P	0.39/0.42	0.47/0.58	(0.84/0.96)	
S	0.22/0.31	0.16/0.39	0.50/0.63	(0.93/0.79)

Note. All inter-correlations were significant at $p < 0.01$. Cronbach alpha coefficients are on the diagonal. Left values are those of C-SD4 subscales, right values are those of standard values.

Table 8

Correlations of SD4 subscales with facets of standard measures.

	C-SD4 subscales			
	Machiavellianism	Narcissism	Psychopathy	Sadism
Mach-IV facets				
Cynical Worldview	**0.49**(0.39)****	0.12	0.16*	0.20**
Machiavellian Tactic	**0.51**(0.31)****	0.17*	0.26**	0.19**
NPI facets				
Leadership/Authority	0.32**	**0.50**(0.50**)**	0.43**	0.42**
Grandiose exhibitionisms	0.23**	**0.48**(0.44**)**	0.23**	0.10
Exploitative/Entitlement	0.41**	**0.40**(0.39**)**	0.56**	0.38**
SRP facets				
Interpersonal/Affective	0.47**	0.39	**0.60****	0.49**
Social Deviance	0.33**	0.33	**0.61****	0.53**
Sadism facets				
Direct sadism	0.32**	0.19**	0.37**	**0.48****
Vicarious sadism	0.21**	0.18**	0.48**	**0.50****

Note. NPI=Narcissism Personality Inventory; SRP-SF= Self-Report Psychopathy Scale- Short Form; VAST= Varieties of Sadistic Tendencies. $N = 214$. Boldfaced values are those between subscales and their corresponding standard measures. Values in parentheses are those of SSD4.

present study, the C-SD4 subscales had equal correlations with facets of standard measures, indicating that C-SD4 captured the content of four constructs in a balanced way. The above results suggest that we reduced the overlap of four constructs to a reasonable level, which avoid a lot of problems and controversy mentioned by previous researchers [4,25,26]. More importantly, the core content of the four constructs were relatively intact and comprehensive.

The brevity of the SSD4 [49] could lead to psychometric limitations [50]. Thus, we made a comparison between C-SD4 and SSD4 preliminarily. Since one item each in the sadism and psychopathy subscales of SSD4 is not included in the C-SD4, we failed to compare the sadism and psychopathy subscales. According to the results of Machiavellianism and narcissism subscales, compared with the C-SD4, correlations with standard measures and their facets of SSD4 decreased significantly. In addition, longer measures usually have higher stability, and an equal number of items would reduce potentially misleading inferences (see Ref. [14]). Therefore, it is reasonable to believe extra items in the C-SD4 are worth retaining, and the longer but still brief instrument C-SD4 is a better option.

5.3. Theoretical contribution on members of Dark Tetrad

The present study also further clarified the essence of the four constructs. First, we clarified the feature of sadism, the newest member of dark personality. Consistent with the previous study, sadism strongly correlated with proactive aggression [8,16], indicating that sadists' aggression is instrumental and purposeful. Meanwhile, the correlation between sadism and dominance was weak, which is consistent with previous studies' results [14,22]. This suggests that sadism is independent of dominance, and the aggressive behavior of sadists is not for control or tangible benefits. Howard [80] divided proactive aggression into two types, one is for control and dominance, the other is for pleasure and recreation (also see in Refs. [81-83]). Similarly, Weierstall & Elbert [70] pointed out appetitive aggression, which is defined as the "perpetration of violence and/or the infliction of harm to a victim for the purpose of experiencing violence-related enjoyment". Sadism had a pretty high correlation with appetitive aggression. The low correlation of sadism with dominance, accompanied by a high correlation with appetitive aggression, indicated that the proactive aggression of sadists is not for positive outcome or superiority but the intrinsic pleasure of aggression.

Meanwhile, sadism is also different from the general pursuit of reward and pleasure. The correlation between sadism and BAS was not significant, and the correlation with sensation seeking only reached a moderate level, indicating that the core of sadism is not the pursuit of pleasure, but instead is premised on causing pain to others. Chester et al. [16] showed that sadism was positively correlated with pleasure during aggression only when victims gave painful feedback, which highlights the "mean" characteristics of sadism.

In addition to sadism, the present study also clarified the characteristics of the other three constructs. Psychopathy showed high trait anger, reactive aggression and low self-control, suggesting that impulsivity is the key distinguishing element of psychopathy among dark traits [6,32]. Narcissism had a strong correlation with dominance, reflecting the entitlement and superiority component of narcissism [29]. As a variable with some controversy in dark personality, narcissism has been considered to be both adaptive and maladaptive [29,59,60]. Its low or nonsignificant correlations with aggression, trait anger, and self-control also confirmed that narcissism does show a relatively "bright" and adaptive side compared to the other three. Narcissism has two aspects, grandiosity and vulnerability, in which grandiose narcissism is seen as relatively adaptive [84,85]. Only the content of grandiose narcissism is included in the construct of dark personality [7], similar to the diagnostic criteria for narcissistic personality disorder in DSM-5 [40]. We could consider including the content of vulnerable narcissism in the measure of dark personality to better reflect the totality of narcissism.

The relationship between impulsivity and Machiavellianism is controversial. Some research showed that Machiavellians are impulsive [86,87] but it is inconsistent with the original conception of Machiavellianism [31] and expert ratings [3,88]. In the present study, Machiavellianism showed significant but low correlations with trait anger and self-control. Meanwhile, as in previous research, Machiavellianism is strongly correlated with reactive aggression [89]. Although reactive aggression is often considered impulsive [90], there are differences between reactive aggression and impulsive aggression, as reactive aggression can also be premeditated, often for revenge [81–83]. The Machiavellianism subscale contains some retaliation-related content (such as "You should wait for the

right time to get back at people"), which may be associated with reactive aggression. Considering that Machiavellianism has a high correlation with reactive aggression, and the relationship between Machiavellianism and impulsivity is controversial, we could further subdivide reactive aggression into controlled-reactive aggression and impulsive-reactive aggression (see Refs. [81–83]) to further explore the correlation between Machiavellianism and aggression and have a deeper understanding of the impulsivity of Machiavellianism.

5.4. Limitations and future directions

Although we got the C-SD4 with good psychometric properties and promoted the development of dark tetrad, the present study also has some limitations.

First, the present study indicated that C-SD4 had good psychometric properties, and overcame some common problems of brief measures. However, shortcomings of brief measures are unavoidable. For example, Miller et al. [88] suggested treating each construct of dark personality as multidimensional, and brief measures cannot meet such needs. It is reassuring that the C-SD4 had balanced correlations with facets of standard measures. However, using standard measures is a better choice when more nuanced study is needed.

Second, the present study examined the correlations with standard measures but did not put them together to predict other variables. We suggest further research to compare the nomological network of C-SD4 subscales and standard measures.

Third, dark personality does exist among ordinary people, but it is apparent that they are more common and severe in forensic samples such as offenders. We should test psychometric properties and measurement invariance of C-SD4 in offenders and other samples with the antisocial tendency in the future.

6. Conclusion

In sum, in the present study we developed the Chinese version of SD4. The C-SD4 is a 28-item instrument with four subscales that are correlated but also clearly distinct in terms of factor structure and criterion correlations. As a brief measure, C-SD4 has excellent internal consistency and test-retest reliability and retains the original conception of the dark tetrad domains accurately and comprehensively. It provides researchers with a practical and efficient instrument to measure dark tetrad traits in Chinese samples.

Author contribution statement

Yuping Liu: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Bingtao Zhou: Performed the experiments; Analyzed and interpreted the data.

Yuting Ouyang: Performed the experiments.

Bo Yang; Qinhong Xie: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data.

Data availability statement

Data will be made available on request.

Declaration of interest's statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.heliyon.2023.e12929.

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