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Original Article

The Nomological Network of the Short Dark Tetrad Scale (SD4)

Christian Blötner[1] , Matthias Ziegler[2], Caroline Wehner[2], Mitja D. Back[3], and Michael P. Grosz[3]

[1]Department of Psychology, TU Dortmund University, Germany
[2]Psychologische Diagnostik, Humboldt-Universität zu Berlin, Germany
[3]Department of Psychology, University of Münster, Germany

Abstract: The present study examined the nomological network of the Short Dark Tetrad scale (SD4). The SD4 measures narcissism, psychopathy, Machiavellianism, and sadism. We translated the original English SD4 into German and used an online sample (N = 594, 77% women) to investigate its nomological network with regard to the Big Five, honesty-humility, maladaptive personality traits, impulsivity, aggression, motives, values, sociosexual orientation, the octants of the interpersonal circumplex model, and self-esteem. The overall profile similarities between the observed and hypothesized nomological networks were very high. Few correlations differed concerning direction or magnitude. Hence, our study extends the nomological network of the Dark Tetrad in a meaningful way and suggests that the SD4 can be validly interpreted and used for the assessment of narcissism, psychopathy, Machiavellianism, and sadism.

Keywords: Dark Tetrad, narcissism, Machiavellianism, psychopathy, sadism

The Short Dark Tetrad scale (SD4) is a personality questionnaire (Paulhus et al., 2020) that was recently developed to measure the four antagonistic traits narcissism, psychopathy, Machiavellianism (Mach), and sadism. The Dark Tetrad is an extension of the Dark Triad (narcissism, psychopathy, and Mach; Paulhus & Williams, 2002). During the last two decades, a great deal of research has been conducted on the Dark Triad – either as a whole or on its three traits in isolation (Muris et al., 2017). Yet, research on the Dark Tetrad has burgeoned only recently (Chabrol et al., 2009). Paulhus et al. (2020) developed the SD4 to provide a more economical and comprehensive measure of the Dark Tetrad and to sufficiently distinguish the four constructs while retaining the core features of each construct. So far, tests of the nomological network as assessed with the SD4 have been limited. The original SD4 paper investigated relationships with the interpersonal circumplex model, the Big Five, adjustment, and sex drive. A more extensive test of the often-postulated nomological network of the captured traits is needed as a crucial part of the construct validity (Campbell & Fiske, 1959). The current study expands research on the nomological network of the SD4 and is the first to introduce and validate a German version of the SD4.

Previous research and theory indicate that the constructs captured by the SD4 are related to numerous other constructs and real-life outcomes, ranging from personality to aggressive behavior. In the following, we sketch the most common relations that the nomological network should entail. Table 1 provides a summary of all hypotheses, whereas the preregistration contains derivations of all hypotheses of the nomological network. As a common frame for all estimations, we referred to Gignac and Szodorai's (2016) and Funder and Ozer's (2019) guidelines (rs = |.10|, |.20|, |.30|, and |.40| are deemed small, moderate, high, and very high, respectively).

The Nomological Network of the Dark Tetrad Traits

Narcissism
Narcissism is characterized by self-exhibition, a sense of entitlement, and a very high valuation of one's skills and achievements. It can be divided into an agentic, self-promoting facet (i.e., *narcissistic admiration*), an antagonistic, self-defending facet (i.e., *narcissistic rivalry*; Back et al., 2013), and a neurotic, unstable facet (*vulnerable narcissism*; e.g., Crowe et al., 2019). The narcissism scale of the

Table 1. Expected and observed nomological networks of the SD4

	SD4-N	SD4-P	SD4-M	SD4-S	SD4 Mean
Narcissism					
SD4-N[1,2]		.42 (.30)[b]	.26 (.30)[a]	.29 (.30)[a]	.71
Admiration[1]	.77 (.60)[a,b]	.31 (.20)[b]	.31 (.20)[b]	.17 (.10)[a,b]	.56
Rivalry[1]	.35 (.50)[b]	.40 (.40)[a]	.40 (.40)[a]	.49 (.30)[b]	.57
NPI-13[2]	.59 (.70)[b]	.30 (.40)[b]	.25 (.30)[a]	.31 (.20)[b]	.52
Psychopathy					
SD4-P[1,2]	.42 (.30)[b]		.19 (.30)[b]	.54 (.50)[a]	.76
P7[1]	.41 (.20)[b]	.79 (.70)[a,b]	.28 (.30)[a]	.57 (.40)[b]	.72
SRP-III[2]	.34 (.30)[a]	.71 (.70)[a]	.27 (.40)[b]	.59 (.40)[b]	.67
Machiavellianism					
SD4-M[1,2]	.26 (.30)[a]	.19 (.30)[b]		.32 (.40)[b]	.61
M7[1]	.21 (.20)[a]	.17 (.30)[b]	.84 (.70)[a,b]	.37 (.40)[a]	.55
Mach-IV[2]	.23 (.30)[a,b]	.36 (.40)[a]	.57 (.70)[b]	.55 (.40)[b]	.59
Sadism					
SD4-S[1,2]	.29 (.30)[a]	.54 (.50)[a]	.32 (.40)[b]		.75
VAST[2]	.19 (.30)[b]	.52 (.50)[a]	.12 (.40)[b]	.65 (.70)[a,b]	.52
Normal and maladaptive personality					
Openness[1,2]	.11 (.20)[b]	−.03 (0)[a]	−.12 (0)[b]	−.10 (0)[b]	−.04
Conscientiousness[1,2]	.01 (0)[a]	−.37 (−.30)[a]	−.04 (−.10)[a]	−.30 (−.30)[a]	−.24
Extraversion[1,2]	.51 (.30)[b]	.15 (0)[b]	−.10 (0)[b]	−.06 (.10)[b]	.19
Agreeableness[1,2]	−.06 (−.20)[b]	−.34 (−.40)[a]	−.21 (−.30)[b]	−.42 (−.40)[a]	−.36
Neuroticism[1,2]	−.27 (−.20)	.09 (0)[b]	.02 (.10)	.10 (−.20)[b]	−.03
H-H[2]	−.30 (−.30)[a]	−.26 (−.40)[b]	−.50 (−.40)[b]	−.38 (−.30)[b]	−.50
Negative affectivity[1]	0 (0)[a]	.26 (0)[b]	.21 (.10)[b]	.23 (−.10)[b]	.24
Detachment[1]	−.17 (0)[b]	.17 (.20)[a]	.29 (.20)[b]	.24 (−.10)[b]	.18
Antagonism[1]	.44 (.30)[b]	.51 (.50)[a]	.31 (.50)[b]	.51 (.50)[a]	.63
Disinhibition[1]	.15 (.10)[a]	.68 (.40)[b]	.15 (0)[b]	.42 (.10)[b]	.49
Psychoticism[1]	.24 (0)[b]	.56 (0)[b]	.28 (0)[b]	.41 (0)[b]	.52
Impulsivity					
Negative urgency[1]	.17 (0)[b]	.55 (.20)[b]	.22 (0)[b]	.34 (0)[b]	.45
Lack of premeditation[1]	.04 (0)[a]	.48 (.30)[b]	−.24 (0)[b]	.17 (0)[b]	.17
Lack of perseverance[1]	−.05 (0)[a]	.25 (.30)[a]	.08(0)	.26 (0)[b]	.19
Sensation seeking[1]	.23 (.20)[a]	.23 (.40)[b]	.11 (−.10)[b]	.19 (.10)[b]	.27
Positive urgency[1]	.29 (0)[b]	.67 (.30)[b]	.22 (−.10)[b]	.47 (0)[b]	.58
Aggression					
Anger[2]	.06 (.10)[a]	.33 (.30)[a]	.04 (.10)[a]	.24 (.20)[a]	.24
Physical aggression[2]	.18 (.10)[b]	.62 (.30)[b]	.11 (0)[b]	.50 (.40)[b]	.50
Verbal aggression[2]	.30 (.10)[b]	.49 (.30)[b]	.13 (0)[b]	.37 (.30)[a]	.46
Mistrust[2]	−.03 (0)[a]	.33 (.20)[b]	.21 (.20)[a]	.34 (0)[b]	.29
Personal values					
Self-transcendence[1]	−.12 (0)[b]	−.20 (−.10)[b]	−.06 (−.20)[b]	−.31 (−.20)[b]	−.24
Self-enhancement[1]	.53 (.30)[b]	.03 (.20)[b]	.31 (.20)[b]	.08 (.20)[b]	.34
Openness to change[1]	.10 (.10)[a]	−.04 (.10)[b]	.03 (0)[a]	−.17 (0)[b]	−.03
Conservation[1]	.06 (−.10)[b]	−.23 (−.10)[b]	.15 (−.10)[b]	−.12 (−.10)[a]	−.05
Unified motives					
Hope for achievement[1]	.18 (.30)[b]	−.11 (.20)[b]	.11 (.20)[b]	−.10 (.10)[b]	.03
Hope for power[1]	.72 (.30)[b]	.30 (.20)[b]	.25 (.30)[a]	.22 (.20)[a]	.54
Hope for affiliation[1]	.24 (−.20)[b]	−.09 (−.30)[b]	−.12 (−.20)[b]	−.20 (−.20)[a]	−.05
Fear of loss[1]	−.16 (−.20)[a]	−.09 (−.10)[a]	.14 (.10)[a]	−.03 (0)[a]	−.05

(Continued on next page)

Table 1. (Continued)

	SD4-N	SD4-P	SD4-M	SD4-S	SD4 Mean
Dominance, prestige, and leadership					
Dominance[2]	.41 (.20)[b]	.46 (.20)[b]	.42 (.20)[b]	.50 (.20)[b]	.63
Prestige[2]	.33 (.30)[a]	.01 (0)[a]	.34 (0)[b]	.07 (0)[a,b]	.27
Leadership[2]	.63 (.30)[b]	.25 (.20)[a]	.14 (.10)[a]	.20 (0)[b]	.44
SSO[2]	.14 (.30)[b]	.34 (.30)[a]	0 (.20)[b]	.18 (.20)[a]	.24
Interpersonal circumplex					
Assertiveness[1]	.54 (.30)[b]	.20 (.20)[a]	−.05 (.10)[b]	.01 (0)[a]	.26
Cynicism[1]	.28 (.20)[b]	.45 (.20)[b]	.19 (.30)[b]	.39 (.20)[b]	.46
Hostility[1]	.24 (.20)[a]	.42 (.30)[b]	.24 (.20)[a]	.53 (.30)[b]	.51
Unsociability[1]	−.19 (−.10)[†,b]	.11 (.20)[b]	.19 (.20)[a]	.22 (.20)[a]	.11
Shyness[1]	−.39 (−.20)[b]	−.15 (−.20)[a]	.16 (−.10)[b]	.01 (0)[a]	−.14
Obedience[1]	−.22 (−.20)[a]	−.29 (−.20)[b]	.13 (0)[b]	−.14 (−.20)[a]	−.19
Empathy[1]	−.09 (−.20)[b]	−.38 (−.30)[b]	−.08 (−.20)[b]	−.41 (−.20)[b]	−.34
Sociableness[1]	.35 (.10)[†,b]	.01 (−.20)[b]	0 (−.20)[b]	−.12 (−.20)[b]	.10
Self-esteem[2]	.29 (.30)[a]	−.17 (0)[b]	0 (.10)[b]	−.18 (0)[b]	−.01

Note. SD4-N, -P, -M, -S, = Narcissism, Psychopathy, Machiavellianism, and Sadism, as measured by the SD4; NPI-13 = 13-item version of the Narcissistic Personality Inventory; H-H = Honesty-Humility; SSO = Sociosexual Orientation. [1]Presented in Condition 1 (n_1 = 271); [2]Presented in Condition 2 (n_2 = 323). Values in parentheses are hypothesized *r*s. [†]In Table 1 in the preregistration, correlations of narcissism with unsociability and sociableness were labeled with incorrect signs (*r*s = .10 and −.10), whereas in the text, the correct signs were mentioned. [a]Correlation was within the boundaries ($p < .05$); [b]Correlation was different from the expected *r* ($p < .05$).

SD4 focuses more strongly on the agentic than on the antagonistic and vulnerable facet. We expected a large positive correlation between SD4 narcissism and extraversion because individuals with high scores in narcissism engage in social interactions to seek confirmation (Morf & Rhodewalt, 2001). This effect size is in line with meta-analytical results (Muris et al., 2017; Vize et al., 2018). Further considering high narcissistic individuals' beliefs of grandiosity and uniqueness (Back et al., 2013), we expected large positive correlations with self-enhancement values, motivation for prestige, assertiveness, and self-esteem. We expected a moderate, negative correlation between SD4 narcissism and neuroticism (see Back et al., 2013, for a similar correlation for narcissistic admiration).

Psychopathy

Psychopathy is defined by impulsive, aggressive, irresponsible, and socially aversive behaviors (e.g., Skeem et al., 2011). We expected large positive correlations with both key components of impulsivity (Whiteside & Lynam, 2001): *Lack of premeditation* (i.e., preference for non-reflected behaviors over long-term planning) and *lack of perseverance* (i.e., low stamina on dull tasks). Following meta-analyses (Muris et al., 2017; Vize et al., 2018), we expected large positive correlations with physical and verbal aggression. Addressing selfishness and irresponsibility, we attempted to roughly replicate Balakrishnan et al.'s (2017) finding on self-transcendence values ($r = −.10$).

Machiavellianism

Prominent characteristics of Machiavellianism are planfulness, manipulation, immorality, and a cynical worldview (Christie & Geis, 1970). Dahling et al. (2009) emphasized distrust and fear of being deceived, which the authors linked with affective lability. We expected small and moderate positive correlations with neuroticism and mistrust, respectively. Mach should be more strongly positively associated with self-control and less positively with aggression than psychopathy (Paulhus et al., 2018). Therefore, we expected null correlations of Mach with lack of perseverance, physical aggression, and verbal aggression. Given the role of cynicism in Mach, we hypothesized a large positive correlation with cynicism.

Sadism

Highly sadistic individuals enjoy doing or viewing harm (*direct* and *vicarious sadism*, respectively; Paulhus & Jones, 2015). The research mentions verbal and physical violence but physical violence is more typical for sadism (Paulhus et al., 2020). We, therefore, expected sadism to reveal large and very large positive correlations with verbal and physical aggression, respectively. Because sadistic aggression is seen as a means to feel dominant (e.g., Buckels et al., 2018), we expected a moderately positive correlation with dominance. Considering intentional violence and trivializing others' pain (Buckels et al., 2018), and in line with Southard et al. (2015), we expected a moderate, negative correlation with empathy.

The Dark Tetrad Traits' Shared Variance

The Dark Tetrad is a combination of disagreeable traits (Chabrol et al., 2009). Thus, we expected negative correlations with agreeableness for all four traits. Because the present narcissism scale is rather agentic and less antagonistic, we expected a moderately negative correlation with agreeableness. For psychopathy, we referred to recent meta-analyses (Muris et al., 2017; Vize et al., 2018) and hypothesized a very large positive correlation with agreeableness. For Mach, we expected a smaller correlation than was found in these meta-analyses ($r = -.30$). The meta-analyses focused on findings from Mach scales that correlated more strongly with psychopathy than the Mach scale of the SD4 is supposed to (Paulhus et al., 2020). Following Book et al. (2016), we expected a very strong negative correlation of sadism with agreeableness.

Method

Participants and Procedure

We recruited our participants via social media. Only adults were allowed to participate. A lottery for ten 25 € shopping vouchers, scientifically based feedback on the personality (Big Five), and/or course credit served as incentives. All participants filled out demographic questionnaires, the SD4, and a Big Five measure. Afterward, participants were randomly assigned to one of two conditions in which only a subset of the items was administered (*planned missingness design*; e.g., Enders, 2010; for the assignment, see Table 1). We took care of having equal numbers of items and at least one additional narcissism, psychopathy, and Mach scale in each condition. Following Schönbrodt and Perugini's (2013) sample size recommendation for estimating stable correlation coefficients, we aimed to have at least 250 participants in each condition. To compensate for exclusions and unequal partitioning at the outset, we recruited 600 participants (i.e., in both conditions combined). We excluded six participants because they were under 18 years old ($n = 2$) or due to technical problems in the assignment ($n = 4$). The final sample size was 594 (77% women, $M_{age} = 28.4$, $SD_{age} = 9.0$) with 271 in Condition 1 and 323 in Condition 2. This study received approval from the institutional review board of the University of Münster.

Measures

Dark Tetrad Traits

Narcissism was measured with our German translation of the SD4 narcissism scale (Paulhus et al., 2020), the German short form of the Narcissistic Admiration and Rivalry

Questionnaire (NARQ-S; Leckelt et al., 2018), and a 13-item German version of the Narcissistic Personality Inventory (NPI-13; Brailovskaia et al., 2019). Psychopathy was measured with our German translation of the respective SD4 scale, a self-translated version of the 28-item Self-Report Psychopathy Scale-III (SRP-III; Gordts et al., 2015), and the German P7 (Grosz et al., 2020). Mach was measured with our German translation of the SD4 Mach scale, a German version of the Mach-IV (Henning & Six, 1977), and the German M7 (Grosz et al., 2020). Sadism was measured with our German translation of the SD4 scale and a German translation of the Varieties of Sadistic Tendencies (VAST; Paulhus & Jones, 2015) as used in Wehner et al. (2020). The German translation of the SD4 is presented in the Appendix. Two groups of two researchers each translated the items independently and, in cases of disagreement, reached a consensus for the translations. Table S1 in the supplement provides more information concerning the measures' compositions of subscales, numbers of items, descriptive statistics, internal consistency estimates, and rating scales (https://osf.io/9ewjr/).

Broad Personality Traits

For the assessment of the Big Five, we used Danner et al.'s (2016) German version of the Big Five Inventory-2. We measured Honesty-Humility (H-H) with the respective subscale from Moshagen et al.'s (2014) German HEXACO-60. For maladaptive personality traits, we used Zimmermann et al.'s (2014) German short form of the Personality Inventory for DSM-5.

Impulsivity

To measure the facets of *Negative Urgency, Premeditation* (reverse-scored), *Perseverance* (reverse-scored), and *Sensation Seeking*, we applied the German short form of the Urgency Premeditation Perseverance and Sensation Seeking Impulsive Behavior Scale (Keye et al., 2009; original by Whiteside & Lynam, 2001). To measure *Positive Urgency*, we used self-translated versions of Cyders et al.'s (2014) positive urgency scale and Cyders et al.'s (2007) item "When I am very happy, I feel like it is OK to give in to cravings or overindulge."

Aggression

We assessed *Physical Aggression, Verbal Aggression, Anger*, and *Mistrust* with the German Aggression Scale (Werner & von Collani, 2014).

Personal Values

Self-Transcendence, Self-Enhancement, Openness to Change, and *Conservation* were measured with Beierlein et al.'s German Personal Values Scales (GESIS, 2014).

Motives

We used the German Unified Motives Scale (Schönbrodt & Gerstenberg, 2012) to measure *Hope for Power, Hope for Achievement, Hope for Affiliation*, and *Fear of Loss*.

Dominance, Prestige, and Leadership

To measure the motivations for *Dominance*, *Prestige*, and *Leadership*, we used Suessenbach et al.'s (2019) respective scales.

Sociosexual Orientation

Sociosexual Orientation (SSO) was measured with the German Revised Sociosexual Orientation Inventory (Penke, 2011).

Interpersonal Circumplex

The octants of the *Interpersonal Circumplex* were assessed with the German short form of the Interpersonal Adjective List (Jacobs & Scholl, 2016).

Self-Esteem

To measure *Self-Esteem*, we used von Collani and Herzberg's (2003) German version of the Rosenberg Self-Esteem Scale.

Analytic Strategy

We based our analyses on bivariate product-moment correlations between the SD4 traits and the presented criteria. Different from the preregistered plan of calculating all results with the subsample sizes on which each correlation was based (random Conditions 1 and 2), we imputed missing mean values (50 imputations) with the R-package *mice* (version 3.11.0; van Buuren, 2020). We then evaluated the congruence between each Dark Tetrad trait's hypothesized and observed nomological networks (profile similarity), the agreement between the observed nomological networks of the SD4 traits, and the agreement of the hypothesized and observed correlations for each combination of Dark Tetrad trait and criterion (equivalence test). Thus, equivalence tests enabled us to identify high and low contributions to overall profile similarity.

Profile Similarity Between Expected and Observed Nomological Networks of the SD4

For the profile similarity analyses, we used the Contrast-Construct Validity method (CCV; Furr & Heuckeroth, 2019). That is, we correlated contrast-weighted expected correlations and Fisher-z-transformed actual correlations with each other ($r_{\text{alerting-CV}}$). This bare-bones correlation quantifies agreement regardless of numerical similarities. An adjusted index, $r_{\text{contrast-CV}}$, additionally integrates information regarding the variance of hypothesized correlations

and the shape of the empirical correlations' distribution. It is more informative than $r_{\text{alerting-CV}}$ and thus, we preferred to interpret $r_{\text{contrast-CV}}$. Furr and Heuckeroth (2019) considered profile similarity indices around .70 or larger as good congruence. To run the analyses, we used the R-package *qcv* (version 1.0; Furr & Heuckeroth, 2018).

Comparisons of the Observed Nomological Networks of the SD4 Traits

To compare the observed nomological networks between the four traits, we computed double-entry intraclass correlations (ICC_{DE}) with the R package *iccde* (version 0.3.1, Blötner & Grosz, 2021). This analysis was based on the observed correlations of the SD4 traits with the traits of the nomological networks (excluding intercorrelations among the SD4 traits). Hence, the CCV method (Furr & Heuckeroth, 2019) tests the agreement between expected and observed correlations for each SD4 trait in particular, whereas the ICC_{DE}s quantify the agreement of the observed correlations between two different SD4 traits. This analysis was based on a reviewer's recommendation.

Equivalence Test

The procedure of testing equivalence between expected and observed correlations consists of two one-sided tests (TOSTs; Lakens, 2017). We tested whether an observed correlation was significantly larger than a lower equivalence bound while simultaneously being significantly smaller than an upper equivalence bound. The equivalence bounds depended on the smallest effect size that could yield significance, given the actual statistical power (smallest effect size of interest; SESOI). Lower and upper boundaries resulted from subtracting the SESOI from the expected correlation and adding the SESOI to the expected correlation, respectively. To identify the SESOI, we used the R-package *pwr* (version 1.3-0; Champely et al., 2020). Given $N = 594$ and a target power of 95%, the analysis revealed SESOI = |.13|. Equivalence tests were computed with the R-package *TOSTER* (version 0.3.4; Lakens, 2017). In addition to the preregistered equivalence tests, we tested whether each observed correlation was significantly different from its expected correlation by using the R-package *diffcor* (version 0.6.4; Blötner, 2021). We decided to do so because empirical correlations can be within the equivalence bounds, but their confidence intervals might not overlap with the expected value (Lakens, 2017). Considering both equivalence tests and correlation difference tests enabled us to evaluate the findings in a more differentiated way. When the TOSTs were significant (both $ps_{\text{TOST}} < .05$) and the difference test was not significant ($p_{\text{diff}} \geq .05$), we concluded equivalence between the expected and observed coefficients. When the observed correlation differed significantly from the hypothesized correlation ($p_{\text{diff}} < .05$), but only one

of the TOSTs was significant, we interpreted this to indicate nonequivalence. Finally, we treated a finding as being inconclusive if (a) both TOSTs and the correlation difference test yielded significance or (b) none of the tests yielded significance.

Results and Discussion

Confirmatory Factor Analyses (CFA)

Before we conducted our main analyses, we replicated Paulhus et al.'s (2020) confirmatory factor analyses with and without parceling (Weighted Least Square Mean and Variance Adjusted [WLSMV] estimator from the R package *lavaan* version 0.6-7; Rosseel, 2012; see Tables S2–S7). Without parceling, the model fit was poor with regard to the Comparative Fit Index (CFI) but acceptable with regard to Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR) (Hu & Bentler, 1999), $\chi^2(344) = 963.12$, $p < .001$, CFI = .78, RMSEA = .06, 90% CI = [.05, .06], SRMR = .07. Modification indices especially suggested cross-loadings of the items onto other factors. The fit improved with parceling (random assignment of 2, 2, and 3 items to each parcel per factor), $\chi^2(48) = 157.50$, $p < .001$, CFI = .92, RMSEA = .06, 90% CI = [.05, .07], SRMR = .04. Paulhus et al.'s (2020) CFAs had similar RMSEAs and SRMRs but higher CFIs. However, Hu and Bentler's benchmarks are based on simulations with extremely high factor loadings. These conventions are inappropriate in models with more realistic loadings (Heene et al., 2011). Our results are thus in line with many other studies that used questionnaire data (Hopwood & Donnellan, 2010).

Table 1 presents the correlations between the SD4 scales and the constructs from the nomological network. Our supplement provides the details of all used instruments (reliability estimators, descriptive statistics, information on subscales, response scales; Table S1, https://osf.io/9ewjr/), CFAs of the SD4 (Tables S2–S7, https://osf.io/9ewjr/), all results of our equivalence tests (Table S8, https://osf.io/9ewjr/), a comparison of our results with and without imputation (Table S9, https://osf.io/9ewjr/), a comparison of the results for native-speakers and non-native speakers (robustness analysis; Table S10, https://osf.io/9ewjr/), and the ICC$_{DE}$s (Table S11, https://osf.io/9ewjr/).

Narcissism

For the congruence between the hypothesized and observed correlations involving SD4 narcissism, the profile similarity indices were $r_{alerting-CV} = .81$ and $r_{contrast-CV} = .95$. That is, the rank orders of the expected and observed

coefficients revealed a correlation of .81. After correcting the biases that were due to the distribution properties of the observed and expected coefficients, the correlation between the observed and expected values was .95. This indicates that many of our observations converged with our expectations in terms of direction (Furr & Heuckeroth, 2019). Similarly, 19 of the 52 equivalence tests indicated that the hypothesized and observed correlations were equivalent. For example, the observed correlations of narcissism with the motivation for prestige ($r = .33$) and self-esteem ($r = .29$) were significantly within the boundaries (both expected rs = .30, ps$_{TOST} \leq .002$) and were not different from the expected values (ps$_{diff} \geq .42$). Thus, we concluded that equivalence held. For the correlation between self-esteem and narcissistic admiration, Back et al. (2013) found a similar effect size. For neuroticism and admiration, our findings were inconclusive because neither ($r = -.27$; expected $r = -.20$, all ps $\leq .07$) or both tests were significant, respectively ($r = .77$, expected $r = .60$, all ps $< .001$). Finally, we concluded that non-equivalence held when the observed and hypothesized parameters differed, while only one of the TOSTs was significant. We found non-equivalence for 30 of 52 correlations. For instance, we observed correlations that were higher than expected for criteria reflecting grandiose exhibition and self-promotion (Back et al., 2013): These were the correlations with extraversion ($r = .51$), self-enhancement values ($r = .53$), and assertiveness ($r = .54$, all expected rs = .30). Furthermore, we found a correlation with agreeableness that was smaller than expected ($r = -.06$, expected $r = -.20$, ps$_{TOST} \leq 1.00$, ps$_{diff} < .001$). Last, the narcissism scale from the SD4 revealed stronger than expected correlations with physical and verbal aggression (rs = .18 and .30, both expected rs = .10) and antagonism ($r = .44$, expected $r = .30$, $p_{diff} < .05$, ps$_{TOST} \leq .97$). Paulhus et al. (2020) found similar correlations with neuroticism, agreeableness, and extraversion. Given that the aggression-, antagonism-, and self-promotion-links were stronger than expected, we concluded that the SD4 narcissism scale might not only assess agentic but also partly antagonistic narcissism.

Psychopathy

For the congruence between hypothesized and observed correlations involving SD4 psychopathy, profile similarity indices were $r_{alerting-CV} = .84$ and $r_{contrast-CV} = .95$. We concluded that equivalence held for 18 of 52 correlations. For example, the observed and expected correlations were equivalent for lack of perseverance ($r = .25$, expected $r = .30$) and agreeableness ($r = -.34$, expected $r = -.40$). The equivalent correlations we found corroborated aversive, uncontrolled tendencies in psychopathy (Skeem et al., 2011). On the contrary, physical ($r = .62$) and verbal

aggression (r = .49, both expected rs = .30), and self-transcendence values (r = −.20, r = −.10, ps$_{\text{TOST}}$ < 1.00, p_{diff} < .01) were closer related to psychopathy than we expected. These correlations and an additional 30 other correlations were not equivalent (see Table 1). However, the directions and strengths of the correlations emphasize the validity of the SD4 subscale as the stated constructs refer to central characteristics. For example, the psychopathy subscale of the SD4 explicitly names conflicts with others and with authorities. A positive, non-equivalent correlation with neuroticism (r = .09, expected r = 0, $p_{\text{diff}} \leq$ .03, ps$_{\text{TOST}} \leq$ .16) emphasizes the emotionally unstable side of psychopathy, whereas, for instance, the inverse, very high correlation with empathy (r = −.38, expected r = −.30, p_{diff} = .03, p_{TOST} = .07) indicates parallels with the callous facets of psychopathy (Skeem et al., 2011).

Machiavellianism

For SD4 Mach, the profile similarity indices were $r_{\text{alerting-CV}}$ = .77 and $r_{\text{contrast-CV}}$ = .94. For 13 of 52 correlations, equivalence between observation and expectation held (see Table 1). Among others, the correlation with mistrust (r = .21, expected r = .20, ps$_{\text{TOST}} \leq$ .001, p_{diff} = .80) was equivalent to our expectation. Combining this finding with a negative correlation with a lack of premeditation (r = −.24, expected r = 0), our results underlined long-term planning and skepticism of others (Dahling et al., 2009). On the other hand, we found small, non-equivalent correlations with physical and verbal aggression (rs = .11 and .13, respectively, both expected rs = 0, ps$_{\text{TOST}}$ < .50, ps$_{\text{diff}} \leq$ .001). These correlations disagreed with the Machiavellian tendency to avoid violence (Paulhus et al., 2018) but were smaller than findings from earlier studies that were based on measures that revealed stronger overlaps with psychopathy (Muris et al., 2017; Vize et al., 2018). Likewise, the agreement of the observed nomological networks of SD4 Mach and SD4 psychopathy (ICC$_{\text{DE}}$ = .33; see Table S11, https://osf.io/9ewjr/) was smaller than the agreement found for other Mach and psychopathy scales (e.g., Miller et al., 2017). The correlation between SD4 Mach and neuroticism was inconclusive (r = .02, expected r = .10, ps$_{\text{TOST}}$ $\leq$ .11, p_{diff} = .051). Relatedly, Muris et al.'s (2017) meta-analysis suggested that the link between neuroticism and Mach varies from Mach scale to Mach scale. Some correlations were not equivalent but were in the predicted direction and relatively close to the expected values, for example, the correlations with cynicism (r = .19, expected r = .30) and agreeableness (r = −.21, expected r = −.30, ps$_{\text{TOST}}$ < .16, ps$_{\text{diff}} \leq$ .02). However, the current Mach scale has remarkably less cynical or overtly disagreeable item content than other scales (e.g., Mach-IV) and rather emphasizes strategic orientations. This might have accounted for smaller than expected correlations with agreeableness and cynicism.

Sadism

Profile similarity indices for the congruence between expected and observed correlations in sadism were $r_{\text{alerting-CV}}$ = .83 and $r_{\text{contrast-CV}}$ = .95. Seventeen of 52 observed correlations were equivalent to the expected correlations and thus contributed to high profile similarity. For example, the correlations with agreeableness (r = −.42, expected r = −.40; for a similar correlation, see Paulhus et al., 2020) and verbal aggression (r = .37, expected r = .30, ps$_{\text{TOST}} \leq$ .04, ps$_{\text{diff}}$ > .05) were equivalent. However, we found more extreme correlations than expected for physical aggression (r = .50, expected r = .40), empathy (r = −.41, expected r = −.20), and dominance (r = .50, expected r = .20, ps$_{\text{TOST}}$ < 1.00, ps$_{\text{diff}} \leq$ .002). Other sadism scales were also associated with high aggression and dominance and low empathy, but the effect sizes for these other scales were smaller (Dinić et al., 2020). An explanation for this discrepancy might be that the sadism scale from the SD4 is less affected by variance restriction than other sadism scales because SD4 sadism measures more common forms of sadism (e.g., SD4 sadism: "It's funny when idiots fall flat on their face" vs. VAST: "In video games, I like the realistic blood spurts").[1] However, sadism and psychopathy as measured by the SD4 were strongly correlated with each other (r = .54) and quite similar in their nomological networks (ICC$_{\text{DE}}$ = .88, see Table S11, https://osf.io/9ewjr/). Thus, the overlap between SD4 sadism and SD4 psychopathy should be probed by future research.

We compared the results we obtained with and without imputation. Due to higher statistical power, a higher amount of the observed correlations was not equivalent to the expected correlations when missing data were imputed. Many of these correlations were equivalent when missing data were not imputed. This further underlines the strictness of our analyses. Note that only a few parameters differed between the analyses with and without imputations (see Table S9, https://osf.io/9ewjr/).

Conclusions and Limitations

By offering a broadband validation, this project provided further insights into the nomological network of the SD4 while simultaneously presenting a German version.

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[1] Furthermore, the dominance scale we employed strongly related to high agency but low communion (i.e., Quadrant II from the IPC). Antagonistic traits typically project on Quadrant II (Jones & Paulhus, 2011), which explains the very high correlation between dominance and SD4 sadism.

Although only about a third of our hypotheses on equivalence were supported, our findings can be interpreted in favor of the construct validity because most correlations were in the expected direction (as can be seen in the profile similarity indices) and many were relatively close to previously observed correlations. It should be noted that our analyses were very strict so that non-equivalence of correlations resulted quite easily. Relatively similar effect sizes were equivalent or not equivalent, depending on the sample size (see Table S9, https://osf.io/9ewjr/). Another possible way to define the boundaries for the equivalence tests would have been to test if the observed correlations differed from the expected ones by more than $r = |.20|$ (moderate effect size according to Gignac & Szodorai, 2016). Under these circumstances, more correlations would have yielded equivalence.

This study was confronted with some limitations. First, we only used cross-sectional self-report data. Second, our sample was imbalanced in that it predominantly comprised women, and it is men who tend to score higher on dark traits (Chabrol et al., 2009; Muris et al., 2017). Third, we did not test the measurement invariance of the SD4 across language groups (English vs. German). To overcome the shortcomings, we encourage future research to investigate the psychometric properties of the SD4 in more gender-balanced samples. Future research should also test the measurement invariance of the German version of the SD4.

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Publication Ethics

This study received approval from the institutional review board of the University of Münster.

Open Science

We report how we determined our sample size, all data exclusions (if any), all data inclusion/exclusion criteria, whether inclusion/exclusion criteria were established prior to data analysis, all measures in the study, and all analyses including all tested models. If we use inferential tests, we report exact *p*-values, effect sizes, and 95% confidence or credible intervals.

Open Data: We confirm that there is sufficient information for an independent researcher to reproduce all of the reported results, including the codebook if relevant (Blötner et al., 2021).

Open Materials: We confirm that there is sufficient information for an independent researcher to reproduce all of the reported methodology (Blötner et al., 2021).

Preregistration of Studies and Analysis Plans: This study was preregistered with an analysis plan. All data, materials, and preregistration can be retrieved from https://osf.io/9ewjr/ (Blötner et al., 2021).

ORCID

Christian Blötner
https://orcid.org/0000-0001-7415-4756

Christian Blötner
Faculty for Educational Sciences and Psychology
Department of Psychology
TU Dortmund University
Emil-Figge-Str. 50
44227 Dortmund
Germany
christian.bloetner@tu-dortmund.de

Appendix

German SD4

Table A1. German translations of the SD4

Item labels	German item content
Mach_1	Es ist nicht ratsam, seine Geheimnisse preiszugeben.
Mach_2	Man muss die wichtigen Personen auf seine Seite ziehen, koste es, was es wolle.
Mach_3	Vermeide direkte Konflikte mit Anderen, denn sie könnten in der Zukunft von Nutzen sein.
Mach_4	Verhalte dich unauffällig, wenn du deinen Willen durchsetzen willst.
Mach_5	Die Situation zu manipulieren, erfordert Planung.
Mach_6	Schmeicheln ist ein gutes Mittel, um Leute auf deine Seite zu ziehen.
Mach_7	Ich liebe es, wenn ein kniffliger Plan gelingt.
Narc_1	Andere sehen mich als geborene Führungsperson.
Narc_2	Ich habe eine einzigartige Begabung, andere zu überzeugen.
Narc_3	Gruppenaktivitäten sind ohne mich eher langweilig.
Narc_4	Ich weiß, dass ich etwas Besonderes bin, da mir andere das immer wieder sagen.
Narc_5	Ich habe einige außergewöhnliche Qualitäten.
Narc_6	Ich werde in der Zukunft wahrscheinlich ein Star in einem bestimmten Bereich sein.
Narc_7	Ich mag es, hin und wieder anzugeben.
Psyc_1	Menschen sagen oft, dass ich außer Kontrolle bin.
Psyc_2	Ich neige dazu, gegen Autoritäten und deren Regeln zu kämpfen.
Psyc_3	Ich war in mehr Auseinandersetzungen verwickelt als die meisten Menschen meines Alters und Geschlechts.
Psyc_4	Ich neige dazu, mich kopfüber in etwas zu stürzen ohne Fragen zu stellen.
Psyc_5	Ich hatte schon Schwierigkeiten mit dem Gesetz.
Psyc_6	Ich gerate manchmal in gefährliche Situationen.
Psyc_7	Leute, die sich mit mir anlegen, bereuen es immer
Sad_1	Bei einem Faustkampf zuzuschauen begeistert mich.
Sad_2	Ich genieße gewalttätige Filme und Computerspiele.
Sad_3	Es ist witzig, wenn Idioten auf die Nase fallen.
Sad_4	Ich genieße es, bei gewalttätigem Sport zuzuschauen.
Sad_5	Manche Menschen verdienen es zu leiden.
Sad_6	Rein zum Vergnügen habe ich schonmal gemeine Dinge in sozialen Medien gesagt.
Sad_7	Ich weiß, wie ich jemanden allein mit Worten verletzen kann.

Note. Mach = Machiavellianism; Narc = Narcissism; Psyc = Psychopathy; Sad = Sadism.