

Giving Meaning to the Dark Triad: Comparison of Different Factor Structures of the Dirty Dozen through Eight Regions of the World

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Abstract

The traits of the dark triad (narcissism, psychopathy and Machiavellianism) capture the individual differences in the aversive personality. The dark triad has shown significant relations with behaviors that affect people's lives. One of the best-known instruments to assess the dark triad is the Dirty Dozen. However, controversy continues over the use of one general dark triad score or, conversely, three different scores. This study aimed to investigate the factor structure of the Dirty Dozen across eight global regions. There were 11,477 participants in 49 countries grouped into eight regions. Different factor structures were studied using confirmatory factor analyses. Both the three-dimensional models and the bifactor models (symmetrical or traditional and non-symmetrical or bifactor-(S-1)) showed a good fit to the data. The bifactor-(S-1) models (with psychopathy or Machiavellianism as the reference factors) show adequate fit to the data, supported by the coherence of the factorial loadings and the bifactor indices. Regarding measurement invariance for both models, configural, metric, and scalar invariance were satisfied. The results indicate that it is not clear whether a psychopathy or Machiavellianism reference factor predominates in the Dirty Dozen. For both models, templates are provided to obtain standardized scores for applied researchers in the eight studied world regions until future studies offer a greater amount of validity evidence for this instrument.

Keywords. Dark triad; Dirty Dozen; bifactor-(S-1); transcultural; measurement invariance

What is the Dark Triad

Twenty years ago, Paulhus and Williams (2002) grouped psychopathy, Machiavellianism, and narcissism under the term "the dark triad of personality". Their grouping was based on the "socially malevolent" characteristics that these traits share, sufficient to be considered traits close to one another, but with differences that justify not treating them as equivalent traits in the general population (Paulhus & Williams, 2002; pp. 557-562). Although subsequent developments proposed the inclusion of new traits, like sadism (Buckels et al., 2013), spitefulness, greed (Marcus & Zeigler-Hill, 2015), or even the definition of a dark core that captures the variance shared among all of them (e.g., Bader et al., 2021; Moshagen et al., 2020), the dark triad continues to be the prevalent model in research on dark traits.

The components of the dark triad have origins in separate traditions that studied them independently. For instance, psychopathy (as currently understood) originated in forensics with a focus on explaining certain criminal behaviors (Hare, 1980; Porter, 1996). Subclinical psychopathy refers to individuals scoring high on manipulation, callousness, and impulsivity, as reflected in numerous models (Cooke & Michie, 2001; Hare & Neumann, 2008; Lilienfeld & Widows, 2005; Patrick & Drislane, 2015). Machiavellianism emerged within the realm of social psychology, characterized by a relative lack of affect in interpersonal relationships, a disregard for conventional morality, and low ideological commitment (Christie & Geis, 1970, pp. 1-4). Lastly, narcissism stems from the clinical domain (Ellis, 1898; Freud, 1986), conceptualized as a construct comprising three dimensions: leadership/authority, grandiose exhibitionism, and entitlement/exploitativeness (Ackerman et al., 2011).

Thus, it is evident that the three traits exhibit a significant degree of overlap, a recognition already established in the seminal article of this research tradition (Paulhus & Williams, 2002). Empirically, this theoretical overlap is affirmed by the high correlations among the three traits. Furnham et al. (2013) discovered, in an analysis of over 100 studies, that the correlation between narcissism and Machiavellianism is .56, between Machiavellianism and psychopathy .55, and between narcissism and psychopathy .36. Jakobwitz and Egan (2006) identified correlations of .70 between Machiavellianism and psychopathy, with other studies reporting correlations exceeding .80 (Klimstra et al., 2014; Pineda et al., 2020). In fact, some authors demonstrate that when assessed together,

narcissism and psychopathy load on the same factor (Furnham & Trickey, 2011; McHoskey et al., 1998).

Factor Structure of the Dirty Dozen

When the three traits of the dark triad are assessed simultaneously, one of the best-known instruments is the Dirty Dozen (DD). Although it is certain that the DD has received criticism due to its brevity, given that the items are not representative of all the aspects of the construct being measured (Miller et al., 2019), the main advantage is indeed its brevity as defended by other researchers, stating that the instrument provides a reasonable balance between efficiency and accuracy (Jonason & Luévano, 2013). Furthermore, the DD structure is very stable across languages and contexts (Rogoza et al., 2021). These two advantages (brevity and stability) explain the large number of validations that have been made of the DD, generating versions in Polish (Czarna et al., 2016), Chinese (Geng et al., 2015), Portuguese (Macedo et al., 2017), Turkish (Özsoy et al., 2017), French (Gamache et al., 2018), Serbian (Dinić et al., 2018) and Spanish (Pineda et al., 2020), among others.

The DD gives scores for each of the three dark traits, as well as a general dark triad score (Jonason & Webster, 2010). Giving a total score is a common practice, which is based on the already mentioned correlations between psychopathy, Machiavellianism and narcissism (Baughman et al., 2012; Carter et al., 2014; Crysel et al., 2013; Jonason et al., 2009; Jonason & Kavanagh, 2010). In this vein, the simultaneous presence of a general factor and specific factors provides the best representation of the DD structure (McLarnon & Tarraf, 2017, 2021). An item on a multidimensional instrument can explain the variance from three different sources: the variance associated with the construct for which it was developed, the variance associated with a conceptually similar construct, and the variance associated with a global construct (Morin et al., 2016). For example, an item developed to evaluate psychopathy can explain the variance associated with this construct, but, in turn, can explain the variance of a hierarchically superior construct. This hierarchically superior construct would be integrated by psychopathy and other constructs that belong to its nomological network. Although this total score has been conceptualized as a second order factor that combines three first order ones (Jonason & Webster, 2010), another possible approach is the bifactor models around the factorial structure of the DD (Bonfá-Araujo et al., 2021; Gamache et al., 2018; Jonason & Luévano, 2013; McLarnon & Tarraf, 2017).

The present study aims to contribute to the comprehension of the factor structure of the DD. Specifically, it endeavors to provide an alternative perspective to the research by Rogoza et al. (2021), where the authors examined the measurement invariance of the DD across various global regions while assuming a structure of three correlated factors. The authors contend that employing a bifactor model to investigate the structure of DD traits might not be an optimal approach, despite this model demonstrating a superior fit to the data. Their primary arguments are twofold: firstly, a general factor does not imply a general causal structure, and secondly, a general factor captures a portion of the variance of the factors in the group, leaving them as residualized estimates. This could potentially introduce significant interpretational challenges (e.g., quantifying the residual narcissism once the dark core is accounted for; Rogoza et al., 2021). Nevertheless, these limitations associated with bifactor models are applicable only when symmetrical models are tested in psychological constructs with distinct structural domains. Following Burns et al. (2020), the symmetrical model (traditional bifactor model) posits that all specific factors should have a similar weight of contribution to the general factor. In contrast, the asymmetrical model (bifactor-(S-1) model) is the model that has "structurally different" domains in the sense that certain specific factors have a greater weight in contributing to the general factor and, therefore, can act as reference factors. Referring to the DD from a theoretical point of view, some authors have argued that the positive variety of dark traits defines a common conceptual space that may have its own psychological meaning (Paulhus, 2014). This means that narcissism, Machiavellianism and psychopathy should be seen as lower order traits that load on a higher latent trait of malevolence (Muris et al., 2017).

Meanwhile, it is also possible that the three DD traits are not equally important. For example, some authors have conceded that psychopathy has a higher position and have argued that the malignant elements of narcissism and Machiavellianism are essentially subordinate traits of psychopathy (Lilienfeld & Andrews, 1996; McHoskey et al., 1998; McLarnon & Tarraf, 2017), which is the most prominent trait in the history of socially aversive personalities since its conceptualization in 1941 (Cleckley, 1988). Indeed, Machiavellianism is a more recent trait (Christie & Geiss, 1970) and some authors believe that it is just a form of subclinical psychopathy (McHoskey et al., 1998; Miller et al., 2017). Thus, the DD items have a high component of psychopathy. For example, the items of the Machiavellianism in the DD are expressions that are somehow related to psychopathy.

Finally, some aspects of narcissism are not considered socially aversive (Campbell, 2001; Miller et al., 2016) being this trait the “less dark” of the triad.

In this context, the bifactor-($S - 1$) models could seamlessly integrate into the DD structure by proposing a specific trait as the general factor, thereby resolving several conceptual challenges. The nomenclature "bifactor-($S - 1$) model" denotes having one less specific factor than the domains considered (with $S = K$, where K is the number of domains included; Eid et al., 2017). Within bifactor-($S - 1$) models, the specific factors may exhibit correlations with one another. Moreover, the interpretation of the general factor remains consistent irrespective of adding or removing domains, but changes concerning the reference domain (Eid et al., 2017). These models offer greater theoretical significance, where both the reference and specific facets hold distinct meanings. The reference factor (i.e., psychopathy) signifies a level where an individual displays a lack of remorse and moral concern, characterized by cynicism and insensitivity. On the other hand, the specific facets (narcissism and Machiavellianism) represent the extent to which an individual deviates from the expected level of narcissism and Machiavellianism based on their psychopathy level. For instance, a high value in narcissism (specific factor) suggests a person's heightened propensity for seeking admiration compared to others with the same psychopathy level (see Heinrich et al., 2020 for an illustrative example with depression). Another advantage lies in the reduction of parameters, effectively addressing the issue of overparameterization (Burns et al., 2020). Items within the reference factor only load on the general factor (within their respective facet), while items in all other facets load both on the general factor and a specific group factor related to all items within a facet (Eid, 2020).

It's important to emphasize that the selection of the reference facet is driven by purely theoretical considerations. In the case of the dark triad, psychopathy - as previously mentioned - appears to be the foundational trait sustaining it (McHoskey et al., 1998; Miller et al., 2017; Muris et al., 2017). The notion that amorality and insensitivity are central aligns with earlier research positing psychopathic traits as the core of the dark triad (Hare, 2003; Jones & Figueredo, 2014; Paulhus, 2014). The initial emphasis is on a person's display of these behaviors, followed by an analysis of how narcissistic (exuding superiority and dominion) and Machiavellian (demonstrating glib social charm and manipulateness) they are compared to others. Indeed, Vize et al. (2020) reported that psychopathy is the dimension

of the dark triad most strongly linked to other proposed dark cores, such as low Honest-Humility (Book et al., 2015) or low Agreeableness (Jakobwitz & Egan, 2006). In this context, designating psychopathy as the general factor of the DD establishes a common baseline for everyone in this variable, allowing subsequent differentiation based on levels of narcissism and Machiavellianism.

Cross-Cultural Comparison

Transcultural studies on dark traits hold significant interest due to the potential adaptive nature of these traits based on the cultural context (Ma et al., 2021). Concerning psychopathy, substantial variations aren't anticipated across countries, given its challenging adaptive character to justify (Ma et al., 2021), and its potential genetic underpinnings could minimize the impact of culture (Jonason et al., 2020). On the other hand, regarding narcissism, two hypotheses are posited: firstly, that it is driven by a neoliberal culture, and secondly, that it is reinforced by scarcity (Jonason et al., 2020). Jonason regards narcissism as the trait most susceptible to cultural influence, supporting the latter perspective: "The less developed, less free, more corrupt, less peaceful, and more sex-asymmetrical a country is, the more narcissistic its population is" (Jonason et al., 2020, p. 1263). For this to be studied, measurement invariance across different regions of the world must be achieved, ensuring that cross-cultural comparisons of DD scores can be made. On the contrary, any cross-cultural comparison made with the DD instrument could not ensure that possible differences found are due to real differences in the several constructs assessed by this instrument.

The Present Study

Given the aforementioned, it is necessary to explore the different factor structures that can conceptualize the DD. This need, together with the interesting transcultural findings on the dark triad, give rise to the two objectives of this study. First, to study the factor structure of the DD through different regions of the world, putting those theoretically coherent models to the test. For this purpose, the descriptive statistics of the items will be studied in order to analyze how the scores are distributed in each of the items as well as their variability. Then, different analyses of the internal structure will be carried out to study which model can best fit with the factor structure of the DD. Second, to analyze the measurement invariance of DD among the different regions of the world, ensuring that the DD measures the same constructs in all of them.

Method

Participants

For the present study, the data were obtained from Open Science Framework (OSF), a public and open access repository (<https://osf.io/8nsc3>; Rogoza, 2021). First, the authors collected the data from 11,723 participants between April 2016 and October 2017 as part of the “Cross-Cultural Self-Enhancement Project”, which brought together more than 70 academics from 56 countries (Rogoza et al., 2021). The researchers in each country proposed recruiting 250 participants to reduce the error of estimation in the personality study (Schönbrodt & Perugini, 2013). In a minority of samples (Hong Kong, Spain, Uganda, Uruguay), the minimum number of participants was not reached and, consequently, these samples were excluded from the analyses. The participants from two countries (the Philippines and Vietnam) did not complete the questionnaires, so their data were excluded from the analyses. Finally, the Iranian sample was also excluded due to data quality issues. Although some sites did not reach the ideal of 250 participants, the authors considered their inclusion justified, given the novelty of this project and the difficulty of collecting data in some regions (Rogoza et al., 2021).

For the present study, the final sample consisted of 11,477 participants ($M = 21.53$ years, $SD = 4.02$ years, 66.9% women), belonging to 49 countries and grouped into eight world regions: Western Europe, Eastern Europe, the Middle East, sub-Saharan Africa, Australia and Oceania, Asia, North America and South America.

Instruments

Dirty Dozen

The traits of the dark triad were assessed using the Dirty Dozen (DD; Jonason & Webster, 2010). The DD is a measurement instrument that evaluates the dark triad using 12 items (four items per dimension): Machiavellianism, psychopathy and narcissism. The items on the instrument are of the type “I tend to want that others admire me” (narcissism), “I tend to lack remorse” (psychopathy), and “I have used deceit or have lied to get away with something” (Machiavellianism). The items are on a Likert scale that goes from 1 (completely disagree) to 7 (completely agree). The authors of the original study (see Rogoza et al., 2021) translated the instrument when it was relevant, following the guidelines of the International

Test Commission for translating and adapting transcultural measuring instruments (Hernández et al., 2020; Muñiz et al., 2013). In particular, the authors of the study translated the 12 items to each language with the aid of two native speakers, and back-translated the items with the aid of a third party. Later, they reviewed the version re-translated to English with the author of the scale (Peter Jonason) and, in case of comments or suggestions, a translator adjusted the scale until reaching a final version accepted by both sides. The internal consistency of this measurement was adapted to the original version of the DD (Jonason & Webster, 2010): Machiavellianism ($\alpha = .77$), psychopathy ($\alpha = .69$), narcissism ($\alpha = .85$), and total score ($\alpha = .83$). In the present study, the McDonald's Omega coefficient was used to analyze the reliability of the scores due to the ordinal nature of the items. These were adapted to each one of the regions (Table 1).

Table 1
Reliability Coefficients (McDonald's Omega) according to the Eight World Region Samples

	Total sample	Middle East	Wester Europe	Non-Western Europe	Australia and Oceania	North America	South America	Asia	Sub-Saharan Africa
Machiavellianism	.845	.866	.827	.864	.836	.841	.861	.812	.848
Psychopathy	.758	.777	.738	.789	.834	.829	.766	.690	.831
Narcissism	.856	.847	.840	.860	.859	.856	.871	.844	.873
Dark Triad	.876	.880	.872	.890	.896	.893	.899	.848	.882

Procedure

This study was not preregistered. The full information on the data collection procedure can be found in the original study (Rogoza et al., 2021). The informed consent procedures were followed in each country. In the present study, to ensure transparency and the solid inferences derived from the new practices of open science, inclusion criteria were established according to the study objective (Weston et al., 2019).

Data Analysis

Descriptive Statistics and Discrimination Indices

The same analysis was performed with the total sample and the eight samples that make up the different world regions: North America, South America, Oceania, Western Europe, non-Western Europe, the Middle East, Asia and sub-Saharan Africa. To examine the quality and distribution of the items that comprise the DD, the descriptive statistics of the items (mean, standard deviation, skewness and kurtosis) were calculated. We analysed the

discrimination indices (corrected item-test correlation), with them being considered suitable above .20 (Muñiz et al., 2005; Muñiz & Fonseca-Pedrero, 2019).

Model Fit Comparisons

Second, to examine the internal structure of the DD, a series of confirmatory factor analyses (CFA) were conducted using the Diagonally Weighted Least Squares (DWLS) method for treating ordinal variables and for the large sample size (Ferrando et al., 2022). Specifically, six models were tested: (a) one-factor (one-factor) model, where all the items load on a single factor, (b) orthogonal three-factor model that restricts the correlations between the factors at zero, (c) three correlated factors model, which allows the factors to be correlated to each other, (d) indirect hierarchical or second order model (i.e., model with three first-order factors and one second-order factor), (e) bifactor model, where the items load on a general factor, but also within their corresponding specific factors (i.e., symmetrical bifactor model), and (f) bifactor (S-1) model, where one of the specific factors acts as a general factor, with the remainder staying as specific factors (i.e., non-symmetrical bifactor model). The different models were evaluated using factorial loadings as well as the indices of fit. Therefore, the non-normed fit index (NNFI), the comparative fit index (CFI), the root mean square error of approximation (RMSEA) and the standardized root mean square residual (SRMSR). The CFI and NNFI values ≥ 0.95 indicate an excellent fit whereas between .90 and .95 they indicate an acceptable fit. The RMSEA and SRMSR values $\leq .06$ and $\leq .08$ show an excellent and acceptable fit respectively (MacCallum et al., 1996). Added to this, the kaikai Information Criterion (AIC) and Bayesian Information Criterion (BIC) were calculated, being especially useful indices for the comparison of diverse models. The criterion is that the lowest AIC and BIC values are indicators of a better fit of the model.

Bifactor Indices

Indices related to the bifactor models were obtained to test the extent to which the general factor influences the participants' responses to the items compared to specific factors. In particular, a hierarchical Omega (ω_H) and a hierarchical Omega for specific factors (ω_{H_s}) show the amount of total variance attributed to the general factor and to the specific factors (once the effect of the general factor is excluded), respectively (McDonald, 1999). Values over .70 for ω_H and .30 for ω_{H_s} support an essentially latent one-dimensional structure, but also a sufficient identity on the part of the specific factors (Reise et al., 2013). In addition, the

H_h coefficient (Hancock, 2001; Hancock & Mueller, 2001) assesses the degree to which a latent variable is represented by a set of items and, in fact, indicates if the measurement model would be suitable and replicable through different studies. H_h values over .80 suggest a defined latent variable with a greater likelihood of being stable through different studies (Rodríguez et al., 2016). In addition, the factor determinacy (FD; Grice, 2001) was calculated to study the degree to which the individual differences studied through the factor scores are good representations of the true individual differences in the factor. The possible values range from 0 to 1, and the values closest to 1 indicate a better determination. It is recommended that the estimations of factor scores only be considered if their determination values are over .90 (Rodríguez et al., 2016). The explained common variance (ECV; Sijtsma, 2009) provides information on the explained common variance for a certain factor, either the general factor (ECV_G) or the specific factors (ECV_S). On the other hand, the percentage of uncontaminated correlations (PUC) does not indicate the proportion of correlations without multidimensional influence. The factors with a general ECV over .80 could be considered representative of a defined latent variable (Reise et al., 2013). In addition, when the PUC values are over .80, the ECV values of the general factor are less important when predicting bias. For example, when the PUC values are high ($> .80$) and ω_H over .70, if the general ECV values are over .60, this suggests that the presence of some multi-dimensionality is not sufficiently severe as disassembling the interpretation of the instrument as essentially one-dimensional (Reise et al., 2013). ECV and PUC values over .70 also inform favorably on the one-dimensionality (Rodríguez et al., 2016). The ECV was also calculated for each of the items ($I-ECV_G$), which measures the percentage of variance that explains the item in terms of the general factor.

Measurement Invariance Based on the Different Regions of the World

If the equivalence or invariance of an evaluation instrument is not fulfilled, the validity of the inferences and interpretations extracted from the data can be erroneous (Byrne, 2008), and the conclusions based on the comparisons of the groups cannot be valid. Therefore, finally, once the fit of the models had been verified separately, successive multi-group (MG) CFAs were performed to analyze the measurement invariance in the different world regions to which the test has been applied.

The first step is the configural invariance model, where it is determined that the same items belong to the same factor in all the groups, but all the factorial loadings and the intercepts vary freely among the groups, i.e., that the measuring instrument has the same factor structure in the groups being compared. As the second step, the metric invariance was estimated, where the factorial loadings are made equal among the groups. The third and final step was to estimate the scalar invariance, where, in addition to what was mentioned previously, the equality between the intercepts of the items are established, treating ordinal data (Pendergast et al., 2017; Thompson, 2016), determining that the units of measurement are equivalent among the groups. The fulfillment of this type of invariance indicates that the differences between the groups in means, variances and covariances are only due to differences in the latent variable (Dimitrov, 2010). To assume the existence of measurement invariance, a decrease in CFI lower than .01 ($\Delta\text{CFI} < -.01$) and an increase in RMSEA less than .015 ($\Delta\text{RMSEA} < .015$; Chen, 2007) is accepted.

All the analyses were performed with the R software, the lavaan package (Rosseel, 2012) and semTools (Jorgensen et al., 2021).

Results

Descriptive Statistics and Discrimination Indices

First, the descriptive statistics of the items were studied (Table S1). The items show adequate values in skewness and kurtosis for each of the samples, varying in general terms between ± 1 . On the other hand, the discrimination indices of the items are very good in each of the samples, both when the general dimension is treated as when it is analyzed by dimensions (Table S1).

Model Fit Comparisons

Next, the factor structure of the DD was studied for the total sample (Table 2). The Orthogonal three-factor model is the one that shows the worst fit of the data, it being logical due to the high relation between the different traits that compose the dark triad. The one-factor model does not show a suitable fit to the data either, with the indices of the errors (RMSEA and SRMSR) being very high. On the other hand, the Three Correlated factors model and the second-order model show a similar fit to the data for being mathematically identical. Both models show a reasonable fit in each of the samples, although the RMSEA

value is too high in most regions. Finally, the bifactor models, both the symmetrical model and the bifactor-(S-1) models show a good fit to the data, especially the symmetrical bifactor model. Referring to the bifactor-(S-1) models, the model that takes psychopathy as the reference facet is the one that shows the best fit to the data, above the model that takes Machiavellianism as the reference facet. Finally, taking narcissism as the reference facet worsens the fit to the data, with respect to the rest of the bifactor-(S-1) models.

Table 2*Fit Indices for the Dirty Dozen Confirmatory Factor Models in Total Sample*

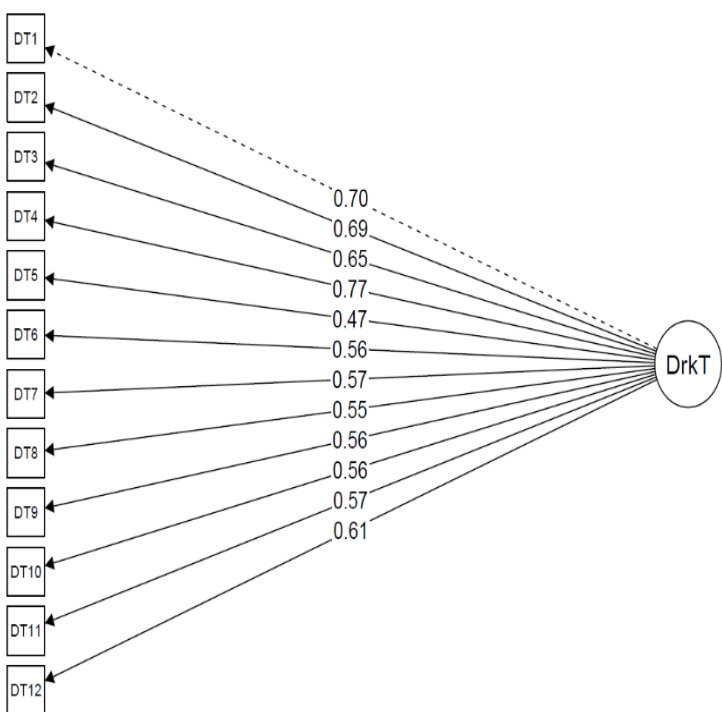
	One-factor model	Orthogonal three-factor model	Three correlated factors model	Second-order model	Bifactor	Bifactor-(S – 1) psychopathy as reference factor	Bifactor-(S – 1) Machiavellianism as reference factor	Bifactor-(S – 1) narcissism as reference factor
RMSEA	.176 [.174 - .178]	.137 [.135 - .139]	.086 [.084 - .088]	.086 [.084 - .088]	.066 [.064 - .069]	.079 [.077 - .081]	.083 [.081 - .085]	.112 [.110 - .114]
SRMSR	.108	.248	.049	.049	.030	.055	.039	.105
NNFI	.613	.765	.907	.907	.945	.922	.914	.842
CFI	.683	.808	.928	.928	.965	.945	.940	.890
AIC	488,690.93	481,303.59	474,171.56	474,171.56	472,013.56	473,173.73	473,493.37	476,440.54
BIC	488,866.78	481,479.44	474,369.38	474,369.38	472,277.329	473,408.20	473,727.83	476,675.00

Note. RMSEA = Root mean square error of approximation [90% CI]; SRMSR = Standardized root mean square residual; NNFI = Non-normed fit index; CFI = Comparative fit index; AIC = Akaike information criterion; BIC = Bayesian information criterion.

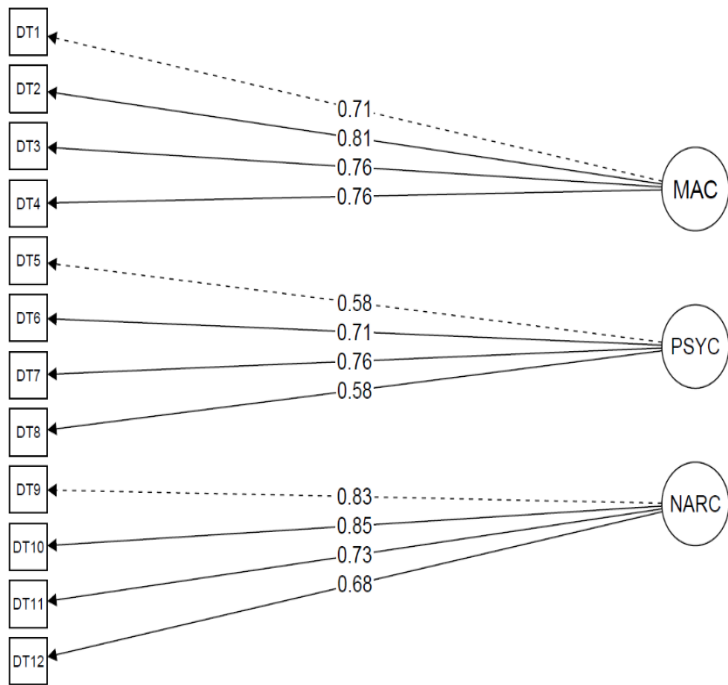
The factorial loadings of the total sample were estimated (Figure 1). The bifactor model presented a problem: Items 1 and 4 (Machiavellianism) present non-significant factorial loads in the specific factor of Machiavellianism, once the general factor of the dark triad had been excluded. This problem is solved in the bifactor-(S-1) model by taking psychopathy as the reference facet.

Figure 1

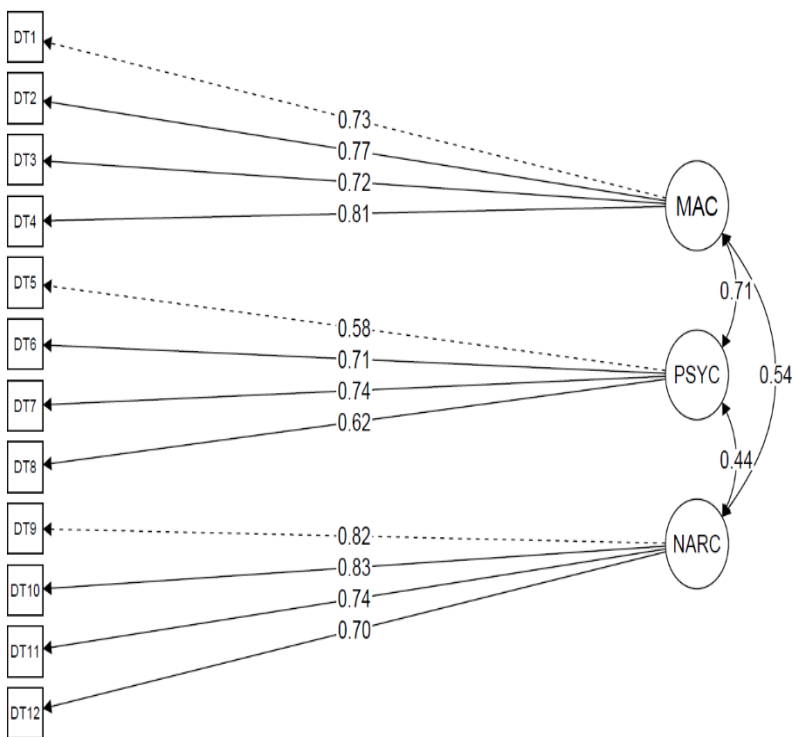
Different Standardised Factor Structures for the Dirty Dozen for the Total Sample



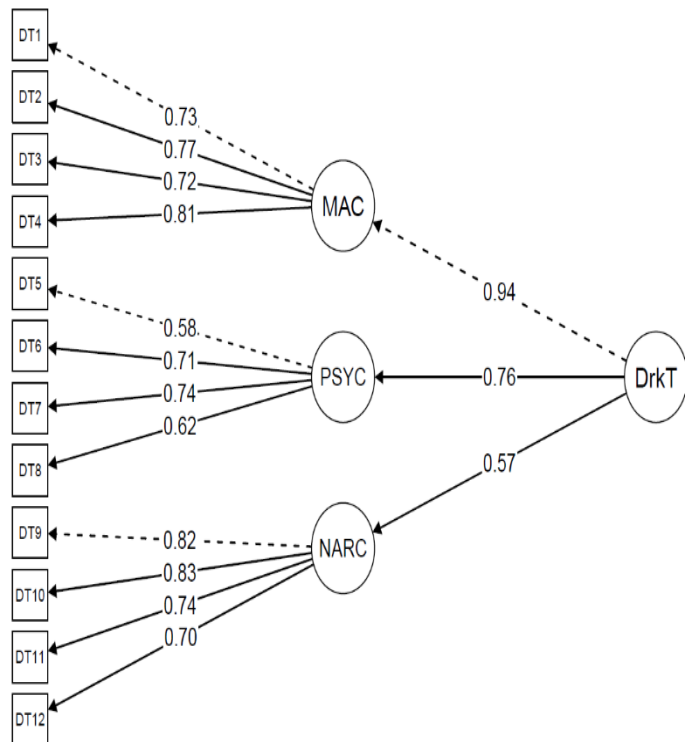
One-factor model



Orthogonal three-factor model

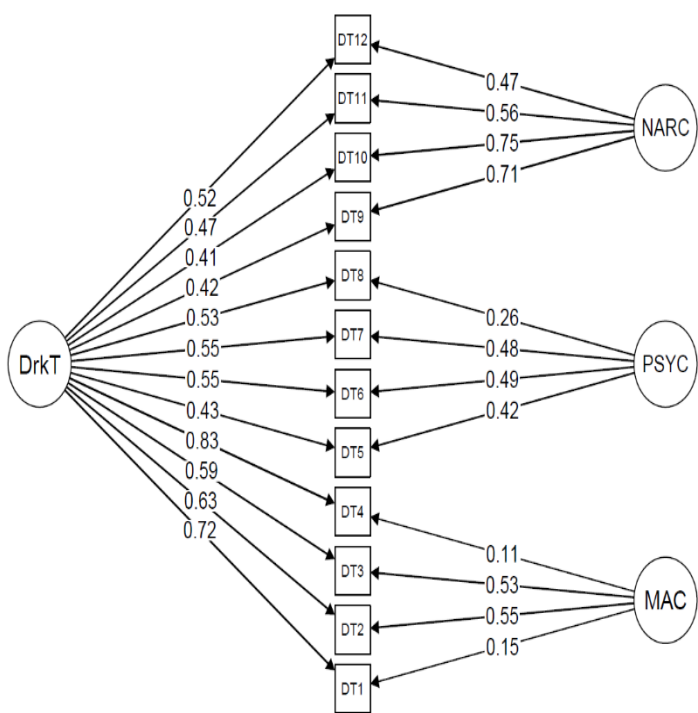


Correlated three-factor model

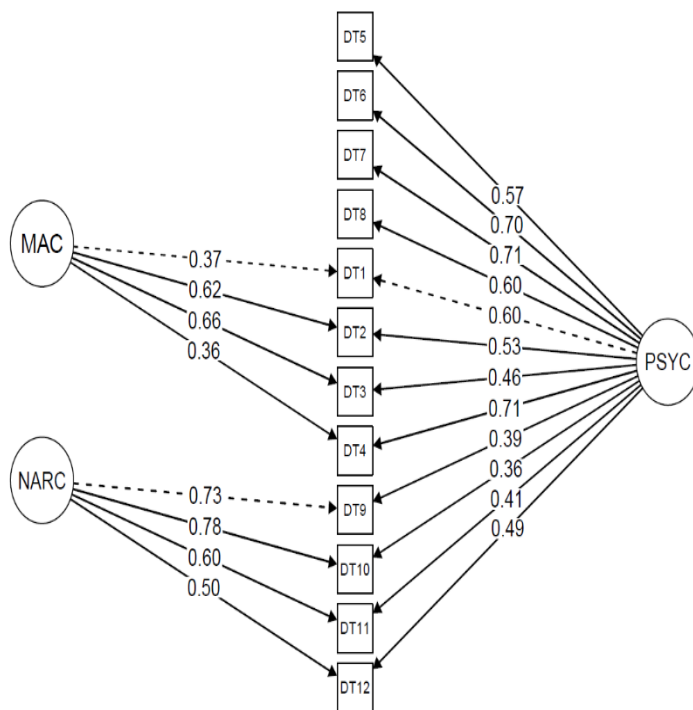


Second-order factor model

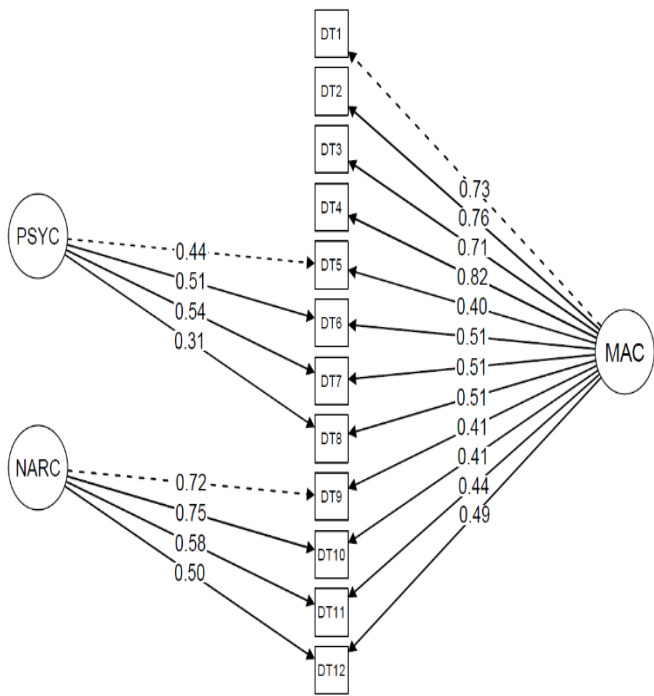
Figure 1
(continued)



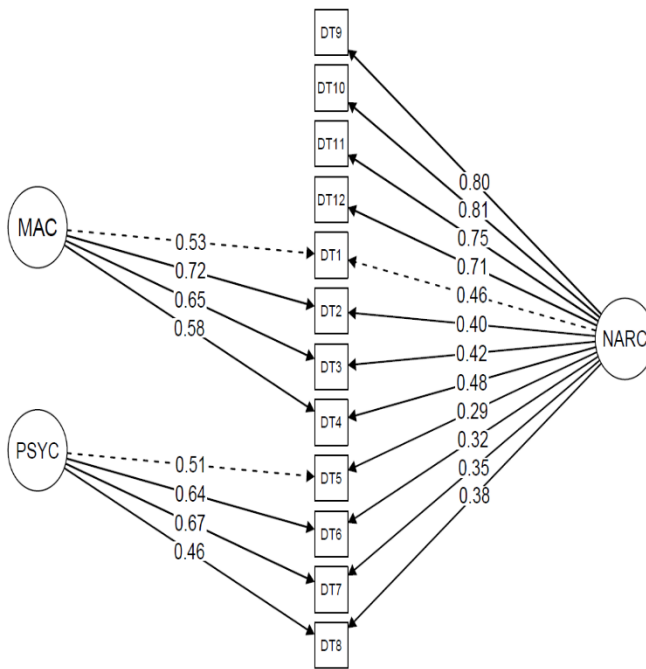
Fully symmetrical bifactor model



**Bifactor-(S-1) model
psychopathy as reference factor**



**Bifactor-(S-1) model
Machiavellianism as reference factor**



**Bifactor-(S-1) model narcissism
as reference factor**

Note. DrkT = Dark Triad; MAC = Machiavellianism; PSYC = Psychopathy; NARC = Narcissism

Bifactor Indices

Next, and following the philosophy about the bifactor model beyond the model fit having to be analyzed, the different bifactor indices were analyzed for the symmetrical model and the bifactor-(S-1) model. Table 3 illustrates how the different bifactor indices (ECVs, ω_{HS} , H and FD) are most suitable in the bifactor-(S-1) model by taking psychopathy as the general factor in the total sample. For example, the reference factor “psychopathy” in the bifactor-(S-1) model explains a greater amount of variance (ECV_G and ω_{H-G}) than the general “dark triad” factor in the symmetrical bifactor model and, in addition, narcissism and Machiavellianism (ECV_S and ω_{HS}) explain a greater amount of variance than in the symmetrical model, although the variance that explains narcissism once psychopathy is excluded continues to be low. The low functioning of the narcissism items may be because it is the construct least related to the dark triad. This leads to its indicators explaining very little of the reference factor (psychopathy) and most of the variance that they explain being from the specific factor of narcissism. In addition, the FD values are better than in the symmetrical model, having a greater determination of the factor scores in the bifactor-(S-1) model.

Referring to the I- ECV_G (Table 4), both the items in the bifactor model and in the bifactor-(S-1) model broadly explain the same amount of variance of the general factor (psychopathy and dark triad, respectively). Table S3 and S4 shows the bifactor indices for each of the regions of the world, whose results are in line with the total sample.

Table 3

Bifactor Indices for the Symmetrical Bifactor Model and for the Bifactor-(S-1) in the Dirty Dozen for Total Sample

	ECV _G	ECV _{MA}	ECV _{PSI}	ECV _{NA}	PUC	ω	ω_{H-G}	ω_{H-MA}	ω_{H-PSI}	ω_{H-NA}	H _G	H _{MA}	H _{PSI}	H _{NA}	FD _G	FD _{MA}	FD _{PSI}	FD _{NA}
Fully symmetrical bifactor	.567	.091	.105	.237	.727	.914	.735	.166	.295	.563	.876	.464	.474	.756	.910	.718	.708	.883
Bifactor-(S-1) psychopathy as reference factor	-	.166	.567*	.267	.818	.908	-	.373	.723*	.613	-	.629	.859*	.782	-	.808	.908*	.895
Bifactor-(S-1) Machiavellianism as reference factor	-	.615*	.130	.255	.818	.909	-	.747*	.353	.582	-	.886*	.529	.760	-	.932*	.757	.891

Note. * = this factor works as a general factor; G = Dark Triad; MA = Machiavellianism; PSI = Psychopathy; NA = Narcissism; ECV = Explained Common Variance; PUC = Percentage of Uncontaminated Correlations; ω = Omega; ω_H = Hierarchical Omega; H = H index; FD = factor determinacy

Table 4*I-ECV_G of Each of the Dirty Dozen Items for Total Sample*

	Machiavellianism				Psychopathy				Narcissism			
	i01	i02	i03	i04	i05	i06	i07	i08	i09	i10	i11	i12
Fully symmetrical bifactor	.957	.567	.553	.982	.512	.558	.573	.812	.255	.228	.406	.554
Bifactor-(S-1) Psychopathy as reference factor	.720	.424	.327	.790	1.00	1.00	1.00	1.00	.224	.172	.323	.493
Bifactor-(S-1) Machiavellianism as reference factor	1.00	1.00	1.00	1.00	.459	.500	.463	.737	.246	.234	.369	.489

Note. I-ECV_G = item explained common variance in general factor; i = item (e. g., i01 = item 1)

Measurement Invariance Based on the Different Regions of the World

Finally, the factor structure of the DD was studied for the eight study samples (one for each region of the world; Table S2). In general, the reading of each of the models is the same in all the samples. The factor structures (with the loadings of each of the items) for each world region studied are reflected in the supplementary material (Figure S1). Also, for practical purposes, a template is provided in which, from the transformation of direct scores to factor scores, the person's standardized score (Z score and T score) is provided according to the region of the world in which he/she is located (Supplementary material, "FactorScoresCalculator"; https://osf.io/x2j6g/?view_only=4702359fea5549ad8c31450649fc0717). Given the good fit and methodological coherence of both models (psychopathy and Machiavellianism as reference factors), the template has been provided considering both models. In this way, the person using the DD can indicate his or her direct scores observed on the 12 items, and obtain his or her weighted score transformed to Z-score ($M = 0$; $SD = 1$) and T-score ($M = 50$; $SD = 10$).

The next step was to study the measurement invariance among the different world regions in both models. As noted in Table 5, through the MG-CFA different levels of invariance were compared among the eight regions of the world. For both models, configural, metric, and scalar invariance were satisfied, indicating that the scores are comparable across different world regions, whether using the Psychopathy or the Machiavellianism model as the reference factor (Table 5).

Table 5*Measurement Invariance for the Dirty Dozen in the Different Regions of the World*

	CFI	RMSEA	ΔCFI	ΔRMSEA
Bifactor-(S-1) Psychopathy as reference factor				
Configural	.987	.097	-	-
Metric	.981	.104	-.007	-.007
Scalar	.976	.086	-.005	-.018

Bifactor-(S-1) Maquiavellianism as reference factor					
	Configural	.991	.082	-	-
	Metric	.985	.091	-.006	.01
	Scalar	.979	.081	-.007	-.01

Discussion

The dark triad has been a widely studied subject in the last 20 years (Furnham et al., 2013; McLarnon & Tarraf, 2021; Muris et al., 2017; O’Boyle et al., 2012; Paulhus, 2014), contributing very interesting data on its influence in people’s lives (Baughman et al., 2012; Crysel et al., 2013; Jonason et al., 2009; Jonason & Kavanagh, 2010; Ma et al., 2021). By evaluating this construct, the DD instrument has been one of the most widely used. In the DD, some authors offer a score in each of the triad dimensions, whereas others use a total dark triad score. All this leads to a considerable diversity in the studies and their conclusions, having, on the one hand, studies that defend a DD structure of three correlated factors (Jonason et al., 2020) and, on the other, studies that defend a bifactor structure with a general dark triad factor (Bonfá-Araujo et al., 2021; McLarnon & Tarraf, 2017). Specifically, Rogoza et al. (2021) studied the measurement invariance of the DD on a three-factor structure correlated in eight regions of the world. Given the debate that exists nowadays on the structure of the DD, the objective of the present work was to conduct an exhaustive study on the factor structure of the DD through the eight world regions included in the study by Rogoza et al. (2021).

First, the skewness and kurtosis of the items were adequate, generally varying between ± 1 in each of the regions of the world (Jonason & Webster, 2010). The mean of the items across all world regions is notably high, especially for the Narcissism items (Table S1). Furthermore, the standard deviation of each item is remarkable, indicating a certain variability in people’s responses, applicable to the eight world regions. Regarding the discriminative power of the items, the discrimination index is high for all of them, indicating an important relationship in the response to items within the same dimension.

Rogoza et al. (2021) explored the measurement invariance of the DD in eight regions of the world. However, a model of three correlated factors was used. Although it is a reasonable model both theoretically and empirically (Jonason & Webster, 2010), it seems necessary to explore different structures around the DD and to give evidence for and against a general dark triad factor. The present study explored different hierarchical structures for each

of the world regions. The one-factor and orthogonal three-factor models showed a poor fit of the data to the model, whereas the three-dimensional model (three correlated factors) showed a suitable fit. The models with the best fit were the bifactor models, for both symmetrical and structurally different domains (bifactors-(S-1)). However, this is not sufficient indication of a general dark triad factor in the DD against three correlated factors, since the bifactor model tends to overparameterization and, therefore, to show a better fit to the data (Bonifay et al., 2017; Burns et al., 2020; Gignac, 2016).

In this context, a more detailed examination of the general factor and the specific factors included in the bifactor model is necessary. For instance, if the three specific factors of the DD were symmetric, the items of the three factors would be similar, and therefore, there would be no items with very low or even negative factorial loadings. However, as shown in Figure 1 with the total sample, there is a psychopathy item below .30, and two Machiavellianism items below .20. On the contrary, all the items in the specific factor of narcissism (once the general factor is excluded) show considerable factorial loadings, which may be evidence of the asymmetry of which the DD is composed, demonstrating structurally different domains. This asymmetry leads to the general factor absorbing all the variance of the item, which is why this explains nothing of the specific factor (Eid et al., 2017; Geiser et al., 2015). On the other hand, exploring the bifactor indices, in general terms, a general dark triad factor in the DD can be defended. The specific factors, however, seem not to have sufficient identity once this general factor is excluded. Narcissism seems to be the only specific factor with its own identity, but not psychopathy or Machiavellianism. This, being supported by all the bifactor indices, seems to be more evidence that the DD is composed of structurally different domains. Thus, the narcissism items are those that least help to explain the general dark triad factor ($I-ECV_G$) compared to the items of Machiavellianism and psychopathy.

This idea is reflected in the bifactor-(S-1) models, taking psychopathy and Machiavellianism as the reference factors. Regarding the psychopathy as reference factor model, the psychopathy is a very broad characteristic and is usually described as a “constellation” of interpersonal, affective, and behavioral traits, to such an extent that the concepts of grandiose narcissism and Machiavellianism are included in most descriptions and operationalizations of psychopathy (Glenn & Sellbom, 2015). In addition, it is a known feature of the DD that is particularly saturated with psychopathy content, which may be a

reason that helps explain the relevance of psychopathy in the factorial structure of the DD. However, the bifactor-(S-1) model taking Machiavellianism as the general factor has also shown a very adequate fit, as well as notable methodological logic, both in terms of item factorial loadings and bifactor indices of the model. This model provides a logical understanding of the factorial structure of the DD, both at the level of the reference factor (Machiavellianism) and at the level of specific facets.

This leads to the assertion that psychopathy and Machiavellianism, measured through the DD, are very similar. Although the items of the psychopathy DD focus more on insensitivity and the Machiavellianism items focus more on manipulation, both dimensions show a very high relationship. In this regard, the present study demonstrates that both bifactor-(S-1) models are methodologically appropriate, so both psychopathy and Machiavellianism can act as reference factors for the DD. Additionally, this is applicable in the eight studied world regions (see Figure S1 and Tables S2, S3, and S4). Both models address the issues of the symmetrical bifactor, which leads to low or even negative factorial loadings on specific factors (Heinrich et al., 2020). Moreover, psychopathy or Machiavellianism as reference factors shows sufficient identity in the DD, surpassing even the general dark triad factor, as indicated by the ECV_G and ω_{H-G} . Furthermore, the bifactor-(S-1) model enhances the information contributing to the factors in the symmetrical bifactor model (ω_{H-S} , index H and FD).

Given that we consider both bifactor-(S-1) models equally valid regarding the factorial structure of the DD, measurement invariance was studied across the eight world regions in both models. In both models, whether considering psychopathy or Machiavellianism as the reference factor, configural, metric, and scalar invariance were satisfied, which means that a) the same factor structure is maintained for each region, b) the same importance of each item is maintained for each region, and c) the units of measurement are equal across the groups. These findings support the cross-cultural validity of the DD, which is fundamental for its application and use in international contexts. Thus, future comparisons made with the DD instrument across different parts of the world can be reliable, and any potential differences found can be attributed to actual differences between populations.

The practical implications of the study are the following. When using the DD instrument, studies tend to offer a global score of the dark triad (Baughman et al., 2012;

Carter et al., 2014; Crysel et al., 2013; Jonason & Kavanagh, 2010). However, the present study shows that a general dark triad score is not supported as its domains are not symmetrical. This is to say, showing emotional insensitivity (psychopathy) and manipulation towards others (Machiavellianism) does not have the same importance as showing superiority over others (narcissism). However, when considering the bifactor-(S-1) models with psychopathy or Machiavellianism as reference factors, it gains methodological coherence. Thus, when the DD is applied, it is possible to analyze what score people have in psychopathy or Machiavellianism and, once equalized in this dimension, to analyze how they are perceive themselves in the remaining specific factors. In this line, a template is provided in which, from the transformation of direct scores to factor scores, the person's standardized score (Z score and T score) is provided according to the region of the world in which he/she is located. For example, the applied worker who wants to use the DD can use this template to weight the score of the person he or she wants to evaluate, depending on the region of the world in which is located. Lacking clarification on which model provides a greater amount of validity evidence in the future, this new way of proposing the DD will be highly relevant for studying its three dimensions in relation to other variables with which it has been shown to have predictive capacity, such as aggression, burnout and selfish behaviors (Baughman et al., 2012; Crysel et al., 2013; Jones & Figueredo, 2013; Ma et al., 2021), among others. Finally, achieving cross-cultural measurement invariance also holds significant practical implications. This outcome affirms that the DD instrument is consistent across different world regions, which can aid in designing more effective interventions and policies to address dark triad traits in diverse cultural contexts.

These results must be considered with some limitations. First, only one dark triad questionnaire was used (DD). In this vein, it would be interesting for future studies to perform the same analyses with the SD3 instrument, which has more items and the bifactor-(S-1) structure of which can work adequately. Furthermore, the DD demonstrates an imbalance in content when assessing the constructs of the dark triad, with a high content of psychopathy. This inherent flaw in the DD may be affecting the results of the current study, and it would be interesting for future research to explore these structural models in other dark triad instruments. Second, no other variables have been used in the study, those belonging to the Dark Triad nomological network, and those criterion variables that can predict this construct. Without such variables it is difficult to know whether the general factor, the specific factors

and the reference facet as a general factor are really different constructs (they show different patterns of relationships with other variables; e. g., Gonzalez et al., 2021). This is a limitation of the present study and should be raised in future studies to support or not the factorial structure defended in the present research. On the other hand, all the data in the present study were collected through self-reporting, which can lead to acquiescence and social desirability biases (e. g., Vigil-Colet et al., 2020). Future studies could compare the results obtained from the present study with other types of data collection instruments, such as ipsative tests or situational judgment.

Conclusions

While some authors argue for the distinctiveness of DD traits, the interrelations among Machiavellianism, narcissism, and psychopathy, along with the findings of this study, suggest a plausible integration of the three traits into a singular construct. This study supports the exploration of a hierarchical structure within the DD, challenging conventional perspectives on the unique attributes of DD traits. Moreover, our research underscores the need for further research into whether psychopathy or Machiavellianism can serve as foundational reference factors within the DD. While more comprehensive validity evidence is essential, this study provides a preliminary framework for researchers and practitioners across eight diverse global regions. By standardizing DD scores considering both psychopathy and Machiavellianism as potential reference factors, this study enhances the methodological coherence of scoring and bolsters the practical applicability of the DD in various real-world contexts.

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