

■ Psychometric properties of the 12 items Dark Triad of Personality Scale (Dirty Dozen Scale) in Ecuadorian adolescents: Analysis from the Classical Test and Item Response Theory

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Abstract

The objective is to analyze the validity of the 12 items Dark Triad of Personality Scale (Dirty Dozen Scale; DDS) under the precepts of Classical Test Theory (CTT) and Item Response Theory (IRT) in a sample of Ecuadorian adolescents. The methodology is a descriptive and instrumental study with a sample of 5,132 adolescents, 50.2 % male and 49.8 % female; aged between 11 and 20 years, attending schools in nine cities in the Province of Tungurahua, Ecuador. About the results, from the perspective of CTT, the evidence suggests that the DDS presents a bi-factor internal structure with adequate fit indicators. Furthermore, it has an appropriate internal consistency for both the specific factors (Machiavellianism, Psychopathy, and Narcissism) and the general factor. From the perspective of IRT, all items have appropriate discrimination and difficulty, with item 4 best aiding the interpretation of the latent construct of the Dark Triad of Personality. In conclusion, the DDS is a valid and reliable scale for use with Ecuadorian adolescents, demonstrating optimal functionality from several theoretical models of measurement.

Keywords: machiavellianism; narcissism; psychopathy; dark triad; validity.

Resumen

Propiedades psicométricas de la escala de la Tríada Oscura de la Personalidad de 12 ítems (Dirty Dozen Scale) en adolescentes ecuatorianos: Análisis desde la Teoría Clásica de los Tests y la Teoría de Respuesta al Ítem. El objetivo es analizar la validez de la Escala de la Tríada Oscura de la Personalidad de 12 ítems (Dirty Dozen Scale; DDS) bajo los preceptos de la Teoría Clásica de los Tests (TCT) y la Teoría de Respuesta al Ítem (TRI) en una muestra de adolescentes ecuatorianos. La metodología es un estudio descriptivo e instrumental con una muestra de 5,132 adolescentes, 50.2 % varones y 49.8 % mujeres; con edades comprendidas entre 11 y 20 años, que asisten a escuelas en nueve ciudades de la Provincia de Tungurahua, Ecuador. En cuanto a los resultados, desde la perspectiva de la TCT, la evidencia sugiere que la DDS presenta una estructura interna bifactorial con indicadores de ajuste adecuados. Además, tiene una consistencia interna apropiada tanto para los factores específicos (Maquiavelismo, Psicopatía y Narcisismo) como para el factor general. Desde la perspectiva de la TRI, todos los ítems tienen una discriminación y dificultad apropiadas, siendo el ítem 4 el que mejor ayuda a la interpretación del constructo latente de la Tríada Oscura de la Personalidad. Como conclusión, la DDS es una escala válida y confiable para su uso con adolescentes ecuatorianos, demostrando una funcionalidad óptima desde varios modelos teóricos de medición.

Palabras clave: maquiavelismo; narcisismo; psicopatía; tríada oscura; validez.

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Highlights

- The Dark Triad of Personality is a theoretical model that attempts to explain people's erratic, dysfunctional, dissocial, and antisocial behavior.
- To evaluate this construct, the Dirty Dozen is used, which is validated in different national contexts; however, a validated version is not available for Ecuadorian adolescents, which limits its evaluation processes.
- Using both the Classical Test Theory and the Item Response Theory in The Dirty Dozen, it is concluded that it has adequate psychometric properties for its full use in Ecuadorian adolescents.

Puntos clave

- La Tríada Oscura de la Personalidad es un modelo teórico que intenta explicar el comportamiento errático, disfuncional, disocial y antisocial de las personas.
- Para evaluar este constructo, se utiliza el Dirty Dozen, el cual ha sido validado en diferentes contextos nacionales; sin embargo, no se dispone de una versión validada para adolescentes ecuatorianos, lo que limita sus procesos de evaluación.
- Mediante la Teoría Clásica de los Test y la Teoría de Respuesta al Ítem en el Dirty Dozen, se concluye que posee propiedades psicométricas adecuadas para su uso completo en adolescentes ecuatorianos.

Personality development during adolescence is a complex process influenced by various factors. On the psychological aspect, it requires the formation of identity, as it allows him/her to define personal values, beliefs and goals, hand in hand with increased experimentation and search for autonomy that culminates in the development of stable personality traits (Steinberg, 2017). At the biological level, it is necessary to develop brain areas associated with impulse control, planning and empathy (Casey et al., 2011). And on the socio-environmental aspect, social support (from peers and family members) and a favorable environment are required to ensure a balanced personality, with self-esteem, social skills and greater emotional control and resilience (Telzer et al., 2018). The lack or structural deficit of one to several of these factors in adolescence or exposure to adverse environments including situations of violence or lack of emotional support, may divert the course of proper personality development, leading to the formation of problematic traits that have inclusively shaped specific personality characteristics such as the Dark Triad of Personality (DTP).

This would later lead to externalizing behaviors, defined as external manifestations of emotions and problems through behaviors that violate social norms or are harmful to others (Krueger et al., 2005) and which are exemplified as behaviors of aggression, disobedience, adaptation and others that may predict more serious behavioral disorders in the future and therefore it is necessary to monitor these aspects and develop early interventions (Achenbach & Edelbrock, 1981). Without adequate intervention, these behaviors can evolve into persistent antisocial behavior patterns, affecting life into adulthood (Moffitt, 1993). Therefore, early detection is fundamental and for this purpose it is necessary to have specific instruments properly calibrated for timely work.

The DTP is a construct proposed by Paulhus and Williams (2002) to interpret personality through the interplay of 'dark', equivocal traits, typically associated with problematic, antisocial, and dysfunctional behavior. The construct comprises three distinct traits, each encompassing a range of characteristics: (a) narcissism, defined by an inflated sense of one's own importance and capabilities, a craving for admiration and constant attention, and a lack of empathy for others; (b) machiavellianism, characterized by a propensity to manipulate and deceive others to gain power and control; and (c) psychopathy, marked

by a lack of empathy and remorse, impulsivity, irresponsibility, and a tendency toward disruptive and potentially antisocial behavior (Djakovic & Rowlands, 2024; Jonason et al., 2017; Jones & de Roos, 2017; Walker et al., 2022). The Dark Triad was introduced to aid in identifying and understanding the roots of aggressive, dissocial, sadistic, and antisocial behaviors (Triberti et al., 2021), as well as non-normative, oppositional-defiant, sabotaging, minor infractions, or other behaviors that are often observed during adolescence and early adulthood (Brugués & Caparrós, 2022).

The manifestation of Dark Triad traits has been linked to both the individual's internal and contextual elements, such as substantial emotional deficits (Hussain et al., 2021) or moral disengagement (Chávez-Ventura et al., 2022). An important element to consider about this construct is the apparent association it has with both discomfort and psychological distress, indicating in this regard that the individual's inappropriate or aggressive behavioral response towards others also apparently stems from the internal discomfort that he or she has and that he or she externalizes (Moroz et al., 2018). Gender also appears to be a determining factor for these traits, with men tending to score higher in Dark Triad traits than women (Muris et al., 2017; Rogoza et al., 2021). The identification of the defined features in the Dark Triad has traditionally been controversial due to the complexity of the phenomena it encapsulates. This complexity is further compounded by the lack of adequately validated measurement instruments that guarantee a reliable and precise evaluation of the Dark Triad dynamics, particularly since these measures have not been tested and calibrated across all population groups (including the Ecuadorian population). Furthermore, while validations have been conducted in other countries, there have been few studies on the adolescent population, especially in Latin America, despite their vulnerability and susceptibility to risk and significant harm due to their maturational characteristics, which can potentially hinder their normal development (Aponte-Zurita & Moreta-Herrera, 2023; Moreta-Herrera et al., 2024; Larzabal-Fernández et al., 2024).

Measuring the Dark Triad of Personality in adolescents

Among the few validated tools for measuring the Dark Triad is the 12 items Dark Triad Personality Scale or 'Dirty

Dozen Scale' (DDS; Jonason & Webster, 2010). This 12-item test is a condensed version of the original proposed by Paulhus and Williams (2002) to assess this construct. The DDS examines the three traits of the Dark Triad through an internal structure of three correlated but independent factors. It has been found to have good levels of reliability and convergent validity with personality and socio-sexual development instruments. This instrument, primarily validated in adults, has numerous translation, adaptation, and validation studies in various cultural and national contexts. It even has macro-studies conducted in over 40 countries and eight regions of the world, including Ecuador, that corroborate its reliability (Jonason et al., 2020; Rogoza et al., 2021), thus making it a highly reliable tool.

However, studies on the use of this instrument in adolescents are considerably less common. Noteworthy are the DDS validation studies based on the original structure, such as those developed in the Dutch adolescent population (Klimstra et al., 2014), which demonstrated gender factorial invariance, adequate reliability, and convergence with personality and aggression scales. Studies on adolescent offenders in Portugal found similar conclusions, also showing convergent validity with measures of self-esteem, self-control, and self-reported criminal activities (Pechorro et al., 2021). There have also been studies that present a more complex factorial structure, such as the incorporation of an additional factor through a bi-factor structure that contemplates a general factor to globally assess the 'darkness of the personality', without neglecting the traits that constitute it as specific factors (SF). The search for a global factor in the DDS has apparently been an element to be considered in the validation processes of the measure in adolescents. Mainly because the inclusion of a general factor allows us to identify if SF belongs to a broader defined construct and to be able to model common and unique points about this construct (Bornoalova et al., 2020). This factor structure was found in validations of Polish adults (Czarna et al., 2016) and Peruvians (Copez-Lonzoy et al., 2019), as well as in Spanish youth (Maneiro et al., 2019) and, in French-Canadian adolescents (Savard et al., 2017). These studies also reported consistent reliability for its four factors, as well as convergence validity with self-report measures of psychopathology and personality. Despite this, the current body of evidence remains limited with respect to identifying the best factorial structure that represents the items of DDS in adolescents, indicating the need for further research and study.

Psychometric limitations of the Dirty Dozen Scale for adolescents

The factorial structure of the DDS remains a subject of debate, as there are no instrumental studies of the measure in Spanish-speaking adolescent populations (including in Ecuador). This limits the scope of empirical research due to the lack of assurance in the precision of results yielded by these measurements. Current evidence primarily focuses on analyses grounded in Classical Test Theory (CTT) principles, such as validity and reliability. These analyses assume the suitability of the measures from a holistic perspective (Brennan, 2010), but do not delve into the individual dynamics of the instrument's items. To accomplish this, item-specific analyses are required, including (a) discrimination, (b) difficulty, and (c) pseudo-guessing, drawing on Item Response Theory (IRT). This analytical approach enables more insights into the dynamics

of the scale under observation (Hambleton & Swaminathan, 2013). It should be noted that analyses based on CTT and IRT are not mutually exclusive. In fact, their combined application facilitates a more comprehensive evaluation of the measures, as recent studies have highlighted (e.g., Caycho-Rodríguez et al., 2022; Moreta-Herrera et al., 2024).

Despite the dearth of research into DDS using IRT in adolescents, one study stands out demonstrating that the instrument's 12 items possess adequate discrimination and difficulty, concluding that all items are relevant for assessing the Dark Triad construct (Savard et al., 2017). However, this study does not explore the items' capacity to evaluate the latent construct. In contrast, a study conducted on an adult sample indicated that the DDS yields higher precision when a participant exhibits traits near the average of the latent trait. This study also revealed that the DDS is more effective at identifying medium to high levels of the latent core than at lower levels (Kajonius et al., 2016), suggesting a need for further investigation in this area.

The current study

The evidence reviewed underscores the need to investigate the properties of the DDS specifically in adolescents. There appears to be insufficient evidence to definitively establish the optimal factorial structure, which currently oscillates between an oblique factorial adjustment model and a bi-factor model. Furthermore, there have been no instrumental studies conducted on Latin American adolescent populations, making the generalization of measurement validity currently unfeasible. Lastly, the use of analyses based on IRT is almost non-existent, and when applied, it has not provided answers to questions associated with the independent performance of the items, nor has it determined the score level participants should achieve to maximize the latent core of the measurement in adolescents.

Therefore, this study aims to: (a) analyze the factorial structure of the DDS in an Ecuadorian adolescent sample using CTT principles; (b) estimate the scale's internal consistency; (c) analyze the validity of the DDS based on the relationship with other variables, which in the present case is carried out with the construct of psychological distress (using the Kessler's scale) due to evidence of mutual association; and (d) determine the discrimination and difficulty parameters of the DDS items using IRT. We hypothesize that (H₁) the DDS will better fit a bi-factor model with three SF and one general factor; (H₂) that the internal consistency of the SF and the general factor of the DDS will be satisfactory; (H₃) that the DDS has positive convergent validity with the construct of psychological distress; and (H₄) that the discrimination and difficulty parameters of the items that constitute the DDS will be appropriate for measuring the Dark Triad construct.

Method

Design

This empirical study utilizes a cross-sectional psychometric design (Ato et al., 2013). It aims to analyze the factorial validity of the DDS, its internal consistency based on the principles of the CTT, and discrimination and difficulty parameters as per the IRT in an adolescent sample from Ecuador.

Participants

The study involved 5,132 adolescents, with a near-equal distribution of males (50.2 %) and females (49.8 %). Participants ranged from 11 to 20 years old, with 28.4 % aged between 11-13 years, 46.6 % aged between 14-16 years, and 24.9 % aged between 17-20 years. Participants were students from nine cities in the province of Tungurahua, Ecuador. About 51.9 % were students in the 8th, 9th, and 10th grades of Basic General Education, while 48.1 % were in the 1st, 2nd, and 3rd years of Baccalaureate from public educational centers. In Ecuador, the Baccalaureate is obtained as a high school degree. Finally, 25 % of the participants reported being of very low socio-economic status.

Instruments

The 12 items Dark Triad of Personality Scale or Dirty Dozen Scale (DDS; Jonason & Webster, 2010). For this study, the Spanish version (Copez-Lonzoy et al., 2019; Maneiro et al., 2019) was used. It assesses components of the Dark Triad (Machiavellianism, psychopathy, and narcissism) through a 12-item questionnaire. Responses are recorded on a five-point Likert scale, where 1 corresponds to '*strongly disagree*' and 5 '*strongly agree*'. The scale does not provide interpretation parameters for its scores based on normative criteria, but a higher score generally indicates a stronger presence of the personality traits under analysis.

9-item version of the Kessler Psychological Distress Scale (K-9; Kessler & Mroczek, 1994). A Spanish version of the questionnaire was used in this study, which has shown adequate psychometric properties in Ecuadorian adolescent samples (Larzabal-Fernandez et al., 2024). This scale gauges non-specific psychological distress. It includes affirmative items such as "*During the past 30 days, about how often did you feel nervous?*" and "*During the past 30 days, about how often did you feel that everything was an effort?*". Responses are provided on a 5-point Likert scale ranging from 1 like *Never* to 5 like *Always*. As for reliability, the scale reports values $\omega = .886$ [.881 - .892].

Procedure

The study was carried out in nine cities in Ecuador in different high schools with the respective authorization. For this purpose, 86 principals of high schools in the 18D02 district of Ecuador's Zone 3 planning zone were contacted and invited. The evaluation questionnaire was applied virtually using the *Google Forms platform* during 2021 and 2022, given the restricted conditions due to the Covid-19 pandemic. Prior to the application of the evaluation, the authorizations of the representatives or legal guardians of the participants were presented through a signed letter of authorization and with their assent, all with the support of the management carried out by the Student Counseling Departments (DECE for its acronym in Spanish). The duration of the evaluation was approximately 15 minutes. To prevent students from answering the questionnaire more than once, it was limited to one evaluation per device. Subsequently, the results were systematized, data management was conducted, and a research report with

conclusions was prepared. The study adhered to the guidelines of the Helsinki Declaration and institutional regulations for research involving human subjects. Ethical approval and oversight were provided by the internal committee of the Postgraduate Office at the Pontificia Universidad Católica del Ecuador Ambato.

Data analyses

The data analysis was conducted in three stages. In the first stage, a preliminary item analysis was performed to examine their individual characteristics using measures of central tendency and dispersion such as arithmetic mean (M) and standard deviation (SD). Additionally, distribution measures including skewness ($g1$) and kurtosis ($g2$) were assessed. The assumption of univariate normality is confirmed if $g1$ and $g2$ are within the range ± 1.5 (Ferrando & Anguiano-Carrasco, 2010). Multivariate normality was checked via the Mardia (1970) test, considered valid if the results in g_1 and g_2 do not demonstrate significance ($p > .05$).

The second stage involved analysis of the DDS based on CTT. This included Confirmatory Factor Analysis (CFA), relationships with other variables, and internal consistency. Since responses from the questionnaire are of ordinal nature and multivariate normality was not confirmed, CFA was carried out using Diagonally Weighted Least Squares (DWLS) estimation from a matrix of polychoric correlations. Three adjustment models were tested in the CFA (unifactorial, oblique factors, and bi-factor) to determine the best model based on absolute and relative fit indicators, and an indicator not based on centrality. These include Chi square (χ^2), normed Chi square (χ^2/df), Mean Squared Standardized Residual (SRMR), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI), and Root Mean Squared Error of Approximation (RMSEA). Furthermore, the internal structure of the bi-factor adjustment model was validated using hierarchical Omega indices (ω_H), factor-specific Omegas (ω_s), Explained Common Variance (ECV), Percentage of Uncontaminated Correlation (PUC), and the Hancock and Mueller coefficient (H). For a model to show a good fit, ω_H and ECV must be $> .70$, $PUC > .60$, $H > .90$ and $\omega_s > .30$ (Dominguez-Lara & Rodriguez, 2017; Moreno-Montero et al., 2023; Moreta-Herrera et al., 2022; Reise et al., 2013; Smits et al., 2015; Rodriguez et al., 2016). The internal consistency was analyzed using the Omega Coefficient (ω) for both the general and SF of the DDS.

In the final stage, IRT-based analyses were conducted, including discrimination [a] and difficulty [b] parameters for the DDS items. This utilizes the Graded Response Model (GRM), which is an extension of the 2-Parameter Logistic Model (2-PLM) for ordered polytomous items. The Item Information Curve (IIC) and the Test Information Curve (TIC) were also reviewed to provide a detailed view of these parameters.

The statistical analyses were carried out using the R programming language version 4.2.2 (R Core Team, 2022) with the foreign, lavaan, ltm, MBESS, and MVN packages for the CFA, Multi-group CFA, and GRM analyses. Bifactor Index Calculator application (Dueber, 2017) was used to calculate bifactor estimates.

Results

Preliminary item analysis

Table 1 presents the preliminary analysis of the DDS items. It can be seen that there is uniformity in the mean scores of the items, with values ranging from $M(\text{item } 6) = 1.03$; $SD = 1.23$ to $M(\text{item } 10) = 2.35$; $SD = 1.39$. About distribution measures, except for items 4 and 8, whose g_1 and g_2 values exceed the ± 1.5 parameter, items comply with the assumption of univariate normality. As for multivariate normality, the results of the Mardia test in g_1 and g_2 indicate that this assumption is not met due to the presence of significant differences ($p < .05$).

Factorial validity analysis

Considering the absence of multivariate normality and considering that responses to the questionnaire are of ordinal nature, the analysis of the internal structure is initiated using robust estimators. To start with, a polychoric correlation matrix is employed. Table 2 displays the internal correlations of the items and the interrelations they maintain. In all instances, the covariances exceed the $> .20$ criterion, indicating a significant contribution of each item in interaction with others. Simultaneously, they are $< .90$, indicating an absence of multicollinearity or redundancy. Therefore, it is not deemed necessary to remove any items.

From the polychoric correlation matrix, the DWLS estimation is used for the CFA, as shown in Table 3. Among the

three proposed adjustment models, the oblique and bi-factor models present the best adjustment indicators. However, the bi-factor model exhibits superior performance in the factorial structure, based on absolute, relative, and non-centrality-based adjustment indicators.

In Figure 1, the factor loadings (λ) that the items present within the bi-factor model, both in the general factor and the SF, are displayed. The explanation of variance through factor loadings is more consolidated in the general factor, with values exceeding $\lambda > .40$, while in the SF, these values are less representative. This suggests that the scale performs better unidimensionally than multidimensionally. This assertion is corroborated by the bi-factor adjustment indicators. In this case, the

Table 2. Polychoric correlation matrix from the Dirty Dozen Scale

Items	1	2	3	4	5	6	7	8	9	10	11	12
Item 1	1											
Item 2	.58	1										
Item 3	.57	.57	1									
Item 4	.63	.58	.56	1								
Item 5	.31	.36	.31	.42	1							
Item 6	.43	.45	.37	.53	.45	1						
Item 7	.51	.49	.40	.57	.42	.53	1					
Item 8	.54	.52	.45	.60	.38	.50	.64	1				
Item 9	.39	.37	.45	.45	.32	.32	.32	.38	1			
Item 10	.33	.34	.39	.40	.25	.30	.29	.32	.65	1		
Item 11	.43	.39	.45	.48	.31	.35	.36	.44	.63	.57	1	
Item 12	.43	.40	.38	.54	.29	.41	.39	.46	.49	.52	.54	1

Table 1. Preliminary analysis of the Dirty Dozen Scale

#	Item	M	SD	g_1	g_2
1	I tend to manipulate others to get my way [Tiendo a manipular a los demás para conseguir lo que quiero]	1.75	1.12	1.49	1.33
2	I have used deceit or lied to get my way [He utilizado el engaño o mentido para conseguir lo que quiero]	1.85	1.12	1.31	0.96
3	I have used flattery to get my way [He utilizado halagos para conseguir lo que quiero]	1.97	1.23	1.13	0.22
4	I tend to exploit others towards my own end [Tiendo a explotar a los demás en mi propio beneficio]	1.51	1.01	2.16	3.94
5	I tend to lack remorse [Tiendo a no tener remordimientos]	2.22	1.35	0.84	-0.50
6	I tend to be unconcerned with the morality of my actions [Tiendo a ser despreocupado con la moralidad de mis acciones]	1.03	1.23	1.04	0.09
7	I tend to be callous or insensitive [Tiendo a ser cruel o insensible]	1.81	1.19	1.40	0.89
8	I tend to be cynical [Tiendo a ser cínico]	1.54	1.00	2.00	3.37
9	I tend to want others to admire me [Tiendo a querer que otros me admiren]	2.12	1.33	0.94	-0.34
10	I tend to want others to pay attention to me [Tiendo a querer que otros me presten atención]	2.35	1.39	0.65	-0.78
11	I tend to seek prestige or status [Tiendo a buscar prestigio o estatus]	1.93	1.20	1.18	0.39
12	I tend to expect special favors from others [Tiendo a esperar favores especiales de los demás]	1.87	1.21	1.35	0.80
Mardia		-	-	20669.77***	182.55***

Note: *** $p < .001$; M: mean; SD: Standard Deviation; g_1 : skewness; g_2 : kurtosis

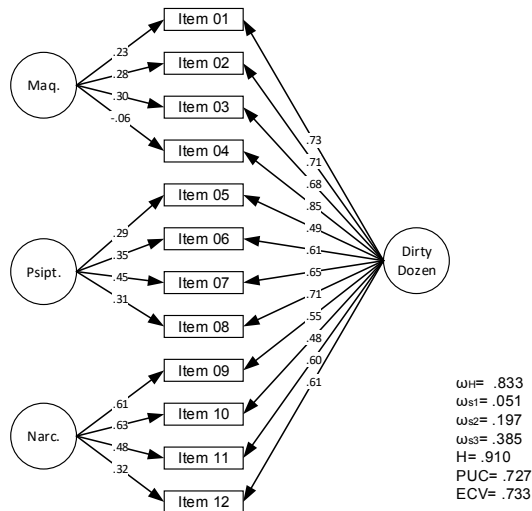
Table 3. Results from the Confirmatory Factor Analysis of the Dirty Dozen Scale

Models	χ^2	DF	χ^2/df	CFI	TLI	SRMR	RMSEA
Unifactorial	81013.5***	66	1227.4	.966	.959	.078	.100 [.096 - .103]
Three oblique factors	618.9***	51	12.1	.993	.991	.038	.047 [.043 - .050]
Bi-factor	272.9***	42	6.5	.997	.996	.026	.033 [.029 - .037]

Note: *** $p < .001$; χ^2 : Chi square; DF: degrees of freedom; CFI: comparative fit index; TLI: Tucker-Lewis Index; SRMR: Mean Squared Standardized Residual; RMSEA: Root Mean Squared Error of Approximation

ω_H , ECV, PUC, and H indicators reflect that the scale is essentially unidimensional. The ω_S indicators, on the other hand, show that the SF are too weak to exhibit independence from the general factor. Consequently, the reliable variance of the measure is attributed more to the general factor than to the SF, with the notable exception of the Narcissism factor.

Figure 1. Factorial structure of the Dirty Dozen from a bi-factor model



Note. ω_H : Hierarchic omega; ω_S : Specific omega; H: Hancock and Mueller coefficient (H); PUC: Percentage of uncontaminated correlation; ECV: Explained common variance; Mach.: Machiavellism; Psyp.: Psychopathy; Narc.: Narcissism.

Internal consistency analysis

Table 4 presents the results from the internal consistency analysis of the DDS. Among the SF, consistency is acceptable, with the Psychopathy factor demonstrating the lowest score, although it is still above the established cut-off point ($\omega > .70$). Overall, the general factor exhibits satisfactory reliability, suggesting that the scores produced by the scale are reliable for Ecuadorian adolescents.

In terms of validity in relation to other variables, the DDS exhibits a mild positive correlation with the Kessler scale, which measures psychological distress, in both its SF (except for Narcissism) and the general factor. Notably in this analysis, the K9 exhibits a stronger correlation with the Psychopathy factor and the general factor of the Dark Triad.

Table 4. Results from the Internal Consistency Analyses of the Dirty Dozen Scale and its correlation coefficients with the K-9

Factors	Items	ω	95 % CI	K-9
Machiavellism	4	.780	[.765 - .794]	.231**
Psychopathy	4	.706	[.689 - .723]	.287**
Narcissism	4	.783	[.771 - .794]	.181**
Dirty Dozen	12	.859	[.852 - .867]	.278**

Note: ω : McDonald's omega; 95 % CI: Confidence interval at 95 %

Graded response model

Given the unidimensionality and independence of the DDS revealed through CFA, the discrimination and difficulty parameters were analyzed using GRM. As shown in Table 5,

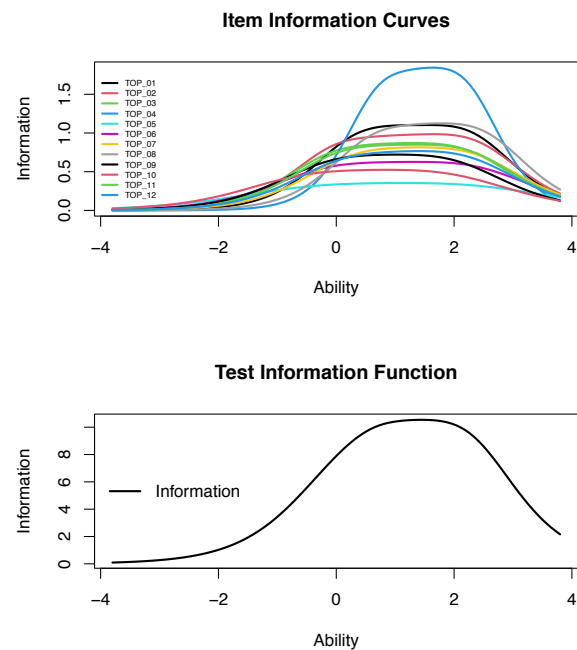
all items appear to be adequate for the parameter [a], as their values exceed 1. Notably, item 4 ("I tend to exploit others towards my own end"), corresponding to Machiavellianism, displays the highest discrimination compared to the other items. In other words, it allows better discrimination between individuals who do and do not have the capability to respond accurately to the latent trait of the Dark Triad.

Table 5. Graded Response Model of the Dirty Dozen Scale

Items	a	b1	b2	b3	b4
Item 1	1.877	0.355	1.052	1.824	2.310
Item 2	1.775	0.063	1.011	1.819	2.378
Item 3	1.659	0.004	0.864	1.590	2.201
Item 4	2.415	0.744	1.350	1.847	2.211
Item 5	1.055	-0.369	0.741	1.759	2.378
Item 6	1.411	-0.121	0.832	1.786	2.357
Item 7	1.601	0.317	1.083	1.788	2.332
Item 8	1.886	0.666	1.425	2.068	2.522
Item 9	1.508	-0.082	0.684	1.483	1.977
Item 10	1.285	-0.491	0.492	1.354	1.912
Item 11	1.644	0.078	0.904	1.732	2.253
Item 12	1.555	0.170	1.081	1.787	2.233

Note: a: discrimination; b: difficulty

Figure 2. Item and Test Information Curves from the Dirty Dozen Scale



Note: IIC: Item Information Curves; TIC: Test Information Curves

Regarding the parameter [b], the estimated thresholds from b1 to b4 for all items collectively increase monotonically, making this parameter also suitable. However, it should be noted that the degree of difficulty for a participant to respond about the presence of the latent trait is quite close to the mean (θ). In other words, these items provide sufficient information and in the long term, the presence of high scores from participants (particularly in the Machiavellianism factor) aids in predicting a participant's latent level of dark personality traits.

Figure 2 presents the information curves for the 12 items of the DDS. Within the Item Information Curve (IIC), item 4 significantly stands out due to its superior relevance and precision in evaluating the latent variable, as it exhibits a more pronounced discriminatory capacity compared to the remaining items. In contrast, item 5 demonstrates the least relevance and precision. Turning to the TIC, the DDS is portrayed as both reliable and accurate in evaluating the latent variable, particularly within the -0.5 and 2 ranges. This suggests that the core aspects of the dark triad are best revealed when participants display levels close to the average of the latent trait. As a result, the DDS proves more effective and has a higher predictive accuracy with individuals who exhibit average or high levels of dark triad traits, but less so for those at the lower levels.

Discussion

The objectives of this study were to discern the factor structure of the DDS, its internal consistency, and the validity of its relationships with other variables, based on the CTT. Additionally, we sought to determine the discrimination and difficulty parameters of the DDS items within a sample of Ecuadorian adolescents.

With respect to factorial validity, our findings indicate that a bi-factorial structure, encompassing the original SF plus a general factor, best fits the Ecuadorian adolescent sample. The fit values reported in the CFA fall within the established tolerance parameters, which suggest an acceptable fit for both the general and specific bi-factor indicators (as cited in Brown, 2015; Byrne, 2008; Domínguez-Lara, 2018; Moreta-Herrera et al., 2021; Mueller & Hancock, 2018; Wolf et al., 2013; Domínguez-Lara & Rodríguez, 2017; Moreta-Herrera et al., 2022; Reise et al., 2013; Smits et al., 2015; Rodríguez et al., 2016). Our findings align with prior research involving adult and youth samples (Czarna et al., 2016; Copez-Lonzoy et al., 2019; Maneiro et al., 2019), and adolescent samples (Savard et al., 2017), suggesting a possible structural similarity across different age groups, although verifying measurement equivalence is necessary. Notably, these results imply that the DDS is essentially unidimensional, and its SF are not independent enough to contribute to their reliable variance uniquely. Instead, they depend on the variance of the general factor, which is more attributed by this than by the SF (with Narcissism being an exception).

In terms of reliability, the specific and general factors of the DDS demonstrated suitable internal consistency, implying that the instrument's scores in Ecuadorian samples can be considered reliable. These reported values align with previous work conducted in Franco-Canadian adolescents (Savard et al., 2017) that started from the same bi-factor internal structure. Regarding the validity of association with other variables, the DDS tends to correlate positively, although with a slight intensity, with the K-9 scale that identifies psychological distress, with the Psychopathy factor and the general factor of the DDS. These findings are consistent with the work of Savard et al. (2017) who analyzed the covariance of the DDS with measures that identify psychopathology (psychopathy). Although it does not establish a specific criterion of convergent validity given the lack of measures that evaluate a similar construct, it is considered pertinent to compare the DDS with other psychopa-

thological constructs. Furthermore, it reaffirms the closeness that the elements of the dark personality have with psychological distress, a fact that would help explain the dynamics of the discomfort associated with specific personality traits (Moros et al., 2018). This, for example, is observed more between the trait of psychopathy and distress. What is relevant in this aspect is perhaps to understand that the dark triad initially presents itself as a phenomenon of maladjustment or social maladjustment in the individual that arises in early stages such as adolescence and can in some way contribute significantly to the appearance of psychological symptoms that in the future would lead to psychopathological conditions. However, this should be taken with caution and verified in future specific studies.

This study also explored the discrimination and difficulty parameters of items based on the IRT. The GRM suggests that all items constituting the DDS exhibit adequate discrimination, distinguishing participants who possess or lack the skills to respond to the presence of the latent trait. Threshold analyses for the DDS difficulty parameters show that while difficulty increases to reach the extreme levels of the scale, the requirement to respond above the latent level across items is close to the average (θ). This indicates that the items provide sufficient information to predict the latent level of the Dark Triad more quickly. These findings are consistent with results from the only other study on the DDS in adolescents (Savard et al., 2017).

Furthermore, the IIC indicates that item 4 has greater relevance and precision in evaluating the latent variable. Finally, the TIC suggests that the DDS reliably determines the predictive level of the latent core of the dark triad. However, this is largely dependent on the abilities to respond to the latent trait being close to the average or higher; at lower abilities, the DDS presents a lower capacity. This parallels the conclusion drawn by Kajonius et al. (2016) in adult populations. As there are no contrasting studies in adolescents, these results break new ground in this age group, indicating that the predictive level of the scale depends on the domain of response skills being close to the average or higher in both adolescents and adults.

These results contribute significantly to the psychometric exploration of the DDS in adolescents, representing a substantial addition to the assessment of the dark triad. It validates a reliable measure for analyzing this construct in Spanish-speaking adolescents from Ecuador. The incorporation of new IRT-based analyses in the methodology also adds novelty, especially in handling the aspect of item difficulty. From a practical point of view, this research presents data demonstrating the optimal functionality of the DDS for individual assessments, whether diagnostic to estimate possible alterations in personality or to expand information on aggressive, violent, manipulative, and antisocial behaviors. Likewise, at the level of psychosocial intervention, especially to promote spaces for strengthening prosocial and proactive traits and behaviors in the individual, as well as focusing on the development of emotional intelligence and containing the development of inappropriate personality traits or patterns. Finally, it also contributes to the field of research for future processes, since it allows us to describe populations, especially Ecuadorian adolescents who are in development, as well as to understand the dynamics of interaction with other elements, both contextual and internal to people and their repercussions on the social fabric.

Limitations

The participants in this study primarily consisted of adolescents in the normative school-going population, making it less likely that we included non-normative or clinical populations associated with aggressive, delinquent, or antisocial behaviors. Therefore, future studies should incorporate a segment of participants with these characteristics to evaluate, for example, the discriminant validity of the DDS. Furthermore, this study did not perform any analyses on the measurement equivalence of the DDS based on socio-demographic variables such as gender, cultural background, or socio-economic conditions. Future research should consider these analyses to determine potential variations in the factor structure resulting from these variables. The study also does not delve into the empirical nature of the research, since it does not include interaction processes (association, prediction, etc.) with other constructs associated with dark personality. However, timely research of this type is recommended, especially in adolescents and emerging adults. Likewise, it does not contemplate modification of the same through intervention processes, especially to minimize the development of these personality traits, which should be taken into account for future work. Another consideration that corresponds to the study is the use of IRT in a limited way. Given that the use of the Multidimensional Item Response Theory (MIRT) could help replace the CFA in the process of verifying the factor structure, which is why studies of verification of the measure are suggested, further extending the use of the IRT.

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Conflict of interests

The authors declare they have no conflicts of interest.

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