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Original Article

Adaptation of a Cultural Measure in Brazil – Developing a Short Version of the Individualism–Collectivism Vertical–Horizontal Scale

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Abstract: We report psychometric analyses of an adapted version of the measure of individualism–collectivism (IC) and its horizontal–vertical (HV) manifestations (Singelis et al., 1995) for Brazilian samples. We used a large sample (N = 1,669) split into an exploratory and two cross-validation samples. Using confirmatory factor analysis and a new metaheuristic machine learning approach inspired by ant colony foraging, we found poor psychometric properties. We developed and compared three short scales, which showed poor reliability and poor factor structures. Considering widely used short scales of this measure, our results suggest that key items may be understood differently by Brazilians, and we urge caution in interpreting individualism–collectivism scores with Brazilian samples. We discuss issues for further developing cultural orientation scales to measure individual differences and the utility of an advanced metaheuristic data-driven approach for psychometric research.

Keywords: internal validity, confirmatory factor analysis, ant colonization optimization, cultural adaptation, cultural orientation

Hofstede's seminal work (Hofstede, 1980; Hofstede, Garibaldi de Hilal, et al., 2010) focusing on identifying major dimensions of cultural variation has been a prominent cornerstone of social science research. Among his empirically defined dimensions, individualism–collectivism has created the greatest interest in the wider literature (for a meta-analysis, see Soh & Leong, 2002). It has been defined as the degree to which each person in a community emphasizes individual goals, in comparison to emphasizing the goals of one's group. A second dimension that initially formed a joint factor with individualism–collectivism is power distance, defined as the nature of the relationship with authority and the degree to which members of society accept an unequal distribution of power and large differences in status. These dimensions have been confirmed by a number of subsequent studies (Fischer & Ferreira, 2023; Minkov, 2018; Taras et al., 2009, 2010) and psychometric instruments that aim to measure the joint distribution idealized as modal distribution of individual behaviors, attitudes, values, and beliefs around cultural means (Ponizovskiy et al., 2019) have become widely used in the literature. However, the development and application of psychometric tests measuring such cultural dimensions face challenges in that the theoretical constructs of interest (specific cultural dimensions) vary systematically across cultures. For example, measures of individualism–collectivism tend to show lower reliability in supposedly more collectivist societies, and most adaptations and test validation efforts are conducted in limited cultural contexts (typically comparing English-speaking and Western European samples with East Asian samples; see, e.g., Muthukrishna et al., 2020; cf. Pérez-Nebra, Tordera, et al., 2023). Relatively few studies have focused instruments that are applicable to South American samples. Thus, this study presents a psychometric study of a widely used instrument and steps to develop a psychometrically sound short form for the Brazilian context, which is the largest and most populous country in Latin and South America.

Vertical–Horizontal Individualism–Collectivism

Initial attempts were made to develop individualism–collectivism measures, but it soon became apparent that the concept of power distance translated as verticality–horizontality in social relations brings an important nuance for understanding how individuals relate to their reference groups. The vertical–horizontal (VH) distinction refers to the extent to which less powerful individuals in groups, organizations, and institutions accept and expect power to be (unequally) distributed. Power and inequality are fundamental facts of any group, and there is substantive variation in inequality and power differential in groups globally (Smith et al., 1998; Torelli & Shavitt, 2010). Singelis et al. (1995) were the first to formally cross these two concepts at the individual level, resulting in both horizontal and vertical components of individualism and collectivism, that is vertical–individualism (VI), vertical–collectivism (VC), horizontal–individualism (HI), and horizontal–collectivism (HC). Across these cultural patterns, collectivism always carries the idea of commitment to others, and HC emphasizes the importance of maintaining harmony within the group through cooperation with in-group members. The notion of hierarchy is salient in VC, with the sense of obligation toward the group and its acceptance of unequal social structure. In individualism, the idea that the individual takes priority over groups in all aspects of life is maintained, but a distinction is being made on how autonomous individuals relate to each other. Horizontal individualism emphasizes the idea of the unique individual that is morally equal with other autonomous and unique individuals, while vertical individualism includes a moral differentiation between individuals derived from a person's success in competing with others. For Triandis (1994), horizontal collectivists exist within groups and the group is of importance to their identity and way of being but do not feel subordinated to the group. Vertical collectivists, on the other hand, submit to their group's hierarchical norms and are willing to sacrifice themselves for the sake of the group. Horizontal individualists do their own thing but accept others as moral equals and do not emphasize interindividual comparisons. Vertical individualists, on the other hand, are concerned with competing and succeeding over others. The original IC-VH scale has been widely used. For example, a Scopus search on May 15, 2023, returned 1,333 published studies citing the original paper, with a steady increase in citations over the last 30 years.

Yet, the original scale has shown problematic psychometric properties, something that Singelis et al. (1995) noted when describing their scale development efforts. Singelis et al. (1995) administered the original English version to a US sample. Responses to the 32 items were rated on a nine-point Likert scale, ranging from 1 = *totally disagree* and 9 = *totally agree*. The scale was equally distributed in number of items (i.e., eight items per cultural pattern) to measure each of the four components. The authors found Cronbach's α coefficients of 0.74 for HC, α = .68 for VC, and for HI α = .67, and VI obtained a reliability coefficient of .74 (Singelis et al., 1995).

Over the years, a number of attempts have been made to improve the scale and derive shorter versions. The first attempt was made by Triandis and Gelfand (1998), who developed a 16-item version. They administered a modified 27-item version of the original Singelis et al. scale to student samples in the United States and South Korea. The four highest loading items per dimension were then used to create a short version. This version has been used widely, as evidenced by over 4,000 citations by early 2023 in Google Scholar. This scale has been included in Brazilian samples, showing problems not with its overall structure, but of items loadings in different factors, particularly in the dimensions of collectivism (Pérez-Nebra, Tordera, et al., 2023), however, with relatively good reliabilities (all above .70). In another example, in an eight-country comparison including Brazilian's participants (Fischer et al., 2009), this scale showed continuing problems with relatively low reliabilities for some samples and components, although average reliabilities for most scales were above .70. Another short scale was developed by Sivadas et al. (2008). They developed a 14-item version based on modestly sized student samples in the United States, China, Denmark, and India. Their results suggested significant problems with model fit and reliabilities for the original Singelis et al. scale, yet they were able to identify a reduced 14-item version, which still showed problems with reliability but overall performed substantively better.

The Study Context

Here, we report on a validation study and exploration of a brief measure in a Brazilian sample. Although there are some examples, Brazil has been an understudied cultural context for studies investigating individualism–collectivism, considering the geographic and population size and the economic impact of the country globally. Brazil is the fifth largest country by geography, the sevenths most populous country and the ninth largest economy in the world. Its individual states are often larger than in size and population than many European nations. Yet, it has not attracted a lot of research attention, considering its size and global importance. For example, from the 1,333 articles citing the original study, only 25 articles were identified that explicitly mentioned Brazil as a study context, compared to over 600 articles mentioning the United States, over 100 each mentioning China, the United Kingdom, and Canada and more than 50 articles mentioning the Netherlands, Hong Kong, Turkey, South Korea, Germany, and Australia (retrieved from Scopus). At the same time, the country has a unique culture that makes it an interesting study case for differentiating vertical and horizontal components of individualism and collectivism. Hofstede's original work had suggested that Brazil is a collectivistic society with a strong hierarchy, which would make the vertical collectivism dimension more salient. Yet, a few distinct features complicate the picture. Brazilian society has been traditionally seen as a *big family* (Cândido, 1972) with few formal rules, but with its members emphasizing conformity and adaptation to social hierarchical rules (Gelfand et al., 2021). This characterization further emphasizes a vertical collectivism component, as Brazilians according to this narrative are being embedded in tight family groups with unquestioned acceptance of authority, be it traditionally the main income provider of the family or the boss at work (Dessen & Torres, 2019). Yet, embedded within this seemingly traditional authoritarian collectivistic orientation, anthropologists and cultural psychologists have pointed a unique mix of social problem-solving strategies that are utilized to level the hierarchies and offer opportunities for individuals to resolve problems in an otherwise hierarchical and bureaucratic context. This strategy is commonly known as *jeitinho brasileiro*, which literally could be translated as the *little way* (Barbosa, 2006), but translation capturing the meaning vary more widely (Fischer & Pilati, 2024). Psychological research over the last decade has demonstrated that there are at least two or three distinct behavioral strategies, ranging from creativity and spontaneity in overcoming problems to establishing social relationships on the spot through smooth interpersonal interactions and activating common in-group markers through casual conversations all the way to using corruption and nepotism to get things done (Akira Miura et al., 2019; Ferreira et al., 2012; Fischer et al., 2014, 2022; Pilati & Fischer, 2022; Pilati et al., 2011). Although some of these problem-solving strategies can be individually found in other contexts (Smith et al., 2011, 2012), the unique combination of strategies that blend both individualistic (creativity and spontaneity) and collectivistic (building social relationships on the fly, relying on family ties) to level social hierarchies makes Brazil an interesting test study of individualism–collectivism.

Perhaps a certain negligence in working with data from Latin America in general, and from Brazil in particular, can be attributed to the scarcity of valid and reliable instruments in these countries. Only a handful of instruments intended to measure individual variation along cultural dimensions have been validated for Brazilian samples (e.g., the Portrait Values Questionnaire – Refined, Torres et al., 2016; Triandis & Gelfand – Portuguese–Brazilian, Pérez-Nebra, Pedersoli, et al., 2023). This scenario creates a clear need for Brazilian scales that measure culture-related variables with Brazilians which have undergone the rigor of cross-cultural translation and adaptation (Brislin et al., 1973; Fischer & Fontaine, 2011; Pérez-Nebra, Pedersoli, et al., 2023; Smith et al., 2013; van de Vijver & Leung, 2011). Therefore, our study fills an important gap in the literature.

Torres and Pérez-Nebra (2015) reported the first translation and adaptation of the original Individualism–Collectivism Vertical–Horizontal Scale. They tested the original scale that showed low reliability coefficients. In the second stage, new items were constructed based on instruments measuring cultural orientation (Gouveia, 1998; Tamayo & Schwartz, 1993) and using input from in-depth interviews. This revised scale did not show a good fit in the first test, but the authors also reported a reduced version that showed improvements in both model fit and reliability. An important point is that several items did not load on the theoretically predicted factors but rather showed a different association with other items. Furthermore, even the reduced version is of substantive length. It would, thus, be desirable to obtain a valid short version for further use in the Brazilian context.

The Present Study

Our study has two major objectives. We test with new data the extended vertical–horizontal individualism–collectivism scale, which includes additional items that have been previously developed for a Brazilian context (Torres & Pérez-Nebra, 2015). Considering the previous problems with the original and revised scales in terms of poor model fit and low reliability, psychometric properties need more attention. Second, the scale is exceedingly long. Previous studies have reported shorter measures (e.g., Pérez-Nebra, Todera, et al., 2023), but these continue to show some problems (e.g., the content of vertical collectivism is composed only by family-related items). Our study goes beyond these earlier studies by utilizing a new psychometric approach called ant colony optimization (Leite et al., 2008; Olaru & Danner, 2021; Olaru et al., 2019; Raborn & Leite,

2018) to derive an optimal scale within the constraints of our sample.

Ant colony optimization (ACO) is an advanced metaheuristic inspired by the collective foraging behavior of ants. Ants exploring an open space to find food mark successful paths leading to food sources with pheromones, and as more ants start to use the most efficient path, the pheromone levels increase, leading to the dominance of the shortest or most efficient route. Drawing inspiration from such a biological model, this computational method employs simulated agents (artificial ants) to search for optimal solutions in a network graph. Through multiple interactions, the algorithm assigns greater weights to the shortest paths encountered, mimicking the pheromone tracks of ants. This method has been widely used to solve complex computational problems and can also be applied to optimize and reduce scales using confirmatory factor analysis (CFA; Dorigo & Stützle, 2004; Olaru et al., 2019).

Essentially, the ACO algorithm iteratively improves the quality of selected items, retaining the best sample-specific solutions against researcher-defined statistical criteria. Using ant colony optimization in scale development offers benefits over traditional methods. Traditional approaches often rely on subjective decisions based on limited criteria, which can lead to suboptimal solutions (Schroeders et al., 2016). For example, factor loading, a conventional method, is prone to researcher bias as decisions regarding item retention or deletion are often based on arbitrary cutoff values or guidelines. This approach may exclude important items or retain less relevant ones, compromising the content validity and psychometric properties of the shortened scale (Matsunaga, 2010). In contrast, ant colony optimization provides a more objective, data-driven approach to item selection, ensuring that the resulting scale is both psychometrically sound and theoretically grounded. The underlying approach is robust and adaptive, designed to efficiently explore complex search spaces and uncover optimal solutions that traditional methods may overlook (Dorigo et al., 1996). By harnessing the collective intelligence of the simulated ant colony, the algorithm strikes a balance between exploration and exploitation, avoiding local optima and converging toward a global optimum solution (Dorigo & Stützle, 2004). Consequently, using ant colony optimization in scale development can lead to the identification of more precise, reliable, and parsimonious measurement instruments of intended constructs such as individualism–collectivism (Olaru & Danner, 2021; Olaru et al., 2019; Schroeders et al., 2016). To sum, ant colony optimization presents an innovative and efficient approach to simplify complex measures while maintaining validity and reliability (Blum & Roli, 2003; Olaru et al., 2019). To ensure that the model selected is not due to sample specificity, we use a cross-validation approach and retest the improved model in a new hold-out sample. In summary, our research questions are (a) to test the factorial structure of an adapted version of the vertical–horizontal individualism–collectivism scale to measure individual differences in a Brazilian context and (b) to develop a short version of the scale.

Method

Participants

Our sample consisted of 1,669 Brazilians. We randomly split this sample into three roughly equal subsamples to allow cross-validation of our empirically derived models. See Table 1 for a breakdown of key demographic indicators. For all our analyses, we excluded cases with missing data and only used cases with complete data (N = 1,660).

Measure and Procedure

We collected the data online and paper-and-pencil with workers in organizations (72.1% of the sample) and paper-and-pencil in a snowball with undergraduate students to improve the variability of the sample. We asked the students to collect two questionnaires each with different work categories to learn how to collect data. Although there are different data collection procedures, there is no difference between workers and students samples. We use the adapted scale of the Singelis et al. (1995) scale with a new subset of items developed by Torres and Pérez-Nebra (2015). Individuals were presented with 45 short statements (see the supplement for a full list of items) and had to answer whether they agreed or disagreed with each statement on a 9-point response scale ranging from 1 (*strongly disagree*) to 9 (*strongly agree*).

Data Analysis

Our analysis proceeded in three major steps (Figure 1) using RStudio. In Subsample 1 (to follow the steps see Table 2), we explored the data structure with a full confirmatory factor model in lavaan (Rosseel et al., 2023), using both maximum likelihood and maximum likelihood estimation with robust standard errors and a mean and variance adjusted test statistic (aka the Satterthwaite approach, WLSMVS). For identification purposes, we set the latent variance to 1. To evaluate model fit, we used the CFI, the RMSEA, and SRMR, with values above .90, below .08, and .08, respectively, indicating acceptable fit. We also reported the

Table 1. Demographic information per subsample

Subsample	*N*	Gender (% men)	Age (*SD*)	Tenure[a] (*SD*)	Region[b]
1	561	65.6	34.68 (8.42)	12.09 (9.64)	45.5% DF 25.2% RJ
2	555	70.3	35.02 (8.17)	12.89 (9.58)	40.1% DF 27.4% RJ
3	544	66.0	35.55 (8.74)	12.72 (10.05)	43.7% DF 26.7% RJ

Note. [a]Tenure = years of working in their jobs. [b]Only the major regions are tabulated; DF – Federal District, RJ – Rio de Janeiro.

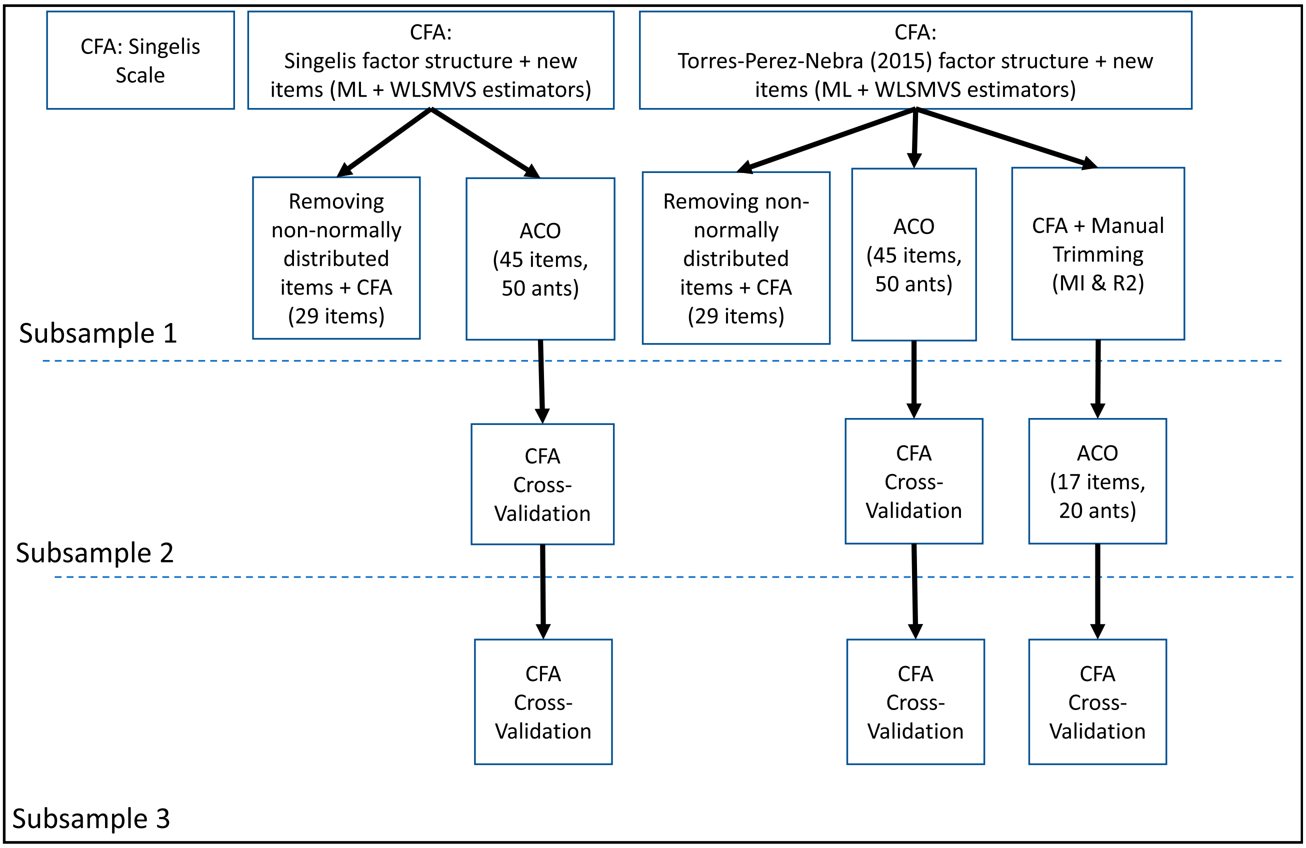

Figure 1. Schematic overview of the models tested. CFA = confirmatory factor analysis, T&PN = Torres and Pérez-Nebra (2015); ACO = ant colony optimization, MI = modification indices, R^2 = R-squared values, ML = maximum likelihood, WLSMVS = maximum likelihood estimation with robust standard errors and a mean- and variance-adjusted test statistic.

TLI. We informed the fit for a model with (a) only the items proposed by Singelis et al. (29 of 32), (b) a model with the factor structure found by Singelis et al. but also adding the 16 new items developed by Torres and Pérez-Nebra (2015), and (c) a model with the factor structure for the Singelis et al. items based on the study by Torres and Pérez-Nebra (2015), including their 16 new items developed. These initial models with all items are provided for reasons of transparency, but given the previously reported problems, we did not expect an adequate fit.

We then proceeded in two steps. Using Torres and Pérez-Nebra's factor structure as a starting point, we examined the distributional properties of all items. We examined skewness and kurtosis and decided to exclude any item that had a z-value for either of these indicators above |10| and visual inspection (Field et al., 2012). As our focus was on identifying individual variation in these cultural patterns, we decided to exclude these items as they show little variability among our participants and are strongly non-normally distributed. We excluded items with high skewness (above |3|) and kurtosis (above |10|). Nevertheless, when running formal statistical tests (e.g., Kolmogorov–Smirnov and Shapiro–Wilk tests), we still found statistically reliable deviation from a normal distribution (e.g., $p < .05$), which may partially due to relatively large sample sizes. We proceeded with a new CFA using the reduced item set. We ran exploratory analyses both with ML and WLSMV estimators, but since the results were qualitatively identical, we only report the ML in the text. We applied the same fit criteria as for the first analysis.

Table 2. Overview of models tested in each sample

Models	Description
Subsample 1	
Singelis (29 items)	Tested the original items and Singelis et al. (1995) structure.
Singelis + TPN.a (45 items)	Tested the original items from Singelis et al. (1995) using their original structure + new items developed by Torres and Pérez-Nebra (2015), CFA with ML estimator.
Singelis + TPN.b (45 items)	Tested the original items from Singelis et al. (1995) using their original structure + new items developed by Torres and Pérez-Nebra (2015), CFA with WLSMVS estimator.
TPN.a (45 items)	Tested the Torres and Pérez-Nebra structure (which uses the Singelis et al. items, but using a different structural organization) with the new items developed by Torres & Pérez-Nebra, CFA with ML estimator.
TPN.b (45 items)	Tested the Torres and Pérez-Nebra structure (which uses the Singelis et al. items, but using a different structural organization) with the new items developed by Torres & Pérez-Nebra, CFA with WLSMVS estimator.
Singelis + TPN (29 items)	Singelis structure + new items after removing 16 items with high skewness/kurtosis values
ACO Singelis + TPN	ACO algorithm applied on Singelis structure + new items after 16 items with high skewness/kurtosis values were removed, target instrument size: 12 items.
ACO TPN	ACO algorithm applied to the alternative Torres and Pérez-Nebra structure (the full list of items), target instrument size: 3 items per factor.
Model 1 (29 items)	Testing the alternative Torres and Pérez-Nebra structure (Singelis et al. items + new items), after removing 16 items with high skewness/kurtosis values.
Model 2 (28 items)	Manual trimming of the alternative Torres and Pérez-Nebra structure (see model 1 above), removal of 1 item with MI >5% of χ^2.
Model 3 (18 items)	Manual trimming of the alternative Torres and Pérez-Nebra structure (see model 2 above), removal of 10 items with $R^2 < .10$.
Model 4 – final (14 items)	Manual trimming of the alternative Torres and Pérez-Nebra structure (see model 3 above), removal of 4 items (with MI >5% of χ^2), no further improvement via R^2 or χ^2).
Subsample 2	
TPN (45 items)	Cross-validation of Torres and Pérez-Nebra structure (alternative Singelis structure + new items) using ML estimator.
Model 4 (14 items)	Cross-validation of Model 4 from subsample 1 (manual trimmed model based on the alternative Torres and Pérez-Nebra structure).
ACO Model 4 (12 items)	ACO application with manually trimmed model 4 as a starting point (14 items), target instrument size: 12 items (3 per factor)
TPN ACO	Cross-validation of TPN ACO model structure identified in Subsample 1
Singelis + TPN ACO	Cross-validation of the Singelis + TPN ACO model structure identified in Subsample 1
Subsample 3	
TPN (45 items)	Second cross-validation of Torres and Pérez-Nebra structure using ML estimator.
Model 4 (14 items)	Second cross-validation of Model 4 from subsample 1 (manually trimmed with alternative Torres and Pérez-Nebra structure as starting point)
ACO Model 4 (12 items)	Cross-validation of ACO application to manually trimmed model 4 (subsample 2)
TPN ACO	Second cross-validation of TPN ACO model structure identified in Subsample 1
Singelis + TPN ACO	Second cross-validation of the Singelis + TPN ACO model structure identified in Subsample 1
Singelis + TPN ACO (only 3 factors)	As the Singelis + TPN ACO model showed convergence issues, we manually identified problems with two items of VI subscale. The VI subscale was removed & the reduced model tested

Note. ACO = ant colony optimization.

Based on that model fit, as the next step we decided to apply manual model trimmings. There were two main issues upon inspection of the models. First, modification indices (MI) indicated substantive cross-loadings or correlated unique factors. Therefore, we used MI to identify those items that may have unique content that is not shared with the intended latent variable. As a threshold we used the chi-square statistic. We excluded any item that showed MI above the 5% threshold of the model χ^2. This heuristic of 5% was arbitrary and in line with other arbitrary decision thresholds in statistics (Brown, 2006). For correlated unique factors, we excluded the item that showed correlated unique factors with more than one other item above the 5% threshold. If this was not the case (correlated unique factors between a single item pair), we randomly selected one item. We then re-ran the model and re-examined fit. If the fit was not above our prespecified threshold, we re-evaluated MI with the 5% of the χ^2 as a threshold. If the fit was insufficient, but no MI was above the 5% threshold, we also examined R^2 values for the individual items. We excluded items that showed R^2 values below .10, which indicates that the items are not strongly related to the latent variable. We iterated these steps until a solution was found that showed an adequate fit.

A second parallel step was to set up an ant colony optimization (ACO) analysis. We combined the original Singelis et al. factor structure and the new items of Torres and Pérez-Nebra (2015) as starting point. We used the ShortForm R package (Raborn & Leite, 2018) and simulated 50 ants, specifying a pheromone evaporation rate of 95% and a step rate of 5,000 (number of simulated ants in a row for which the model does not change). Because initial runs of the CFA suggested very poor fit and estimation problems with the default values, we manually set the CFA to .5, the SRMR to .15, and RMSEA to .15 as cutoff criteria. These criteria are aligned with some of the poorer fitting models in previous research with this scale (Sivadas et al., 2008). Furthermore, we set the optimal item per factor to three. It is important that the ACO proceeded without considering specific model misfit and rather represents a random exploration of item combinations that maximize our prespecified criteria.

In Subsample 2, we first cross-validated the two ACO models from Subsample 1 as well as the final manually trimmed model. For the manually trimmed model (we assumed that more than three items would remain for each factor), we then used the ACO algorithm to identify a best-fitting model that has three items per dimension and follows our prespecified fit criteria. We again used the ShortForm package and simulated 20 ants, specifying a pheromone evaporation rate of 95% and a step rate of 2,000 (number of simulated ants in a row for which the model does not change). We set the maximum number of models to run to 20,000. Due to problems with model convergence in some of the analyses within each run when using higher thresholds, we set the CFI value to .8.

All ACO and manually trimmed models were then cross-validated in our third subsample. For comparison purposes, we also refitted (1) the original model using all items, (2) the model with non-normally distributed items removed, and (3) the optimal model from Subsample 1.

In summary, we used a sequence of exploratory CFAs and ACO with Subsample 1. In Subsample 2, we cross-validated the ACO models and conducted a further optimization procedure, and we then cross-validated all models with Subsample 3. We calculated reliability estimates using the semTools package (Jorgensen et al., 2018) (Table 2).

Results

Step 1: Baseline Results

The first step of analysis was conducted with Subsample 1. As presented in Table 3, none of the models fit well. The results with the Torres and Pérez-Nebra (2015) factor structure fitted marginally better, especially when using

Table 3. CFA-based reduction subsample 1

Step	χ^2	*df*	χ^2/df	CFI	TLI	RMSEA [90%]	SRMR
Singelis (29 items)	1,128.45	371	3.04	.58	.54	.06 [.06–.07]	.08
Singelis + TPN.a (45 items)	2,722.34	939	2.90	.49	.46	.06 [.06–.07]	.09
Singelis + TPN.b (45 items)	2,624.13	939	2.79	.62	.60	.06 [.06–.07]	.08
TPN.a (45 items)	2,638.44	939	2.81	.51	.49	.06 [.06–.07]	.08
TPN.b (45 items)	2,530.82	939	2.70	.64	.62	.06 [.06–.06]	.08
Singelis + TPN (29 items)	1,059.80	371	2.86	.62	.59	.06 [.06–.07]	.07
Singelis + TPN ACO	78.66	48	1.64	.89	.85	.04 [.02–.05]	.05
TPN ACO	93.89	48	1.95	.88	.84	.05 [.03–.06]	.05
Model 1 (29 items)	1,008.70	371	2.71	.65	.62	.06 [.06–.07]	.07
Model 2 (28 items)	784.88	344	2.28	.72	.70	.05 [.05–.06]	.06
Model 3 (18 items)	295.23	129	2.29	.86	.84	.05 [.05–.06]	.06
Model 4 – final (14 items)	133.65	71	1.88	.91	.88	.04 [.03–.06]	.05

Note. TPN = Torres and Pérez-Nebra (2015) model; TPN.a used ML estimator; TPN.b used WLSMVS estimator; Singelis = structure proposed by Singelis et al (1995), Singelis + TPN used the Singelis structure plus the newly created items; Singelis + TPN.b estimated using WLSMVS estimator; Singelis + TPN model fitted after removing 16 items for normality issues; Model 1 – removed 16 items for normality issues; Model 2 – removed one item with MI > 5% of χ^2; Model 3 – removed 10 items with $R^2 < .10$; Model 4 – removed four items with MI >5% of χ^2. ACO = ant colony optimization applied to either the Singelis structure with TPN items or TPN structure with new items.

the WLSMVS estimator. The original Singelis et al. factor structure either using only the original items or in combination with the newly developed items did not work well in our Brazilian sample.

Baseline CFA Results

Model Improvements and Manual Trimming

We first examined the distributional properties of the items in the full 45-item version. A total of 16 items showed substantive problems with non-normality. Of these items, 14 of them belonged to the horizontal collectivism dimension. The other items were from vertical collectivism and horizontal individualism, respectively. The two items with the highest normality issues were "I feel good when I cooperate with others" and "It is important for me to maintain harmony within my group." When rerunning this reduced item set with the Torres and Pérez-Nebra structure, fit remained well below commonly accepted thresholds. We therefore proceeded to trim the models using modification indices and explained the variance in individual indicators. The fourth model showed an acceptable fit with CFI above .90 and SRMR and RMSEA both below .06. This final model in Subsample 1 had already three items for the two individualism dimensions and for the horizontal collectivism dimension. The vertical collectivism dimension had five items.

Ant Colony Optimization

We set up two different ant colony optimization models, starting from either the Singelis et al. factor structure or from the Torres and Pérez-Nebra factor structure, always including the new items proposed for the Brazilian context. The two optimization structures converged when setting the thresholds to essentially poor fit. The Torres and Pérez-Nebra model showed a slightly better fit for this final 12-item model: $\chi^2(939) = 2,638.44$, CFI = .51, SRMR = .083, and RMSEA = .062, compared to the model starting from the Singelis et al. factor structure: $\chi^2(939) = 2,963.12$, CFI = .51, SRMR = .09, and RMSEA = .07.

First Cross-Validation Sample and Second ACO Application

We first ran the original full item set again using Subsample 2. The fit was poor (see Table 4). When we tested the best-fitting manually trimmed model, it showed a better fit. In fact, this manually trimmed model showed the best fit statistics, even when comparing with the ACO models trained on Subsample 1.

We then used the manually trimmed model from Subsample 1 and proceeded with the ACO approach (with 20 ants and evaporation of 95%). Restricting the final model to three items per dimension, the pattern remained similar and in fact showed a slightly worse fit when

Table 4. First cross-validation results in subsample 2

Step	χ^2	*df*	χ^2/df	CFI	TLI	RMSEA [90%]	SRMR
Original TPN (45 items)	2,547.04	939	2.71	.53	.51	.06 [.06–.06]	.09
Model 4 (14 items)	145.37	71	2.04	.87	.83	.05 [.04–.06]	.05
Model ACO (12 items)	107.18	48	2.23	.85	.79	.05 [.04–.07]	.05
Model ACO TPN[a]	143.28	48	2.99	.73	.63	.07 [.05–.08]	.07
Model ACO Singelis + TPN	98.86	48	2.06	.81	.74	.05 [.04–.06]	.05

Note. Estimator used: ML. Original Torres and Pérez-Nebra (2015) model; Model 4 is the same tested in Subsample 1. Model ACO (12 items) came from Model 4 where we remove two items using ACO. Model ACO ←TPN used the original TPN structure and applied ACO specifying a structure with 12 items; Model ACO ← Singelis + TPN we also specify to use 12 items based on the structure of Singelis with TPN where some items changed its factor[a]. This model shows issues with convergence. For more information, see Table 2.

Table 5. Second cross-validation in subsample 3

Step	χ^2	*df*	χ^2/df	CFI	TLI	RMSEA [90%]	SRMR
Original (45 items)	2,932.38	939	3.12	.52	.50	.07 [.07–.07]	.09
Model 4	177.24	71	2.50	.81	.76	.06 [.05–.07]	.06
Model ACO model 4	116.27	48	2.42	.84	.79	.06 [.04–.07]	.05
Model ACO TPN[a]	115.42	38	3.04	.81	.73	.07 [.05–.08]	.07
Model ACO Singelis + TPN[b]	67.06	48	1.40	.94	.92	.03 [.01–.05]	.04
Model ACO Singelis + TPN (3 factors)	24.67	24	1.03	.99	.99	.01 [.00–.04]	.03

Note. Model 4 is the same tested in Subsamples 1 and 2. Model ACO was fitted with 12 items. [a]We had to remove Item 25 due to convergence issues. [b]There were out-of-bound issues with two items of the VI subscale, the three factor solution excluded the VI subscale. For more information on the models, see Table 2.

considering CFI and TLI. However, the Akaike Information Criterion suggested a better fit for the ACO-optimized model compared to the final manually trimmed model from Step 1: AIC = 28,111 versus 32,926, respectively.

Second Cross-Validation Sample

We used the final subsample to cross-validate all our models (Table 5). For the sake of completeness and as a comparison base, we also report the original 45 item

Table 6. Items loadings and reliability estimates of the short forms in the final cross-validation in subsample 3

	ACO TPN (model 4)				ACO TPN				ACO Singelis-TPN[b]					
Item	HI	HC	VI	VC	HI	HC	VI	VC	HI	HC	VI	VC	SBN	TG
12 I am a unique individual (originally HI)	.37												x	
30 I enjoy being unique and different from the others in many ways	.23												x	
40[a] I like having power to influence others.	.55													
2 If a co-worker gets a price (prize) I would feel proud					.13								x	x
10 It annoys me when other people perform better than I do					.16 (R)						(.04)			(x)
26[R] I enjoy being unique and different from the others in many ways					.99								x	
4 What happens to me is my own doing									.51					
6 I like my privacy									.48					
8 I prefer to be direct and forthright when I talk with people									.34					
27 When I succeeded‘ it is usually because of my abilities		.38												
39[a] I like take my own decisions and be free to choose what I want to do		.66				.56								
41[a] I like to be creative and develop my own things in an original way		.48				.60				.53				
43[a] I am an independent person and not better or worse than others						.54				.57				
42[a] I like to feel that I am free to come and go without hindrance														
45[a] People should always follow rules that Benefit the workgroup, even when no one is watching.										.46				
14 I enjoy working in situations involving competition with others.			.67				.99				(.04)		x	
16 Competition is law of nature			.54										x	x
20 Winning is everything			.47											x
5 Without competition it is impossible to have a good society							.45						x	
24[R] Some people emphasize winning; I am not one of them							.12							
32[a] To succeed in life, I need to be smart and know how to overcome obstacles											2.76			
25 I would do what would please my family				.73				+				.58	(x)	
28 Before making a major trip‘ I consult with most members of my family and many friends				.37										
3 My happiness depends very much on the happiness of those around me (originally in HC)				−.08									x	
38[a] I prefer not to stand out or draw the attention of my workgroup to myself								.02						
44[a] It is my duty to always understand the needs and support the people I know								.09						
15 I would sacrifice an activity that I enjoy very much if my family did not approve of it												.58	x	
28 Before making a major trip‘ I consult with most members of my family and many friends												.46		
α	.34	.48	.56	.20	.33	.58	.42	.00	.40	.52	.27	.54		
ω	.34	.52	.57	.34	.61	.58	.56	.00	.42	.53	2.41	.54		

Note. [a]New items; R = reversed item; + removed to overcome convergence issues in Subsample 3; [b]loadings for the solution with out-of-bound issues, loading patterns for the three factor solution are comparable; SBN = Sivadas et al. (2008); TG = Triandis and Gelfand (1998); TPN = Torres and Pérez-Nebra (2015); ACO = ant colony optimization.

version as well as the manually trimmed model from Subsample 1 again. The ACO solution fits slightly better than the model identified in step or the original scale with all items. Yet, the fit was still not at acceptable levels for the CFI or TLI but showed acceptable levels for the RMSEA and SRMR. We also encountered convergence and out-of-bound issues with two of the best fitting models from the previous round.

Factor Loadings and Reliability

Table 6 shows the standardized factor loadings and reliability estimates of the three models that overall showed best statistical properties in Subsample 3. We are showing here the loadings of the final three models: the cross-validated Model 4, the cross-validated TPN-derived ACO model, and the reduced three factor structure of the cross-validated Singelis + TPN-derived ACO model. We also included an indication which of the items were part of the previous short versions of this instrument (Sivadas et al., 2008; Triandis & Gelfand, 1998). As presented in Table 6, loadings were of moderate size and some showed loadings contrary of what would be expected theoretically.

Similarly, the reliability estimates continue to show scope for improvement (see Table 6).

Discussion

We analyzed the psychometric properties of a widely used cultural inventory in a Brazilian sample using a data-driven approach to identify a short version that provides both better fit to data and is better aligned with theoretical expectations and can be used in future studies. As noted, there has been a relative neglect of psychometric examination of psychological instruments, and instruments measuring cultural orientations are no exception. Our results show overall poor fit and problematic reliability estimates for the original version, a previously adapted version and various short versions. We discuss some of the insights gained from both content and psychometric perspectives and discuss avenues forward.

First, the fit statistics of our model were not satisfactory according to widely used criteria. At the same time, our results converge with other studies. For example, Sivadas et al. (2008) reported an average CFI of .78, NFI of .62, and a RMSEA of .068 across five different student samples. These averages are lower (CFI, NFI) or within the range (RMSEA) of what we encountered in our study. This clearly demonstrates that there are bigger issues with the measure itself that need careful attention. If the aim is to construct a valid psychometric tool to be used to identify variation of individuals around cultural orientations, then future research needs to significantly improve on the measurement. If the aim is to simultaneously capture within and between cultural information, then variability within and between cultures needs to be examined.

This brings us to an important second observation: A substantive number of items showed limited variation as indicated by highly non-normal distributions. Most of these items came from the horizontal collectivism dimension. Previous studies have suggested that Brazilians tend to score high in collectivism in general (Hofstede, 1980; Hofstede, Hofstede, & Minkov, 2010; House et al., 2004) but also tend to be strongly focused in their in-groups, prefer group decision-making, and avoid conflicts to preserve group harmony (Bertsch & Ondracek, 2010; O'Keefe & O'Keefe, 2004), which suggest an orientation toward horizontal collectivism. The nearly uniformly high endorsement of these items means that these characteristics are highly important within Brazilian culture, but their utility for an individual difference measure is limited. This trade-off between cultural relevance and individual variability for developing individual-level constructs with adequate psychometric standards is a significant challenge. Other forms of item validation are needed when cross-national comparisons are of interest, and the non-normal distribution of the responses across samples would become meaningful information (but the quality of the item responses within Brazil would still need examination). An important insight from our analysis is that further measurement development must consider variability within and across different cultural samples.

A third observation is that different items have emerged across short scales reported previously. In our study using a bottom-up psychometric approach, none of the items from the widely used Triandis and Gelfand (1998) horizontal individualism and vertical collectivism scale remained. Only one item from the vertical individualism scale was consistently included across subsamples in our short versions. Finally, one horizontal collectivism item in the original version loaded on the horizontal individualism dimension in our study. The sensation of pride when a coworker gets a prize in our samples indicates an element of individualism, but one which emphasizes the moral equality between coworkers as individuals, instead of indicating group affiliation. These patterns suggest that future applications of this widely used scale need to proceed with great caution as the items may actually be understood differently by Brazilians compared to what was intended by the authors and, therefore, resulting mean scores are misleading.

Conceptually, the item content of the original scales and even more so in the brief versions need further work. For instance, the item "My happiness depends very much on the happiness of those around me" showed both positive and negative associations with other items in the different subsamples. These associations highlight that questions of well-being might carry both personal and group associations. Individuals may interpret the item as meaning that personal happiness arises when everyone in one's group is happy, or it may imply some normative component (e.g., "my well-being emerges by doing what the social norm requires me to do and I am happy doing what is important for my group despite the fact that I disagree"; see Tordera et al., 2020). Thus, the content of the items may have been appropriate for describing these cultural characteristics of samples in the 1990s in the US and selected Asian societies, but these items may be interpreted differently and therefore are capturing distinct cultural dynamics in Brazilian samples. Similar problems of limited coverage of collectivism in Western-based scales have been noted before (Györkös et al., 2013).

Elaborating on one further cultural feature that requires careful attention is the conceptualization of vertical collectivism as being predominantly oriented toward the family, which presumes that family represents hierarchy (Pérez-Nebra et al., 2023). For contemporary Brazilians, family may not necessarily represent an authority that requires submission but rather provides a supportive axis within an often harsh and hostile environment marked by decades of military repressions during the dictatorship, institutional discrimination, and notoriously high unemployment. Historically, Brazil featured a marked patriarchal and enslaving social structure, in which the patriarch had complete control and power over both the individual and property (Freyre, 1963) but also formed relationships based on informality and affection (Amado & Vinagre-Brasil, 1991; Da Matta, 1997). More recently, family structures may have served as a buffer in uncertain economic and social conditions, reinforcing two apparently opposing tendencies: great hierarchical distances *between* the different social classes but marked preferences for more informal and affectionate social relationships cutting across social classes (Da Matta, 1986). We encourage more conceptual work to identify vertical collectivism sources that can be included in future individual difference measures of cultural orientation in Latin America.

Limitations

Our study had some noted strengths such as using a broad and large sample beyond just using student samples and repeated cross-validation of empirically derived short versions using both traditional and modern psychometric tools. At the same time, our study is not without limitations. We ran into convergence issues in our cross-validation samples and failed to replicate factor structures. As outlined above, there may be conceptual issues with the scale itself and culture-specific interpretations that lead to weak domain relevance and representativeness (Fontaine, 2005). Therefore, our work highlights the importance of careful psychometric exploration and further conceptual development of cultural instruments in nonstudent samples.

A second limitation is that we employed a new metaheuristic computational approach. In Table 1, the comparison of trimmed models allowed us to suggest that our manually trimmed model performed slightly better in the cross-validation samples compared to the automatically derived computational models. Future work is needed to identify the best parameter values (e.g., simulated ants, evaporation rates, number of steps required) to work with instruments such as ours, which may show poor structural properties.

A further limitation is that we did not use external criteria to cross-validate the scale. We had initially intended to do so, but the poor structural parameters of the current instrument suggest that this step may have been premature. However, we strongly recommend future work to consider developing strong nomological networks, ideally with real-world behavior that can demonstrate the practical relevance of the cultural orientations for real-world phenomena. Such criteria could be implemented within the ACO (Olaru & Danner, 2021; Olaru et al., 2019; Schroeders et al., 2016) that we employed to simultaneously optimize instruments for structural and external validity parameters. It would also be important to more systematically investigate different causal structures that may underlie any measurement model (see https://pubmed.ncbi.nlm.nih.gov/34669630/) and work on stronger theoretical models of culture that can then be translated into psychometric measurements.

Conclusion

In summary, we used large samples and innovative methods to test the factor structure of a widely used instrument that is intended to measure individual differences in cultural orientation. Our results further demonstrate previously identified problems with the psychometric features of this instrument. We also identified issues with the score distributions and factor loadings that may indicate features of Brazilian culture that require attention in future work. Overall, our analyses suggest that the instrument is not fit for purpose, and our analyses highlight the need for simultaneous cross-cultural analyses if the aim is to develop a psychometric tool of cultural orientations that captures relevant features both within and across cultures.

References

Akira Miura, M., Pilati, R., Lemos Milfont, T., Cristina Ferreira, M., & Fischer, R. (2019). Between simpatia and malandragem: Brazilian jeitinho as an individual difference variable. *PLoS ONE*, *14*(4), Article 0214929. https://doi.org/10.1371/journal.pone.0214929

Amado, G., & Vinagre-Brasil, H. V. (1991). Organizational behaviors and cultural context: The Brazilian "Jeitinho." *International Studies of Management and Organization*, *21*(3), 38–61. https://doi.org/10.1080/00208825.1991.11656561

Barbosa, L. (2006). *O jeitinho brasileiro: A arte de ser mais igual do que os outros* [The Brazilian Jeitinho: The art of being more equal than others]. Campus.

Bertsch, A., & Ondracek, J. (2010). The risks and rewards of doing business in Brazil: Can Brazil escape the fate of Greece? Mountain Plains. *Journal of Business and Economics*, *11*(1), 23–42.

Blum, C., & Roli, A. (2003). Metaheuristics in combinatorial optimization. *ACM Computing Surveys*, *35*(3), 268–308. https://doi.org/10.1145/937503.937505

Brislin, R. W., Lonner, W., & Thorndike, R. M. (1973). *Cross-cultural research methods*. Wiley.

Brown, T. A. (2006). *Methodology in the social sciences: Confirmatory factor analysis for applied research*. Guilford Press.

Cândido, A. (1972). The Brazilian family. In T. L. Smith, & A. Marchant (Eds.), *Brazil: Portrait of half a continent* (pp. 291–312). Greenwood Press.

Da Matta, R. (1986). *O que faz o brasil, Brasil?* [What does brazil, Brazil?] Rocco.

Da Matta, R. (1997). *Carnavais, malandros e heróis: Para uma sociologia do dilema brasileiro* [Carnaval, rogues, and heroes: For a sociology of the Brazilian dilemma]. Rocco.

Dessen, M. A., & Torres, C. V. (2019). Family and socialization factors in brazil: An overview. *Online Readings in Psychology and Culture*, *6*(3), 2–19. https://doi.org/10.9707/2307-0919.1060

Dorigo, M., Maniezzo, V., & Colorni, A. (1996). Ant system: Optimization by a colony of cooperating agents. *IEEE Transactions on Systems, Man, and Cybernetics, Part B (Cybernetics)*, *26*(1), 29–41. https://doi.org/10.1109/3477.484436

Dorigo, M., & Stützle, T. (2004). *Ant colony optimization*. MIT Press.

Ferreira, M. C., Fischer, R., Porto, J. B., Pilati, R., & Milfont, T. L. (2012). Unraveling the mystery of Brazilian Jeitinho: A cultural exploration of social norms. *Personality and Social Psychology Bulletin*, *38*(3), 331–344. https://doi.org/10.1177/0146167211427148

Field, A., Miles, J., & Field, Z. (2012). *Discovering statistics using R*. Sage.

Fischer, R., & Ferreira, M. C. (2023). Culture and organizations: Theoretical and methodological perspectives. In M. J. Gelfand, & M. Erez (Eds.), *The Oxford handbook of cross-cultural behavior* (pp. 22–58). Oxford Press.

Fischer, R., Ferreira, M. C., Assmar, E., Redford, P., Harb, C., Glazer, S., Cheng, B.-S., Jiang, D.-Y., Wong, C. C., Kumar, N., Kärtner, J., Hofer, J., & Achoui, M. (2009). Individualism-collectivism as descriptive norms. *Journal of Cross-Cultural Psychology*, *40*(2), 187–213. https://doi.org/10.1177/0022022109332738

Fischer, R., Ferreira, M. C., Milfont, T., & Pilati, R. (2014). Culture of corruption? The effects of priming corruption images in a high corruption context. *Journal of Cross-Cultural Psychology*, *45*(10), 1594–1605. https://doi.org/10.1177/0022022114548874

Fischer, R., & Fontaine, J. R. J. (2011). Methods for investigating structural equivalence. In D. Matsumoto, & F. J. R. van de Vijver (Eds.), *Cross-cultural research methods in psychology* (pp. 179–215). Cambridge University Press.

Fischer, R., Karl, J. A., & Pilati, R. (2022). Cultural syndromes in a changing world: A longitudinal investigation of Brazilian Jeitinho social problem-solving strategies. *Personality and Social Psychology Bulletin*, *48*(10), 1423–1437. https://doi.org/10.1177/01461672211043385

Fischer, R., & Pilati, R. (2024). *A Psicologia do Jeitinho Brasileiro* [The psychology of the Brazilian jeitinho]. Editora Universidade de Brasília.

Fontaine, J. R. J. (2005). Equivalence. In K. Kempf-Leonard (Ed.), *Encyclopedia of social measurement* (pp. 803–813). Elsevier. https://doi.org/10.1016/B0-12-369398-5/00116-X

Freyre, G. (1963). *Casa grande & senzala* [The big house and the house of slaves] (12th ed.). Universidade de Brasilia.

Gelfand, M. J., Jackson, J. C., Pan, X., Nau, D., Pieper, D., Denison, E., Dagher, M., Van Lange, P. A. M., Chiu, C. Y., & Wang, M. (2021). The relationship between cultural tightness–looseness and COVID-19 cases and deaths: A global analysis. *The Lancet Planetary Health*, *5*(3), e135–e144. https://doi.org/10.1016/S2542-5196(20)30301-6

Gouveia, V. V. (1998). *La naturaleza de los valores descriptores del individualismo y del colectivismo: Una comparación intra e intercultural* [The nature of the descriptor values of individualism and collectivism: An intra- and cross-cultural comparison]. Universidade Complutense de Madrid.

Györkös, C., Becker, J., Massoudi, K., Antonietti, J.-P., Pocnet, C., de Bruin, G. P., & Rossier, J. (2013). Comparing the horizontal and vertical individualism and collectivism scale and the Auckland individualism and collectivism scale in two cultures. *Cross-Cultural Research*, *47*(3), 310–331. https://doi.org/10.1177/1069397112470371

Hofstede, G. (1980). *Culture's consequences*. Sage.

Hofstede, G., Garibaldi de Hilal, A. V., Malvezzi, S., Tanure, B., & Vinken, H. (2010). Comparing regional cultures within a country: Lessons from Brazil. *Journal of Cross-Cultural Psychology*, *41*(3), 336–352. https://doi.org/10.1177/0022022109359696

Hofstede, G., Hofstede, G. J., & Minkov, M. (2010). Cultures and organizations: Software of the mind (3rd ed.). McGraw-Hill. https://doi.org/10.1007/s11569-007-0005-8

House, R. J., Hanges, P. J., Javidan, M., Dorfman, P. W., & Gupta, V. (2004). *Culture, leadership and organizations: The GLOBE study of 62 societies*. Sage.

Jorgensen, T. D., Pornprasertmanit, S., Schoemann, A., Rosseel, Y., Miller, P., Quick, C., Garnier-villarreal, M., Selig, J., Boulton, A., Preacher, K. J., Enders, C., Clinton, B., Merkle, E., & Mansolf, M. (2018). *Package semTools version 0.5-1*. https://cran.r-project.org/web/packages/semTools/semTools.pdf

Leite, W. L., Huang, I.-C., & Marcoulides, G. A. (2008). Item selection for the development of short forms of scales using an ant colony optimization algorithm. *Multivariate Behavioral Research*, *43*(3), 411–431. https://doi.org/10.1080/00273170802285743

Matsunaga, M. (2010). How to factor-analyze your data right: do's, don'ts, and how-to's. *International Journal of Psychological Research*, *3*(1), 97–110. https://doi.org/10.21500/20112084.854

Minkov, M. (2018). A revision of Hofstede's model of national culture: Old evidence and new data from 56 countries. *Cross Cultural & Strategic Management*, *25*(2), 231–256. https://doi.org/10.1108/CCSM-03-2017-0033

Muthukrishna, M., Bell, A. V., Henrich, J., Curtin, C. M., Gedranovich, A., McInerney, J., & Thue, B. (2020). Beyond Western, Educated, Industrial, Rich, and Democratic (WEIRD) psychology: Measuring and mapping scales of cultural and psychological distance. *Psychological Science*, *31*(6), 678–701. https://doi.org/10.1177/0956797620916782

O'Keefe, H., & O'Keefe, W. M. (2004). Business behaviors in Brazil and the USA: Understanding the gaps. *International Journal of*

Social Economics, *31*(5/6), 614–622. https://doi.org/10.1108/03068290410529425

Olaru, G., & Danner, D. (2021). Developing cross-cultural short scales using ant colony optimization. *Assessment*, *28*(1), 199–210. https://doi.org/10.1177/1073191120918026

Olaru, G., Schroeders, U., Hartung, J., & Wilhelm, O. (2019). Ant colony optimization and local weighted structural equation modeling. A tutorial on novel item and person sampling procedures for personality research. *European Journal of Personality*, *33*(3), 400–419. https://doi.org/10.1002/per.2195

Pérez-Nebra, A. R., Pedersoli, M., Rodrigues, A., Rodrigues, C. M. L., & Queiroga, F. (2023). Recovery Experience Questionnaire: Validity evidence of the Brazilian-Portuguese version. *Ciência & Saúde Coletiva*, *28*(11), 3383–3394. https://doi.org/10.1590/1413-812320232811.13692022

Pérez-Nebra, A. R., Tordera, N., Rodríguez, I., Sandall, H., Peiró, J. M., & de São Paulo, E. (2023). Individualism-collectivism: A Brazilian-Portuguese version of Triandis and Gelfand's scale. *Trends in Psychology*, *31*(2), 251–268. https://doi.org/10.1007/s43076-023-00275-x

Pilati, R., & Fischer, R. (2022). An exploration of within-cultural differences of a culture-specific syndrome: The case of Brazilian jeitinho. *Cross-Cultural Research*, *56*(5), 423–444. https://doi.org/10.1177/10693971221086818

Pilati, R., Milfont, T. L., Ferreira, M. C., Porto, J. B., & Fischer, R. (2011). Brazilian jeitinho: Understanding and explaining an indigenous psychological construct. *Interamerican Journal of Psychology*, *45*(1), 29–38.

Ponizovskiy, V., Grigoryan, L., Kühnen, U., & Boehnke, K. (2019). Social construction of the value–behavior relation. *Frontiers in Psychology*, *10*, Article 934. https://doi.org/10.3389/fpsyg.2019.00934

Raborn, A. W., & Leite, W. L. (2018). ShortForm: An R Package to select scale short forms with the ant colony optimization algorithm. *Applied Psychological Measurement*, *42*(6), 516–517. https://doi.org/10.1177/0146621617752993

Rosseel, Y., Jorgensen, T. D., Rockwood, N., Oberski, D., Byrnes, J., Vanbrabant, L., Savalei, V., Merkle, E., Hallquist, M., Barendse, M., & Scharf, F. (2023). *Package lavaan*. https://lavaan.ugent.be

Schroeders, U., Wilhelm, O., & Olaru, G. (2016). Meta-heuristics in short scale construction: Ant colony optimization and genetic algorithm. *PLoS ONE*, *11*(11), Article e0167110. https://doi.org/10.1371/journal.pone.0167110

Singelis, T. M., Triandis, H. C., Bhawuk, D. P. S., & Gelfand, M. J. (1995). Horizontal and vertical dimensions of individualism and collectivism: A theoretical and measurement refinement. *Cross-Cultural Research*, *29*(3), 240–275. https://doi.org/10.1177/106939719502900302

Sivadas, E., Bruvold, N. T., & Nelson, M. R. (2008). A reduced version of the horizontal and vertical individualism and collectivism scale: A four-country assessment. *Journal of Business Research*, *61*(3), 201–210. https://doi.org/10.1016/j.jbusres.2007.06.016

Smith, P. B., Dugan, S., Peterson, M. F., & Leung, K. (1998). Individualism-collectivism and the handling of disagreement: A 23 country study. *International Journal of Intercultural Relations*, *22*(3), 351–367. https://doi.org/10.1016/S0147-1767(98)00012-1

Smith, P. B., Fischer, R., Vignoles, V. L., & Bond, M. H. (2013). How to do cross-cultural psychology. In P. B. Smith, R. Fischer, V. L. Vignoles, & M. H. Bond (Eds.), *Understanding social psychology across cultures: Engaging with others in a changing world* (pp. 73–107). Sage.

Smith, P. B., Torres, C. V., Hecker, J., Chua, C. H., Chudzikova, A., Degirmencioglu, S., Donoso-Maluf, F., Feng, N. C. Y., Harb, C., Jackson, B., Malvezzi, S., Mogaji, A., Pastor, J. C., Perez-Floriano, L., Srivastava, B. N., Stahl, G., Thomason, S., & Yanchuk, V. (2011). Individualism-collectivism and business context as predictors of behaviors in cross-national work settings: Incidence and outcomes. *International Journal of Intercultural Relations*, *35*(4), 440–451. https://doi.org/10.1016/j.ijintrel.2011.02.001

Smith, P. B., Torres, C. V., Leong, C. H., Budhwar, P., Achoui, M., & Lebedeva, N. (2012). Are indigenous approaches to achieving influence in business organizations distinctive? A comparative study of guanxi, wasta, jeitinho, svyazi and pulling strings. *International Journal of Human Resource Management*, *23*(2), 333–348. https://doi.org/10.1080/09585192.2011.561232

Soh, S., & Leong, F. T. L. (2002). Validity of vertical and horizontal individualism and collectivism in Singapore: Relationship with values and interests. *Journal of Cross-Cultural Psychology*, *33*(1), 3–15. https://doi.org/0.1177/0022022102033001001

Tamayo, Á., & Schwartz, S. H. (1993). Estrutura motivacional dos valores humanos [The motivational structure of human values]. *Psicologia:Teoria e Pesquisa*, *9*(2), 329–348.

Taras, V., Kirkman, B. L., & Steel, P. (2010). Examining the impact of culture's consequences: A three-decade, multilevel, meta-analytic review of Hofstede's cultural value dimensions. *Journal of Applied Psychology*, *95*(3), 405–439. https://doi.org/10.1037/a0018938

Taras, V., Rowney, J., & Steel, P. (2009). Half a century of measuring culture: Review of approaches, challenges, and limitations based on the analysis of 121 instruments for quantifying culture. *Journal of International Management*, *15*(4), 357–373. https://doi.org/10.1016/j.intman.2008.08.005

Tordera, N., Pérez-Nebra, A. R., Torres, C. V., Villajos, E., & Latorre, F. (2020). La importancia de los valores en el estudio del bienestar laboral/The importance of the values in the wellbeing at work field. In E. Lira (Ed.), *Bienestar social: Organizaciones saludables* (pp. 75–82). Tirant lo Blanch.

Torelli, C. J., & Shavitt, S. (2010). Culture and concepts of power. *Journal of Personality and Social Psychology*, *99*(4), 703–723. https://doi.org/10.1037/a0019973

Torres, C. V., & Pérez-Nebra, A. R. (2015). Evaluación del individualismo-colectivismo vertical-horizontal en Brasil: Una propuesta de medida [Assessment of vertical-horizontal individualism-collectivism in Brazil: A proposal for measurement]. *Perspectivas En Psicología*, *12*(2), 9–21.

Torres, C. V., Schwartz, S. H., & Nascimento, T. G. (2016). A Teoria de Valores Refinada: Associações com comportamento e evidências de validade discriminante e preditiva [The refined values theory: Associations with behavior and evidence of discriminant and predictive validity]. *Psicologia USP*, *27*(2), 341–356. https://doi.org/10.1590/0103-656420150045

Triandis, H. C. (1994). Cross-cultural industrial and organizational psychology. In H. C. Triandis, M. D. Dunnette, & L. M. Hough (Eds.), *Handbook of industrial and organizational psychology* (4th ed., pp. 103–172). Consulting Psychologists Press.

Triandis, H. C., & Gelfand, M. J. (1998). Converging measurement of horizontal and vertical individualism and collectivism. *Journal of Personality and Social Psychology*, *74*(1), 118–128. https://doi.org/10.1037/0022-3514.74.1.118

van de Vijver, F. J. R., & Leung, K. (2011). Equivalence and bias: A review of concepts, models, and data analytic procedures. In D. Matsumoto & F. J. R. van de Vijver (Eds.), *Handbook of cross-cultural research methods* (pp. 17–45). Cambridge University Press.

History
Received December 14, 2022
Revision received November 8, 2023
Accepted November 23, 2023
Published online January 3, 2024

Section: Miscellaneous/Other

Conflict of Interest
We have no conflict of interest to disclose.

Publication Ethics

All procedures in the study were performed in accordance with the ethical standards of the Institute of Psychology of the University of Brasília – Brazil, and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards. Informed consent was obtained from all individual adult participants included in the study.

Open Science

We hereby confirm that we have access to the original data on which the article reports.

Funding

The authors received financing from Brazilian Ministry of Education's Coordination for the Improvement of Higher Education Personnel – CAPES, in the Academic Cooperation Program in Public Security and Forensic Sciences (Grant 88881.516167/2020-01 – CAPES/PROCAD).

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