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Psychometric Study of the Cognitive Flexibility Inventory in a Colombian Sample

Propiedades psicométricas del Inventario de Flexibilidad Cognitiva en una muestra colombiana

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Abstract.

Introduction: A cross-sectional descriptive study was conducted to evaluate the factor structure of Spanish translation and adaptation of the Cognitive Flexibility Inventory (CFI) in a sample of Colombian adults. **Method:** The sample of the study was $n = 968$. Respondents were aged between 18 and 52 years old ($M_{age}=22.81$, $SD=4.42$). Descriptive analyses, confirmatory factor analysis, and Cronbach's Alpha calculation were carried out. **Results:** Internal consistency for the global scale was high ($\alpha=.89$). Likewise, the coefficients of the Alternative factor and the Control factor were similar ($\alpha=.90$, 95% CI=.89-.90 and $\alpha=.83$, 95% CI=.81-.85, respectively). A two-factor structure performed best according to the results of model selection criteria. This model suggested the existence of two correlated factors, with correlated items within factors (Item19~Item20 and Item8~Item10). **Conclusions:** Overall, the results suggest that the CFI scale exhibits construct validity and adequate reliability, both for the general scale and the subscales in the Colombian sample, enabling their use in contexts such as clinical or research.

Resumen.

Introducción: Se realizó un estudio descriptivo transversal para evaluar la estructura factorial de la traducción al español y adaptación del Inventario de Flexibilidad Cognitiva (Cognitive Flexibility Inventory - CFI) en una muestra de adultos colombianos. **Método:** La muestra del estudio fue de $n = 968$. La edad de los participantes osciló entre los 18 y 52 años ($M_{edad}=22.81$, $SD=4.42$). Se llevaron a cabo análisis descriptivos, además del análisis factorial confirmatorio y el cálculo de Alpha de Cronbach. **Resultados:** Los resultados mostraron que la consistencia interna para la escala global fue alta ($\alpha=.89$). Asimismo, los coeficientes del factor Alternativas y del factor Control fueron similares ($\alpha=.90$, IC del 95%=.89-.90 y $\alpha=.83$, IC del 95%=.81-.85, respectivamente). Una estructura de dos factores presentó un buen ajuste de los datos, de acuerdo con los valores de los criterios de selección del modelo. Este modelo sugirió la existencia de dos factores, con elementos correlacionados dentro de estos (Item19~Item20 e Item8~Item10). **Conclusiones:** En general, los resultados sugieren que el inventario CFI muestra una fiabilidad adecuada, tanto para la escala general como para las subescalas y validez de constructo en la muestra colombiana, permitiendo su uso en posibles contextos como el clínico o la investigación.

Keywords.

Cognitive Flexibility Inventory, Construct Validity, Factor Analysis, Internal Consistency, Reliability.

Palabras Clave.

Inventario de Flexibilidad Cognitiva, Validez de constructo, Análisis factorial, Consistencia interna, Confiabilidad.

1. Introduction

Cognitive flexibility (CF) is an important variable to assess since it is an indicator of problem-solving ability, allows generating responses with an adequate degree of inhibitory control, and permits creating a significant number of alternatives from a single solution. Interpersonally, CF allows to establish personal relationships as it helps to combine one's wishes with others' wishes or points of view and seeks lasting solutions (Maddio & Greco, 2010). CF has been widely studied and considered from different perspectives, as a skill and as a property of the cognitive system (Ionescu, 2017). Currently, there is no consensus on a single definition of this variable. However, it is generally conceived as the ability to modify cognitive strategies or the way of thinking in response to changes in the environment or context (Moore & Malinowski, 2009; Stemme et al., 2007). Consequently, it is the specific way in which competence is assessed that differentiates between the various measures of cognitive flexibility (Dennis & Vander Wal, 2010).

CF has been frequently conceived and evaluated as a neuropsychological variable (Nweze et al., 2020; Van Stockum & DeCaro, 2020; Webler et al., 2019). From this approach, it is considered one of the most demanding of the executive functions, related to cognitive control processes, through which a person can flexibly adapt to new tasks or demands, change perspective or approach regarding a problem, and alternate between mental sets or ways of thinking about stimuli (Dajani & Uddin, 2015; Diamond, 2013; Zaehring et al., 2018). Further, CF also has been conceived as the ability to change cognitive content or thinking to adapt to changing environmental stimuli (Dennis & Vander Wal, 2010). In this sense, according to Dennis and Vander Wal (2010), CF includes a wide range of behaviors that allow people to have a more adaptive thinking and coping when facing situations or events that are stressful, which is an essential component in life. This is the definition considered in the present study.

As can be seen, this conception of CF is related to the concept of coping. In fact, Dennis and Vander Wal (2010) reported that there is evidence of convergent construct validity after finding correlations with some subscales of the Ways of Coping Checklist-Revised (WCCLR; Folkman & Lazarus, 1985). Studies such as Kruczek et al. (2020) and Muyan-Yılık and Demir (2020) have shown positive correlation and direct effects between these variables. However, some studies have established that they are different concepts at the theoretical and empirical levels, showing that cognitive flexibility is just a component of a larger concept known as coping flexibility, which refers to the ability to modify coping strategies according to the level of effectiveness when dealing with a stressful situation (Cheng, 2014; Górska & Bańska, 2019; Kato, 2012; Kruczek et al., 2020).

In line with the foregoing, CF has tended to be assessed through neuropsychological measures that require a trained person for their administration, such as the Wisconsin Card Sorting Test (Heaton et al., 1993) and the Trail Making Test Part B (Reitan & Wolfson, 1993). Likewise, there are some self-report tests such as the Behavior Rating Inventory of Executive Function (BRIEF; Gioia et al., 2000) that define cognitive flexibility as a neuropsychological variable. These measures generally configure deficits on CF as an indicator of alterations in the brain.

However, there are other self-report measures that are oriented to assess CF as a reaction to affective states that indicate the type of skill required for the restructuring of maladaptive thoughts (Dennis & Vander Wal, 2010). One of them is the Cognitive Flexibility Inventory (CFI) by Dennis and Vander Wal (2010). This instrument consists of 20 items designed to assess CF aspects that allow people to think adaptively rather than maladaptively when facing stressful events. The inventory has two subscales or dimensions resulting from factor analysis: Control and Alternatives.

The first dimension refers to the ability or tendency to perceive difficult situations as controllable; the second one, to the ability to perceive multiple alternative explanations for human behavior and situations in life, and the ability to generate multiple alternative solutions to difficult situations. The instrument exhibits adequate levels of internal consistency with α values ranging between .84 and .91. Similarly, test-retest reliability evaluation for the total scale and the subscales has also proved to be adequate ($r = .75-.81$; $p < .001$; Dennis & Vander Wal, 2010).

In addition, traditional tests that measure cognitive flexibility as performance require interactive relationships between test administrator and test participant or patient and need more time to administer and score. The CFI and, in general, the self-report measures offer some advantages such as not depending on an evaluator, greater practicality when using them in studies that involve some type of psychological treatment, brevity, and ease of administration and rating (Dennis & Vander Wal, 2010; Kurginyan & Osavolyuk, 2018). This explains why this instrument has been used in numerous studies in different contexts, and has been translated into various languages such as Turkish, Polish, Russian, and Japanese (Caldwell et al., 6; Demirtas & Yildiz, 2019; Kurginyan & Osavolyuk, 2018; Odac & Cikrikci, 2019; Rudnik et al., 2019; Shah, 2019; Shapero et al., 2018).

Regarding possible differences in the CFI in terms of sociodemographic variables, some studies such as Shapero et al. (2018) found no differences in terms of age and gender; others such as Eldesouky and English (2018) found negative relationships between age and CF; Rudnik et al. (2019) found negative relationships between the range of alternatives and age, but not in terms of

gender. That is why studies such as those of Kurginyan and Osavolyuk (2018) point to the need to carry out more balanced studies at taking into account variables such as gender, in order to evaluate the differences in these variables in the total scale and its subscales.

However, no extant studies have sought to translate the CFI into Spanish and apply it to samples in Spanish speaking countries. Therefore, the present study aims to evaluate the factor structure of the Spanish translation and adaptation of the CFI in a sample of Colombian adults. We hypothesized that the CFI has construct validity and is a reliable instrument to assess cognitive flexibility as defined by Dennis and Vander Wal (2010). The analysis focuses on the factorial structure of the CFI, its internal consistency, and the assessment of the differences regarding sociodemographic variables such as gender and age.

2. Method

2.1 Participants

A total of 970 individuals from different Colombian (South America) territories participated in this study. Two of these individuals were removed from the sample because of missing data, resulting in a final sample size of 968. According to Bentler and Chou (1987), the factor analysis requires a minimum sample size of 10 observations per item to process data. Likewise, authors such as Morata et al. (2015) recommend samples greater than 250, in order to avoid Type I error, according to RMSEA. The original study that described and evaluated the psychometric properties of the CFI used a sample of 196 people (Dennis & Vander Wal, 2010). Based on the above, the authors decided, for the present study, to expand the sample size to maximize confidence in model fit.

The inclusion criteria for age and residence were the following: 18 years of age or older, so the participant was able to write and read, and to reside in Colombia. All participants who did not meet these criteria were excluded from the study. The sampling used in the study was non-probabilistic and intentional. The main collection points for the sample were university campuses.

Regarding the gender of the participants, 52.79% identified themselves as women, 45.97% as men, and 1.24% as other. The ages of the participants were between 18 and 52 years old ($M_{\text{age}}=22.81$, $SD=4.42$). About the occupation of the participants, 67% were students, 18.70% were employed, 8.26% were self-employed, 4.03% were studying and working at the same time, and 1.34% were unemployed. Regarding religious belief, 485 participants (50.10%) did not practice any religion, 386 (39.88%) identified themselves as Catholic, 69 (7.13%) as Evangelicals, and 28 of them (2.89%) practiced another religion. In terms of place of residence, 601 (62.09%) lived in cities in the north of Colombia; 194 (20.04%), in cities in the central western area of Colombia; and

173 (17.87%), in the capital city. In this study, gender and age were considered to analyze possible differences in the CFI, as mentioned in the introduction of this manuscript. On the other hand, the variables of religious beliefs, place of residence, and occupation played a descriptive role in the sample.

2.2 Procedure

A cross-sectional descriptive study was performed to evaluate the factor structure of the CFI Spanish version in Colombia. A translation of the CFI from English to Spanish was carried out (See Table S1). Following best-practice guidelines (Escobar-Pérez & Cuervo-Martínez, 2008; González-Consuegra & Verdú, 2010; Hambleton & Zenisky, 2010; Muñoz et al., 2013), this translation was carried out by a native English speaker and then the Spanish version was back-translated into English by a native speaker. There were no significant differences in meaning between the two versions, so these were synthesized into one. Then, the translated CFI was reviewed by seven bilingual expert judges (six of them with a Ph.D. degree and one was a Ph.D. candidate). The next stage involved the application of the instrument to a group of 10 people with similar characteristics to the study sample to assess the understanding of the items. All the participants understood all items in this version of the CFI, according to the cognitive interviews which were carried out.

The application of the CFI was carried out in classrooms and places that were arranged for the process. Each participant read and completed the informed consent, where the purposes, and aspects such as confidentiality, anonymity, voluntariness, and that their participation did not contemplate any direct reward were explained. Consequently, participants completed a short sociodemographic questionnaire and the CFI. In some cases, participants completed the questionnaire using a computer or smartphone. The questionnaire had a digital version that, regarding the content and response options, was equivalent to the paper and pencil version. Contact was maintained in real-time with the person completing the questionnaire to be able to resolve doubts and manage the application time. The questionnaire session required approximately 10 minutes to complete.

2.3 Instrument

CFI (Dennis & Vander Wal, 2010) is a scale of 20 self-report items. It was designed to measure the tendency to perceive difficult situations as controllable, the ability to perceive multiple alternatives or solutions to difficult situations, and the ability to generate multiple alternative solutions for difficult situations. Each statement is rated by the participant from 1 (Strongly disagree) to 7 (Strongly agree). In their original work, Dennis and Vander Wal (2010) found a two-factor structure (Control and Alternatives) and adequate internal consistency

when evaluated in two stages (test-retest). Cronbach's alpha for the scale is .90 (time 1) and .91 (time 2); for the alternative subscale .91 (time 1 and 2); and for the control subscale .86 (time 1) and .84 (time 2). Some examples in the Alternatives dimension are "I consider multiple options before making a decision" and "It is important to look at difficult situations from many angles". Some Control dimension items are "I feel I have no power to change things in difficult situations" and "I am capable of overcoming the difficulties in life that I face" (See Table S1). Studies by Kurginyan and Osavolyuk (2018) and Shareh et al. (2014) confirmed that the scale has adequate psychometric properties.

2.4 Ethical Approval

The present study corresponded to an investigation with minimal risk as established in resolution 8430 of 1993, chapter I, article 11 of the Ministry of Health of Colombia (Ministerio de Salud, 1993), since it only requires the registration of data through an inventory/psychological test in which no intervention was performed. Further, the application of the CFI was contemplated within a research project that was approved by the Ethics Committee of the Universidad Del Norte in Barranquilla, Colombia (act # 172). Therefore, it was deemed that there were no procedures that could affect the physical or psychological integrity of the participants. All the people who voluntarily decided to participate in the research previously completed an informed consent document where they were made aware of the conditions and characteristics of the study.

2.5 Statistical Analysis

All statistical analyses were performed in R version 3.6.1 (The R Foundation, 2019); confirmatory factor analysis was performed using the Lavaan and Psych packages (Rosseel, 2012) available for that software. The internal consistency of the CFI was calculated using Cronbach's α . Following salient recommendations in the extant CFI literature, the scoring procedures specified for the scale require reverse scoring of select items (Items 2, 4, 7, 9, 11, and 17).

The result of the KMO test was .93, Bartlett's test applied to the correlation matrix was $\chi^2 = 8196.783$, $p < .001$ (from principal components analysis - PCA) (Figure 1), and the Mardia test result did not confirm a multivariate normal distribution ($skew = 9236.53$, $p < .001$; $kurtosis = 111.91$, $p < .001$). Given this, it is also not possible to ensure that FC behaves as a continuous variable. Therefore, we used a robust version of maximum likelihood (ML), due to its relatively unbiased standard error estimates, good recovery of the population inter-factor correlations (Cheng-Hsien, 2015), better control of Type I error, and better performance if it is compared with ML in non-normal distribution conditions (Bandalos, 2014),

because it considers the deviation of the multinormality in the variables (Herrero, 2010).

We developed eight models and evaluated their performance to determine which of them had the best fit. We used confirmatory factor analysis (CFA) to determine the goodness of fit of models. To maximize confidence in parameter estimation and model fit, without depending only on the sample size criterion based on the statistical significance of χ^2 , we invoked other fit indices that allowed us to penalize complexity measured in terms of the number of adjustable parameters of the asymptotic chi-square test: the Bayesian information criterion (BIC), Akaike's information criterion (AIC), the comparative fit index (CFI), the non-normed fit index (NNFI), the root mean square error of approximation (RMSEA), and the standardized root mean square residual (SRMR).

It was assumed that RMSEA values over .10 would suggest an unacceptable model fit; values below .05 would indicate a close model fit. SRMR values below .08 suggest an acceptable model fit. CFI and NNFI are bound between 0 and 1; values greater than .95 suggest a close model fit. The model with the lowest value of AIC and BIC among the candidate factorial models was selected as the best model (Cangur & Erca, 2015; Kline, 2016; MacCallum et al., 1996; Schulz et al., 2011).

3. Results

3.1 Confirmatory Factor Analysis

We developed eight models with different structures and assessed their goodness of fit using criteria described in the Method section. Values of χ^2 and df are displayed for each model (see Table 1).

Model 1 considered the existence of two independent factors from PCA, F1, and F2 with no correlation between them allowed, whilst Model 2 allowed these correlations. Model 3 considered the existence of two independent factors from the original scale distribution of items, F1 and F2 with no correlation between them allowed, whilst Model 4 allowed these correlations. Models 5 and 6 were similar to Model 4, but in addition to allowing correlations between factors, they also include correlations between items within factors. Specifically, in Model 5 we considered a two-factor structure and allowed items 19 and 20 to be correlated; in Model 6 these correlations were allowed and also the correlations between items 8 and 10. These correlations were allowed following the model modification indices obtained by the Lavaan package (Rosseel, 2012). We followed the recommendations of MacCallum et al. (1992) and Whittaker (2012), who consider this process appropriate as long as it has theoretical coherence. In this case, the items were part of the same factor and had a high similarity regarding format and content. Model 7 considered the ex-

Table 1

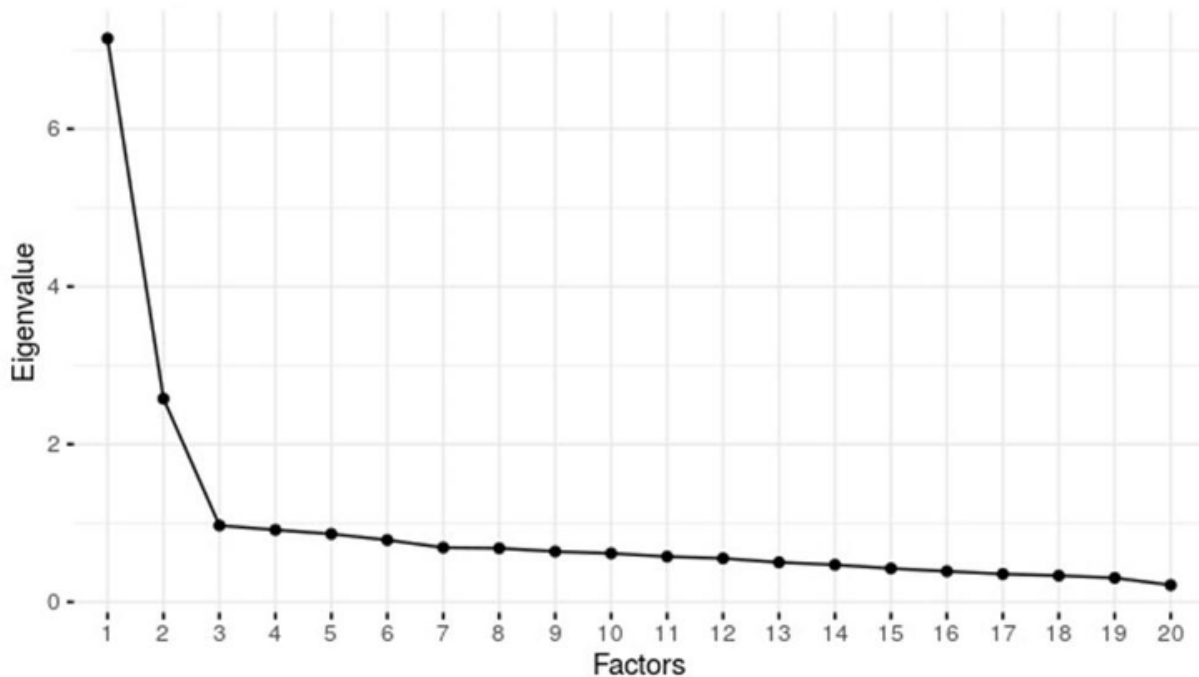
Confirmatory Factor Analysis of the CFI in a Colombian Sample

Model	Description	χ^2	df	NNFI	CFI	RMSEA	SRMR	AIC	BIC
1	2 independent factors from PCA	690.201	170	.897	.907	.056	.134	60489.17	60684.18
2	2 correlated factors from PCA	569.918	169	.914	.923	.050	.048	60319.22	60519.11
3	2 independent factors from original scale	746.495	170	.876	.889	.059	.149	60570.86	60765.87
4	2 correlated factors from original scale	617.214	169	.903	.914	.052	.063	60387.71	60587.60
5	Model 4 plus Item19~Item20	555.350	168	.916	.926	.049	.063	60297.47	60502.23
6	Model 4 plus Item19~Item20, Item8~Item10	513.619	167	.924	.934	.046	.062	60239.37	60449.01
7	2 correlated factors from original scale with a global entity	613.562	168	.903	.915	.052	.063	60389.71	60594.47
8	2 independent factors from original scale with a global entity	613.562	168	.903	.915	.052	.063	60389.71	60594.47

Note. *df*=degrees of freedom; χ^2 =chi-square test statistic; NNFI=non-normed fit index; CFI=comparative fit index; RMSEA=root mean square error of approximation; SRMR=standardized root means square residual; AIC=Akaike's information criterion; BIC=Bayesian information criterion. The “~” sign denotes “correlated”. Thus, for instance, “Item19~Item20” means that items 19 and 20 in the CFI are allowed to be correlated in a model. Best performance indicators are emboldened. In all models, $p < .001$ for the test statistic.

Figure 1

Scree plot for CFI factors



Note. Using the Kaiser criterion (Eigenvalues > 1.0), a two-factor structure is chosen.

istence of two factors and a global factor that depends on them with no correlation between them allowed, whilst Model 8 allowed these correlations.

Considering the various performance measures, Model 6 was selected as the best. This model suggests the

existence of two correlated factors with correlated items within factors. The index values were AIC=60239.37, BIC=60449.01, NNFI=.924, CFI=.934, RMSEA=.046, and SRMR=.062. From the values obtained in these indices, we can interpret that the model fits the data

well and that it was possible to select the best model, so it is viable to draw valid conclusions from this data set. Figure 2 and Table 2 show the estimated structure of the two-factor model along with the existing correlation among composing factors. F1 is comprised of items 1, 3, 5, 6, 8, 10, 12, 13, 14, 16, 18, 19, and 20 (support from Alternatives, Table 3). F2 is comprised of items 2, 4, 7, 9, 11, 15, and 17 (support from Control, Table 3).

Table 2

Factor Matrix for the CFI Scale in a Colombian Sample

Item	Factor		h ²
	Alternatives	Control	
1	.426		.182
2		.535	.287
3	.582		.338
4		.745	.555
5	.623		.388
6	.590		.348
7		.778	.605
8	.530		.281
9		.637	.406
10	.441		.195
11		.811	.658
12	.506		.256
13	.787		.620
14	.787		.619
15		.378	.142
16	.653		.426
17		.536	.287
18	.741		.548
19	.754		.569
20	.817		.668

Note. Only loadings > .35 are shown. h² measures communality.

3.2 Internal Consistency

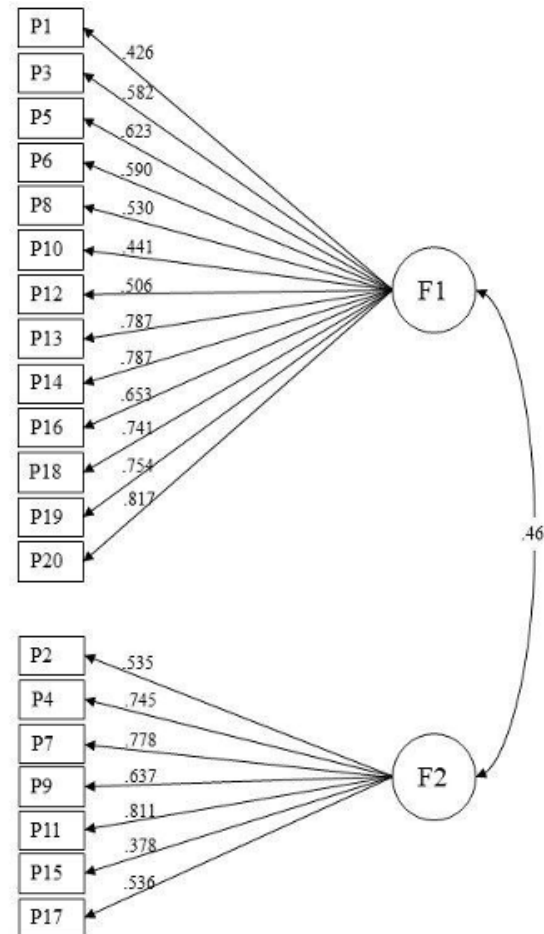
As noted in Table 3, internal consistency for the global scale was $\alpha=.89$ (95% CI=.88–.90). Alternatives factor and Control factor showed similar coefficients: $\alpha=.90$ (95% CI=.89–.90 and $\alpha=.83$ (95% CI=.81–.85), respectively. The correlations between the items, the factors/dimensions, and the overall score were considered suitable. In addition, when specific items were dropped from each dimension, none of the alpha values were greater than the whole scale alpha or factors alpha values. Internal consistency coefficients remained within acceptable limits, which means that there is no need to drop any item. Each item is an important determinant of scale performance. These results suggest a good-to-acceptable internal consistency of the CFI when applied to Colombian adults (see Table 1).

3.3 Gender and Age Differences Testing

Data from the FC construct was not normally distributed (K.S=.41, $p < .05$). Accordingly, differences in mean

Figure 2

Structure of the Two-Factor Model



Note. Values between factors and items correspond to the matrix in Table 2. Those between factors are the estimated linear correlation coefficient. The correlation between Items 19 and 20 is .348 ($p < .001$), and between Items 8 and 10 is .252 ($p < .001$).

ranges for FC and its subscales were calculated using the Kruskal Wallis non-parametric H test for the three gender categories in the sample. Differences were also evaluated considering age, and, for that, we built three age ranges (18–22; 23–27, and 28+).

As for gender, we found differences in the total scale ($\chi^2=11.103$, $df=2$, $p=.004$, $\eta^2=.008$), in the Alternatives subscale ($\chi^2=8.042$, $df=2$, $p=.018$, $\eta^2=.005$), and in the control subscale ($\chi^2=10.637$, $df=2$, $p=.005$, $\eta^2=.008$). Post-hoc tests showed that women scored lower than men on the total scale and the two subscales. However, as seen above, the effect sizes are very low. In terms of age, differences were found in the total scale ($\chi^2=8.407$, $df=2$, $p=.015$, $\eta^2=.006$) and in the Alternatives subscale ($\chi^2=6.976$, $df=2$, $p=.031$, $\eta^2=.004$). Nevertheless, the effect sizes were very low and post-hoc tests did not show a significant difference.

Table 3

Internal Consistency of the CFI in a Colombian Sample

Item	Internal Consistency (95% CI)		If an item is dropped	Global
	Factor/dimension Correlation	Global Correlation		
Alternatives				
1	.49*	.47*	.89	.90
3	.62*	.51*	.89	
5	.67*	.59*	.89	
6	.65*	.56*	.89	
8	.64*	.49*	.89	
10	.55*	.48*	.90	
12	.55*	.48*	.89	
13	.78*	.66*	.88	
14	.79*	.68*	.88	
16	.68*	.61*	.89	
18	.73*	.48*	.88	
19	.76*	.71*	.88	
20	.80*	.73*	.88	
Control				
2	.65*	.46*	.82	.83
4	.78*	.61*	.79	
7	.79*	.63*	.79	
9	.71*	.56*	.81	
11	.82*	.67*	.78	
15	.52*	.59*	.83	
17	.65*	.48*	.82	
Total Scale				.89

Note. * $p < .01$.

4. Discussion

The aim of this study was to assess the factor structure and psychometric properties of the Spanish translation and adaptation of the CFI in a sample of Colombian adults. The original instrument exhibits adequate levels of internal consistency with α values ranging between .84 and .91. Similarly, the test-retest reliability evaluation for the total scale and the subscales also proved to be adequate ($r = .75-.81$; $p < .001$; Dennis & Vander Wal, 2010).

The results showed that the internal consistency for the global scale was $\alpha = .89$ (95% CI = .88-.90). Alternatives factor and Control factor showed similar coefficients: $\alpha = .90$ (95% CI = .89-.90) and $\alpha = .83$ (95% CI = .81-.85), respectively. Other validation studies carried out around the world have found similar results (Kurginyan & Osavolyuk, 2018; Shareh et al., 2014).

Regarding the number of factors, it was found that model 6 was the best fit. This model suggested the existence of two correlated factors, with correlated items within factors (Item 19~Item 20 and Item 8~Item 10). Both the original study (Dennis & Vander Wal, 2010) and another study conducted in Russia (Kurginyan & Osavolyuk, 2018) found the same number of factors and distribution of items. However, in a study carried out

with an Iranian sample (Shareh et al., 2014), it was found that a three-factor model was the best fit, which is suggestive of cultural aspects playing an important role in the results of factor analysis.

Regarding the discriminating power of the scale in terms of variables such as gender and age, we did not observe significant differences on the effect sizes in the total scale and the subscales in the study sample. Some studies have shown similar results, finding no differences in gender, although they report negative relationships between the alternative subscale and age (Rudnik et al., 2019). Further studies should continue to review these differences in diversified samples.

There are currently several areas where CF is recognized as an important variable in different human processes. For example, in the clinical and mental health area, there are some studies that positively relate CF to psychological well-being and family communication environments (Fu & Chow, 2017; Koesten et al., 2009). Likewise, other studies have established negative correlations with depressive symptoms (Wadsworth et al., 2004), psychological stress (Palm & Follette, 2011), and being a mediator between depressive symptoms and negative events in life (Fresco et al., 2007).

Furthermore, the growing number of studies that have been carried out in recent decades, where social and cognitive variables are integrated and cognitive flexibility plays a mediating role between different processes, is highlighted. For instance, in Cardom (2016), CF plays a mediating role between Cross-Race Interactions and psychological well-being, based on theoretical postulates by Crisp and Turner (2011). Brewster et al. (2013) found that CF moderates the relationship between experiences of prejudice and mental health in bisexual people and, more recently, Zuo et al. (2019) have identified the mediating role of CF in the influence of counter-stereotypes on creativity. In fact, in Spanish, some studies such as Angosto and Martínez (2004), Navarro and Mebarak (2014), and Enesco et al. (2014) have highlighted the importance of CF in interventions that seek to reduce prejudice towards stigmatized groups. What these trends show is that instruments such as the CFI have the potential to be used in different contexts such as clinical and research for the evaluation of cognitive flexibility.

Additionally, similar self-report questionnaires that assess perception of cognitive functioning have been shown to be indicators of people's quality of life and social functioning, which is an advantage of this kind of assessments (Daugherty et al., 2020). Another point to consider is that self-reporting scales are easy to manage, interpret and reduce time and costs, allowing the evaluation of larger samples of subjects (McDonald, 2008).

It is worth mentioning some limitations that could be addressed in future work. First, this sample only came from one Hispanic country (Colombia); thus, these results could not be generalized to the rest of the Spanish-speaking countries. Similarly, this study is a cross-sectional study that could make possible to assess the stability of the measure. Finally, self-report instruments may conduct to response bias, which may be a phenomenon to consider.

Future studies should consider clinical samples, to test the utility of the instrument in clinical settings and to yield broader and more generalizable results. Overall, this study showed that the scale exhibits adequate reliability, both for the general scale and for the subscales, which reveals item intercorrelations, indicating that each subscale accounts for a psychologically interpretable construct and that these can consistently be used to generate a composite score for cognitive flexibility.

5. Conclusion

We highlight that the CFI is an adequate measure for the evaluation of the type of cognitive flexibility necessary for individuals to successfully replace maladaptive thoughts with more adaptive thinking, when encountering stressful life events in Colombian adults. This means that this inventory is a useful tool to assess cognitive flexibility and offer some advantages such as brevity, and

ease of administration, and rating. Also providing two factors of cognitive flexibility, it allows assessing possible difficulties in one of them, separately, and carrying out more specific interventions.

References

- Angosto, J., & Martínez, C. (2004). Dimensions and Determinants of the Contact Intention toward Outgroups. *Revista Interamericana de Psicología*, 38, 181–190.
- Bandalos, D. L. (2014). Relative Performance of Categorical Diagonally Weighted Least Squares and Robust Maximum Likelihood Estimation. *Structural Equation Modeling: A Multidisciplinary Journal*, 21, 102–116. <https://doi.org/10.1080/10705511.2014.859510>
- Bentler, P. M., & Chou, C. H. (1987). Practical issues in structural modeling. *Sociological Methods & Research*, 16, 78–117.
- Brewster, M. E., Moradi, B., DeBlaere, C., & Velez, B. L. (2013). Navigating the Borderlands: The Roles of Minority Stressors, Bicultural Self-Efficacy, and Cognitive Flexibility in the Mental Health of Bisexual Individuals. *Journal of counseling psychology*, 60(4), 543–556. <https://doi.org/10.1037/a0033224>
- Caldwell, W., Mcinnis, O. A., Mcquaid, R. J., Liu, G., Stead, J. D., Anisman, H., & Hayley, S. (6). The Role of the Val66Met Polymorphism of the Brain Derived Neurotrophic Factor Gene in Coping Strategies Relevant to Depressive Symptoms, 8, 1–7. <https://doi.org/10.1371/journal.pone.0065547>
- Cangur, S., & Ercan, I. (2015). Comparison of Model Fit Indices Used in Structural Equation Modeling Under Multivariate Normality, 14(1), 152–167. <https://doi.org/10.22237/jmasm/1430453580>
- Cardom, R. D. (2016). *The Mediating Role of Cognitive Flexibility on the Relationship between Cross-Race Interactions and Psychological Well-Being* [Doctoral dissertation, University of Kentucky]. https://uknowledge.uky.edu/edp_etds/50/
- Cheng, C., Lau, H. P., & Chan, M. P. (2014). Coping flexibility and psychological adjustment to stressful life changes: A meta-analytic review. *Psychological Bulletin*, 140(6), 1582–1607. <https://doi.org/10.1037/a0037913>
- Cheng-Hsien, L. (2015). Confirmatory factor analysis with ordinal data: Comparing robust maximum likelihood and diagonally weighted least squares. *Behavior Research Methods*, 48, 936–949. <https://doi.org/10.3758/s13428-015-0619-7>
- Crisp, R. J., & Turner, R. N. (2011). Cognitive Adaptation to the Experience of Social and Cultural Diversity. *Psychological Bulletin*, 137(2), 242–266. <https://doi.org/10.1037/a0021840>

- Dajani, D. R., & Uddin, L. Q. (2015). Demystifying cognitive flexibility: Implications for clinical and developmental neuroscience. *Trends in Neuroscience*, 38(9), 571–578. <https://doi.org/10.1016/j.tins.2015.07.003>
- Daugherty, J. C., Pérez-García, M., Hidalgo-Ruzzante, N., & Bueso-Izquierdo, N. (2020). Perceived Executive Functioning among Female Survivors of Intimate Partner Violence. *Journal of Aggression, Maltreatment and Trauma*, 00(00), 1–18. <https://doi.org/10.1080/10926771.2020.1783734>
- Demirtas, A. S., & Yildiz, B. (2019). Hopelessness and perceived stress: The mediating role of cognitive flexibility and intolerance of uncertainty. *Neurological Sciences*, 32, 259–267. <https://doi.org/10.14744/DAJPNS.2019.00035>
- Dennis, J. P., & Vander Wal, J. S. (2010). The cognitive flexibility inventory: Instrument development and estimates of reliability and validity. *Cognitive Therapy and Research*, 3, 241–253. <https://doi.org/10.1007/s10608-009-9276-4>
- Diamond, A. (2013). Executive Functions. *Annual Review of Psychology*, 64, 135–168. <http://dx.doi.org/10.1146/annurev-psych-113011-143750>
- Eldesouky, L., & English, T. (2018). Another year older, another year wiser? Emotion regulation strategy selection and flexibility across adulthood. *Psychology and aging*, 33(4), 572–585. <https://doi.org/10.1037/pag0000251>
- Enesco, I., Guerrero, S., Solbes, I., Lago, O., & Rodríguez, P. (2014). Ethnic-racial prejudice: A review of developmental research in Spain with Spanish and foreign children and preadolescents. *Culture and Education*, 21(4), 497–515. <https://doi.org/10.1174/113564009790002427>
- Escobar-Pérez, J., & Cuervo-Martínez, Á. (2008). Content validity by experts judgment: Proposal for a virtual tool. *Avances en Medicina*, 6, 27–36. <https://doi.org/10.32870/ap.v9n2.993>
- Folkman, S., & Lazarus, R. S. (1985). If it changes it must be a process: Study of emotion and coping during three stages of a college examination. *Journal of Personality and Social Psychology*, 48(1), 150–170. <https://doi.org/10.1037/0022-3514.48.1.150>
- Fresco, D. M., Rytwinski, N. K., & Craighead, L. W. (2007). Explanatory flexibility and negative life events interact to predict depression symptoms. *Journal of Social and Clinical Psychology*, 26(5), 595–608. <https://doi.org/10.1521/jscp.2007.26.5.595>
- Fu, F., & Chow, A. (2017). Traumatic Exposure and Psychological Well-Being: The Moderating Role of Cognitive Flexibility. *Journal of Loss and Trauma*, 22(1), 24–35. <https://doi.org/10.1080/15325024.2016.1161428>
- Gioia, G., Isquith, P., Guy, S., & Kenworthy, L. (2000). *Behavior Rating Inventory of executive Function. Professional manual*. Psychological assessment resources.
- González-Consuegra, V., R., & Verdú, J. (2010). Spanish adaptation process of the Charing Cross Venous Ulcer Questionnaire (CCVUQ) to measure the quality of life related to health in patients with venous ulcers. *Gerokomos*, 21(2), 80–87.
- Góralaska, K., & Basiska, M. A. (2019). Resiliency as a predictor of flexibility in coping with stress of cardiac patients. *Health Psychology Report*, 7(3), 2353–5571. <https://doi.org/10.5114/hpr.2019.85952>
- Hambleton, R. K., & Zenisky, A. (2010). *Translating and adapting tests for crosscultural assessments*. In D. R. Matsumoto & F. J. Vijver (Eds.), *Cross-cultural research methods in psychology* (pp. 46–74). Cambridge University Press
- Heaton, S. K., Chelune, G. J., Talley, J. L., Kay, G. G., & Curtiss, G. (1993). *Wisconsin Card Sorting Test Manual: Revised and Expanded*. Psychological Assessment Resources.
- Herrero, J. (2010). Confirmatory Factor Analysis in the study of the Structure and Stability of Assessment Instruments: An example with the Self-Esteem Questionnaire (CA-14). *Psychosocial Intervention*, 19(3), 289–300.
- Ionescu, T. (2017). The variability-stability-flexibility pattern: A possible key to understanding the flexibility of the human mind. *Review of General Psychology*, 21, 123–131. <https://doi.org/10.1037/gpr0000110>
- Kato, T. (2012). Development of the Coping Flexibility Scale: Evidence for the Coping Flexibility Hypothesis. *Journal of Counseling Psychology*, 59(2), 262–73. <https://doi.org/10.1037/a0027770>
- Kline, R. B. (2016). *Principals and Practice of Structural Equation Modeling* (Fourth Edition). The Guilford Press.
- Koesten, J., Schrod, P., & Ford, D. J. (2009). Cognitive flexibility as a mediator of family communication environments and young adults' well-being. *Health Communication*, 24, 82–94. <https://doi.org/10.1080/10410230802607024>
- Kruczek, A., Basiska, M. A., & Janicka, M. (2020). Cognitive flexibility and flexibility in coping in nurses – the moderating role of age, seniority and the sense of stress. *International journal of occupational medicine and environmental health*, 33(4), 507–521. <https://doi.org/10.13075/ijomeh.1896.01567>
- Kurginyan, S. S., & Osavolyuk, E. Y. (2018). Psychometric Properties of a Russian Version of the Cognitive Flexibility Inventory (CFI-R). *Frontiers in Psychology*, 9, 1–10. <https://doi.org/10.3389/fpsyg.2018.01896>

- ters in *Psychology*, 9, 1–9. <https://doi.org/10.3389/fpsyg.2018.00845>
- MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods*, 1, 130–149. <https://doi.org/10.1037/1082-989X.1.2.130>
- MacCallum, R. C., Roznowski, M., & Necowitz, L. B. (1992). Model modifications in covariance structure analysis: The problem of capitalization on chance. *Psychological Bulletin*, 111, 490–504.
- Maddio, S. L., & Greco, C. (2010). Flexibilidad Cognitiva para Resolver Problemas entre Pares ¿Difiere esta Capacidad en Escolares de Contextos Urbanos y Urbanomarginales? *Interamerican Journal of Psychology*, 44(1), 98–109.
- McDonald, J. D. (2008). Measuring personality constructs: The advantages and disadvantages of self-reports, informant reports and behavioural assessments. *Enquire*, 1(1), 1–19.
- Ministerio de Salud. (1993, October 4). Resolución 00843 de 1993 [Resolution 008430 of 1993. Establishing scientific, technical and administrative standards for health research]. Ministerio de Salud. https://www.urosario.edu.co/Escuela-Medicina/Investigacion/Documentos-de-interes/Files/resolucion_008430_1993.pdf
- Moore, A., & Malinowski, P. (2009). Meditation, mindfulness and cognitive flexibility. *Conscious and Cognition*, 18(1), 176–186. <https://doi.org/10.1016/j.concog.2008.12.008>
- Morata, M., Holgado, F. P., Barbero, I., & Méndez, G. (2015). Confirmatory factor analysis. Recommendations for unweighted least squares method related to Chi-Square and RMSEA Type I error. *Acción Psicológica*, 12(1), 79–90. <https://dx.doi.org/doi.org/10.5944/ap.12.1.14362>
- Muñiz, J., Elosua, P., & Ronald, K. (2013). Guidelines for translation and adaptation of tests: Second edition. *Psicothema*, 25(2), 151–157. <https://doi.org/10.7334/psicothema2013.24>
- Muyan-Yilik, M., & Demir, A. A. (2020). Pathway Towards Subjective Well-Being for Turkish University Students: The Roles of Dispositional Hope, Cognitive Flexibility, and Coping Strategies. *Journal of Happiness Studies*, 21, 1945–1963. <https://doi.org/10.1007/s10902-019-00162-2>
- Navarro, M. C., & Mebarak, M. (2014). Formation of Social Prejudice, A Review from the Cognitive and Psychoanalytic Unconscious. *Cuadernos de Neuropsicología*, 8(1), 88–106.
- Nweze, T., Agu, E., & Lange, F. (2020). Risky decision making and cognitive flexibility among online sports bettors in Nigeria. *International Journal of Psychology*, 55(6), 995–1002. <https://doi.org/10.1002/ijop.12663>
- Odac, H., & Cikrikci, Ö. (2019). Cognitive Flexibility Mediates the Relationship between Big Five Personality Traits and Life Satisfaction. *Applied Research Quality Life*, 14, 1229–1246. <https://doi.org/10.1007/s11482-018-9651-y>
- Palm, K. M., & Follette, V. M. (2011). The roles of cognitive flexibility and experiential avoidance in explaining psychological distress in survivors of interpersonal victimization. *Journal of Psychopathology and Behavioral Assessment*, 33, 79–86. <https://doi.org/10.1007/s10862-010-9201-x>
- Reitan, R., & Wolfson, D. (1993). *The Halstead-Reitan Neuropsychologic Test Battery: Theory and Clinical Interpretation*. Neuropsychology Press.
- Rosseel, Y. (2012). Lavaan: An R package for structural equation modelling. *Journal of Statistical Software*, 48(2), 1–36. <https://doi.org/10.18637/jss.v048.i02>
- Rudnik, A., Piotrowicz, G., Basiska, M. A., & Rashedi, V. (2019). The importance of cognitive flexibility and flexibility in coping with stress for the quality of life in inflammatory bowel disease patients during biological therapy. A preliminary report. *Gastroenterology Review*, 14(2), 121–128. <https://doi.org/10.5114/pg.2018.81081>
- Schulz, W., Ainley, J., & Fraillon, J. (Eds.) (2011). *ICCS 2009 technical report*. International Association for the Evaluation of Educational Achievement (IEA).
- Shah, D. (2019). *Moderators of bicultural self-efficacy and mental health among Asian Americans* [Doctoral thesis, University of Alaska Fairbanks]. <http://hdl.handle.net/11122/10640>
- Shapero, B. G., Greenberg, J., Mischoulon, D., Pedrelli, P., Meade, K., & Lazar, S. W. (2018). Mindfulness-Based Cognitive Therapy Improves Cognitive Functioning and Flexibility Among Individuals with Elevated Depressive Symptoms. *Mindfulness*, 9, 1457–1469. <https://doi.org/10.1007/s12671-018-0889-0>
- Shareh, H., Farmani, A., & Soltani, E. (2014). Investigating the Reliability and Validity of the Cognitive Flexibility Inventory (CFI-I) among Iranian University Students. *Practice in Clinical Psychology*, 2(1), 43–50. <http://jpcp.uswr.ac.ir/article-1-163-en.html>
- Stemme, A., Deco, G., & Busch, A. (2007). The neuronal dynamics underlying cognitive flexibility in set shifting tasks. *Journal of Computational Neuroscience*, 23(3), 313–331. <https://doi.org/10.1007/s10827-007-0034-x>
- The R Foundation. (2019). *The R project for statistical computing* [Computer software]. The R Foundation. <https://www.r-project.org/>
- Van Stockum, C. A. J., & De Caro, M. S. (2020). When working memory mechanisms compete: Predict-

- ing cognitive flexibility versus mental set. *Cognition*, 201, 2–16. <https://doi.org/10.1016/j.cognition.2020.104313>
- Wadsworth, M., Rieckmann, T., Benson, M., & Compas, B. (2004). Coping and responses to stress in Navajo adolescents: Psychometric properties of the Responses to Stress Questionnaire. *Journal of Community Psychology*, 32(4), 391–411. <https://doi.org/10.1002/jcop.20008>
- Webler, R. D., Fulton, S., Perera, T. D., & Coplan, J. D. (2019). Maturational phase of hippocampal neurogenesis and cognitive flexibility. *Neuroscience Letters*, (711). <https://doi.org/10.1016/j.neulet.2019.134414>
- Whittaker, T. A. (2012). Using the Modification Index and Standardized Expected Parameter Change for Model Modification. *Journal of Experimental Education*, 80(1), 26–44. <https://doi.org/10.1080/00220973.2010.531299>
- Zaehring, J., Falquez, R., Schubert, A. L., Nees, F., & Barnow, S. (2018). Neural correlates of reappraisal considering working memory capacity and cognitive flexibility. *Brain Imaging and Behavior*, 12(6), 1529–1543. <https://doi.org/10.1007/s11682-017-9788-6>
- Zuo, B., Wen, F., Wang, M., & Wang, Y. (2019). The mediating role of cognitive flexibility in the influence of counter-stereotypes on creativity. *Frontiers in Psychology*, 10, Article 105. <https://doi.org/10.3389/fpsyg.2019.00105>

Supplement

Table S1

Translated Version of the Cognitive Flexibility Inventory

	Muy en desacuerdo	En Desacuerdo	Algo en desacuerdo	Neutral	Algo de acuerdo	De acuerdo	Totalmente de acuerdo
1. Soy Bueno/a analizando situaciones	1	2	3	4	5	6	7
2. Me cuesta tomar decisiones cuando me enfrento a situaciones difíciles	1	2	3	4	5	6	7
3. Considero múltiples alternativas antes de tomar una decisión	1	2	3	4	5	6	7
4. Cuando me enfrento a situaciones difíciles, siento que pierdo el control	1	2	3	4	5	6	7
5. Me gusta ver las situaciones difíciles desde diferentes ángulos	1	2	3	4	5	6	7
6. Busco información adicional que no está inmediatamente disponible antes de atribuir causas a un comportamiento	1	2	3	4	5	6	7
7. Cuando me enfrento a situaciones difíciles, me estreso tanto que no puedo pensar en una forma de resolver la situación	1	2	3	4	5	6	7
8. Trato de pensar sobre diferentes cosas desde el punto de vista de otra persona	1	2	3	4	5	6	7
9. Me resulta problemático que haya tantas formas diferentes de lidiar con situaciones difíciles	1	2	3	4	5	6	7
10. Soy bueno/a poniéndome en los zapatos de los demás	1	2	3	4	5	6	7
11. Cuando me enfrento a situaciones difíciles, simplemente no sé qué hacer	1	2	3	4	5	6	7
12. Es importante mirar a las situaciones difíciles desde diferentes ángulos	1	2	3	4	5	6	7



13. Cuando me enfrento a situaciones difíciles, considero múltiples opciones antes de decidir cómo voy a actuar	1	2	3	4	5	6	7
14. A menudo observo una situación desde diferentes puntos de vista	1	2	3	4	5	6	7
15. Soy capaz de superar las dificultades a las que me enfrento en la vida	1	2	3	4	5	6	7
16. Considero todos los hechos y la información disponible cuando atribuyo causas a un comportamiento	1	2	3	4	5	6	7
17. Siento que no tengo poder para cambiar las cosas en situaciones difíciles	1	2	3	4	5	6	7
18. Cuando me enfrento a situaciones difíciles, me detengo y trato de pensar en varias maneras de resolverlas	1	2	3	4	5	6	7
19. Puedo pensar en más de una manera de resolver una situación difícil con la que me esté enfrentando	1	2	3	4	5	6	7
20. Considero múltiples alternativas antes de responder a situaciones difíciles	1	2	3	4	5	6	7