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Articles

The Measure Equivalence Across Gender of The Cognitive Fusion Questionnaire (CFQ) for Ecuadorian college students

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Abstract

**Background:** Cognitive Fusion (CF) limits behavior by perceiving thoughts as real events. It is a crucial process in the evaluation and intervention of contextual therapies. Its measurement is carried out through the Cognitive Fusion Questionnaire (CFQ), which, despite its psychometric analysis in several countries, the studies on its measurement invariance by gender are cases. This lack of information prevents a full understanding of this phenomenon and its comparison by genre.

**Objective:** To evaluate the CFQ measure equivalence across gender, its validity of association with other variables, and its internal consistency using a sample of Ecuadorian university students.

**Method:** Confirmatory factor analyses were designed with the restrictions corresponding to each level of measurement equivalence and the differences between the adjustment indices were evaluated. The validity of association with variables was computed by means of latent relationships and a factorial model was built to evaluate the equivalence of measurement by gender of these correlations. Finally, the total omega for each gender was calculated.

**Participants:** 356 university students (59.1% women), between 18 and 58 years of age (*mean*= 25.52; *sd*= 7.51); 43.9% of these students studied in public institutions (43.9%), 27.5% studied in technical and/or technological institutions and 28.6% were enrolled in private institutions.

**Results:** The CFQ shows factorial validity through a unidimensional structure. The equivalence of the measure across gender is strong. Additionally, the CFQ shows validity and coherence with regards to convergence and divergence, and the questionnaire items have high internal consistency.

**Conclusion:** This study significantly expands the knowledge about the psychometric properties of the CFQ in the university population of Ecuador. Women show a greater tendency to CF in the comparison between genders. These findings are valuable for future research to better understand the influence of gender on this phenomenon.

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## 1. Introduction

The development of evidence-based psychological interventions is necessary to ensure the availability of efficient and reliable intervention strategies (Hayes & Hofmann, 2017). In the past few decades, third-generation cognitive behavioural therapies have highlighted the importance of linking basic research with the development of psychological techniques (Hayes et al., 2013). These therapies emphasize the function of context and of environmental stimuli in the creation, maintenance, or elimination of problematic behaviours (Guercio, 2022). For example, Acceptance and Commitment Therapy (ACT) is based on contextual functionalism and on Relational Frame Theory (RFT) (Ciarrochi et al., 2005). RFT seeks to expand on B. F. Skinner's work with the purpose of proposing fundamental principles for understanding how verbal conduct works and of developing techniques and interventions based on basic processes (De Lourdes R. da F. Passos, 2012; Hayes et al., 2001). ACT gives particular importance to developing psychological flexibility (McLoughlin & Roche, 2022). As such, ACT aims to modify the person's relationship with their thoughts and emotions without altering their topography (Luciano, 2016). Indeed, one of the main differences between third-generation therapies, such as ACT, and classic cognitive therapies, is that rather than aiming to change verbal statements they seek to change the environment in which these are produced so that they may lose relevance in the life of individuals (Dijkstra & Nagatsu, 2022; Assaz et al., 2022). Additionally, ACT gives great importance to 'values' and 'committed work' as means of developing valuable behaviours, even in the presence of negative thoughts and emotions (Berkout, 2021; Starr et al., 2021; Martin, 2023). As such, ACT establishes the six core processes that cause psychological inflexibility: a) inflexible attention; b) attachment to a conceptualized self; c) cognitive fusion; d) experiential avoidance; e) inaction or impulsivity; and f) lack of values clarity (Hayes et al., 2012). The role of these core processes in the development and maintenance of psychopathologies have been researched with promising results (Sierra & Ortiz, 2022; Yao et al., 2023; Ishizu et al., 2022).

Cognitive Fusion (CF) occurs when people are dominated by their thoughts and internal experiences while ignoring environmental stimuli that may lead to more adequate or beneficial conducts (Healy et al., 2008). There are currently a variety of studies showing the significance of CF for the development and maintenance of psychopathologies such as depression (Pinto-Gouveia et al., 2020; Fernández Rodríguez et al., 2022), anxiety (Clauss & Bardeen, 2022; Soltani et al., 2023), stress (Russell et al., 2020) and suicide risk (Krafft et al., 2019). Together, these studies have demonstrated that evaluating CF should be considered when developing clinical

intervention tools (Larsson et al., 2016; Prudenzi et al., 2019; Marasigan, 2019). This is especially important when considering university students because this demographic has been found to be more vulnerable to mental disorders mainly due to high levels of academic pressure (Dominguez-Lara et al., 2022; Moreta-Herrera et al., 2021; Ramlan et al., 2020). The Cognitive Fusion Questionnaire (CFQ) was developed by Gillanders and colleagues (2014) as a self-report instrument for assessing cognitive fusion (CF). The CFQ serves as a measure that can be applied to different contexts –as such, it is not related to specific disorders or processes.

The original version of the CFQ was developed in English and included 42 items (Gillanders et al., 2014). Gillanders and colleagues (2014) used Explorative Factorial Analysis (EFA) to investigate the questionnaire with a sample of university students from the United Kingdom. The result of this first study was a slimmed down 7-item instrument with a unifactorial structure, as verified by Confirmatory Factorial Analysis (CFA). This version of the CFQ showed adequate internal consistency, and a coherent pattern of divergence and convergence validity using the measures of life satisfaction and experiential avoidance. Since then, several studies around the world have offered further evidence of the validity of the CFQ using diverse demographics, for example: Greece (Zacharia et al., 2021), Germany (China et al., 2018), Italy (Donati et al., 2021; Oppo et al., 2019), Turkey (Kervancioglu et al., 2023), China (Zhang et al., 2014), Korea (Kim & Cho, 2015), Brazil (Lucena-Santos et al., 2017), Iran (Soltani et al., 2016), including Spanish-speaking populations, Spain (Romero-Moreno et al., 2014; Luque-Reca et al., 2021), Argentina (José Quintero et al., 2022), Mexico (Zapata Tellez et al., 2020), Colombia (Ruiz et al., 2017) and Peru (Valencia & Falcón, 2019). On the other hand, two instruments were developed to assess CF in specific situations, on thoughts about body image (CFQ-BI; Ferreira et al., 2015) and on CF in chronic diseases (CFQ-CI; Trindade et al., 2018); both studies were carried out based on the investigation of Gillanders and colleagues (2014).

### **1.1 Measure Equivalence of the CFQ Across Gender**

Cognitive Fusion (CF) is a psychological trait that is part of the daily dynamics of people. When mental disorders are present, between them, Nonsuicidal self-injury (Hu et al., 2021), depression (Chen et al., 2023; Noureen & Malik, 2021), anxiety (Cookson et al., 2020; Hellberg et al., 2020), eating disorders (Melo et al., 2020; Scardera et al., 2021) and stress (Barrera-Caballero et al., 2021; Benfer et al., 2020), CF tends to be higher (Donati et al., 2021; Reuman et al., 2018). In general, CF tends to be low in non-clinic samples, like college students (Flynn et al., 2018; Valencia & Falcón, 2019). Some studies have found that certain factors such as gender seem to affect CF (Serrano-Ibáñez et al., 2021; Sánchez-Puertas et al., 2022). However, the evidence is

not conclusive. Bodenlos and colleagues (2020) found that women tend to present higher levels of CF than men. However, other studies haven't found significant gender differences in CF (Isazadegan & Dostalizadeh, 2020; Noureen & Malik, 2021; Chen et al., 2023). These differences in these findings may be due to the ways in which different populations interpret the CFQ items rather than to the intensity of CF according to gender (Chen, 2007; Moreta-Herrera et al., 2022; Rutkowski & Svetina, 2017). As such, the results could be misinterpreted because the precise origin of the differences cannot be established (Asparouhov & Muthén, 2014; Han et al., 2019). For this reason, not only is it important to further study CF measurement tools to ensure measure equivalence and factorial invariance, but additional research is also necessary in order to understand how CF functions.

While multi-group studies of the CFQ's measure equivalence across gender (men and women) is still scarce, research so far suggests that the CFQ exhibits measure equivalence between different groups; this includes studies investigating measure equivalence between the general population, patients with psychological alterations, and caregivers (Gillanders et al., 2014); between adults suffering from chronic pain and university students who smoked regularly (Zacharia et al., 2021); and between the general population and the clinical population (China et al., 2018; Donati et al., 2021; Costa et al., 2017). Studies applying the CFQ to Spanish-speaking populations are sparse; amongst those that stand out is a study from Colombia (Ruiz et al., 2017), which achieved positive results in the metric invariance between genders, and another from Perú (Valencia & Falcón, 2019), that found that the CFQ exhibited strict measurement invariance across gender. As such, by researching the factorial structure of the CFQ and the interpretative capacities of each of its items, this study offers necessary evidence of the validity of the CFQ in a scarcely studied multi-group sample population.

## 1.2 Objectives and Hypotheses

The objectives of this study include a) Evaluating the unifactorial model of the CFQ in a sample of Ecuadorian students; b) Examining the measure equivalence of the CFQ across gender; c) Identify the validity of association of CFQ with other variables (Convergence and divergence); d) Examine the gender invariance of the latent relationships of the CFQ convergence and divergence model, e) Determining the reliability of the CFQ. Our hypotheses are that the one-factor model of the CFQ fits the data best ( $H_1$ ); that the CFQ has measure equivalence across gender ( $H_2$ ); that the CFQ shows appropriate convergence and divergence validity with other variables ( $H_3$ ); the validity of the association of the CFQ with other variables is invariant between groups ( $H_4$ ); and, that the CFQ's internal consistency is appropriate ( $H_5$ ).

## 2. Methodology

### 2.1 Design

This research is a psychometric cross-sectional quantitative study (Furr, 2018) with a sample of Ecuadorian university students. Participants were recruited using convenience and non-probabilistic sampling.

### 2.2 Participants

The sample consisted of a total of 356 Ecuadorian university students. 59.1% were women ( $n=217$ ) and 40.9% were men ( $n=150$ ). The ages of participants ranged between 18 and 58 years of age ( $mean=25.52$ ;  $sd=7.51$ ). Of these 43.9% were enrolled in public institutions, 28.6% in private institutions, and 27.5% in technical and/or technological institutions. 27.5% of participants studied technical or technological careers, 20.4% studied engineering, 18.5% studied psychology, 13.4% studied economy or business, 6.8% studied architecture and/or design, 6.5% studied law, 4.4% studied education, and 1.1% studied sciences. The inclusion criteria were that participants should a) be undergraduate students; b) be enrolled in an Ecuadorian higher education institution (HEI); c) be attending class regularly; and, d) have signed the consent form.

### 2.3 Instrument

**The Cognitive Fusion Questionnaire (CFQ)** (Gillanders et al., 2014) in the Ecuadorian version of Moreno-Montero et al. (2023). It is a psychometric instrument which objective is to measure Cognitive Fusion (CF). The CFQ includes 7 items that use a 7-option Likert scale from 1 (never true) to 7 (always true). The total sum ranges from 7 to 49 points –a higher score is associated with a higher tendency to CF (Gillanders et al., 2014). The Spanish version of the questionnaire (Ruiz et al., 2017) was translated and verified for a Colombian population, and has a high internal reliability (Cronbach Alpha of .93).

**The Acceptance and Action Questionnaire-II (AAQ-II)** (Bond et al., 2011): The AAQ-II was designed to measure experiential avoidance. The instrument includes seven items. Each item uses a 7-option Likert scale similar to the CFQ. Likewise, the total sum ranges from 7 to 49 points –where a higher score is associated with a greater presence of experiential avoidance. This study used the Spanish version of the AAQ-II (Ruiz et al., 2016) translated and validated for a Colombian population. A previous study (Paladines-Costa et al., 2021) analyzed the psychometric properties of the AAQ-II using a sample of Ecuadorian university students; this study obtained a McDonald's Omega ( $\omega$ ) of .928.

**The Satisfaction with Life Scale (SWLS):** This questionnaire measures perceptions of subjective well-being and quality of life to assess global life satisfaction. The SWLS (Diener et al., 1985) is a 5-item instrument, which uses a 7-option Likert scale ranging from 1 (totally disagree) to 7 (totally agree). The total sum ranges from 5 to 35 points, where a higher score is associated with greater life satisfaction. Arias and Garcia (2018) previously studied the psychometric properties of the SWLS using an Ecuadorian population; their study obtained a Cronbach alpha ( $\alpha$ ) of .81.

## 2.4 Method

This study followed the criteria and ethical norms established by the Helsinki Convention. The data sampling stage was conducted between December 2021 and March 2022. The study was carried out in the context of the COVID-19 pandemic. For this reason, all questionnaires were shared and filled online. A Google Forms (<https://forms.gle/Ki56F7XgWYy1Qwvy6>) document was created which included the consent form, sociodemographic survey, and all the study's questionnaires. The first section informed participants about the objectives of the study; it also offered information about participant confidentiality and anonymity. The participants voluntarily read and accepted the informed consent to continue with the survey. Each participant took about 10 minutes to complete the survey. Once all data had been collected, a data base was created, and participants that did not fulfill the inclusion criteria were excluded. Statistical analysis, hypotheses tests, and interpretations of the results were then conducted.

## 2.5 Data Analysis

Firstly, we obtained descriptive statistics by gender. We calculated the mean ( $m$ ), the standard deviation ( $sd$ ), skewness ( $g_1$ ), and kurtosis ( $g_2$ ) for each item of the CFQ. We also checked if the skewness ( $g_1$ ) and the kurtosis ( $g_2$ ) were within  $\pm 2$  as a criterion of univariate normality (George & Mallery, 2010). We then checked for multivariate normality using Mardia's tests (1970).

This study used polychoric correlations between the items of the CFQ to adjust the Confirmatory Factorial Analysis (CFA). The unifactorial model was computed using Diagonally Weighted Least Squares (DWLS) because the data was not multivariate normal (Li, 2016). To test for a good fit of the unifactorial model, the following criteria was used: That Chi square ( $\chi^2$ ) was not significant ( $p > .05$ ); that the adjusted Chi square ( $\chi^2/df$ ) was less than 4; and that the Standardized Root Mean Square Residual (SRMR) was less than .06. The Comparative Fit Index (CFI) and the Tucker Lewis Index (TLI) were used as indicators of relative fit—an acceptable model fit corresponds to values greater than .95. The Root Mean Square Error of

Approximation (RMSEA) was also used as an indicator of model fit because it is not based on centrality; in this case, an acceptable model fit should have a RMSEA less than .08 (Ferrando & Anguiano-Carrasco, 2010; Hu & Bentler, 1999; Moreta-Herrera et al., 2020). The weight ( $\lambda$ ) for each item according to the factorial model was then computed; these values should be greater than .50 (Dominguez-Lara, 2018).

To investigate whether the CFQ has measure equivalence across gender ( $H_2$ ), we fit a multi-group CFA. Using this model, we tested for factorial invariance (configural, metric, strong, residual) (Vandenberg & Lance, 2000). To test if the difference between the models was significant, we used the Chi square index ( $\chi^2$ ;  $p > .05$ ), the CFI differential index ( $\Delta CFI < .01$ ), and the RMSEA differential index ( $\Delta RMSEA < .015$ ) (Chen, 2007; Rutkowski & Svetina, 2017). To have a fuller picture of the invariance of the measure by group, the magnitude of the difference of the CFA weights between the groups was analyzed using the statistic designed by Dominguez-Lara and Merino-Soto (2019). The tool was designed based on the study by Pornprasertmanit (2022) and its objective is to simplify the calculation of the difference between the factorial loads obtained by the items in each group. In addition to the difference, the effect size (Cohen's  $d$ ) is obtained, which determines whether the difference in factor loadings between groups is significant.

To test the validity of association of the CFQ with other variables ( $H_3$ ) we used a structural equation model with three factors (CFQ, AAQ-II & SWLS). The DWLS estimator was applied to compute the coefficients of this model. To assess the gender invariance of the convergence and divergence validity of the CFQ ( $H_3$ ), the four types of factorial invariance across gender (configural, metric, strong, residual) were analyzed using the same indexes as for measure invariance (Chi square index, RMSEA differential index, CFI differential index). Lastly, the Omega coefficient ( $\omega$ ) by gender ( $H_5$ ) was calculated to test the internal consistency of the instrument.

The programming language for statistical computing R, version 4.1.0 (R Core Team, 2021) together with the libraries *psych*, *MVN*, *lavaan*, *misty*, and *semTools* were used for all statistical analysis.

### 3. Results

#### 3.1 Preliminary Analysis of the Items

Table 1 offers a descriptive analysis of the CFQ items by gender. The means of each of the 7 items are heterogeneous for both groups (men and women). The fluctuation of the means

ranged between  $\text{mean}_{(\text{item}5)} = 2.75$  to  $\text{mean}_{(\text{item}3)} = 3.49$  for men and between  $\text{mean}_{(\text{item}2)} = 3.35$  and  $\text{mean}_{(\text{item}1)} = 3.97$  for women. For each individual item, the values of skewness and kurtosis are what is expected for a normal distribution. However, Mardia's test for skewness (293.77 for men, 246.61 for women) and for kurtosis (12.80 for men, 11.17 for women) are significant ( $p < .01$ ). Hence, we cannot assume multivariate normality for either group.

**Table 1.** Preliminary Analysis of the Items of the CFQ by Gender

Item	Men n= 150				Women n= 217			
	M	SD	$g_1$	$g_2$	M	SD	$g_1$	$g_2$
Item 1	3.31	1.61	0.69	-0.32	3.97	1.80	0.10	-1.12
Item 2	3.05	1.69	0.56	-0.69	3.35	1.82	0.41	-1.00
Item 3	3.49	1.91	0.41	-1.06	3.85	1.82	0.07	-1.06
Item 4	3.17	1.72	0.62	-0.51	3.59	1.91	0.28	-1.12
Item 5	2.75	1.75	0.95	-0.11	3.52	2.05	0.29	-1.28
Item 6	3.15	1.80	0.64	-0.67	3.71	1.89	0.16	-1.21
Item 7	3.25	1.84	0.73	-0.60	3.84	2.04	0.13	-1.37
		Mardia	293.77**	12.80**			246.61**	11.17**

Note: M= mean; SD=standard deviation;  $g_1$ = skewness;  $g_2$ = kurtosis; \*\* = $p < .01$ .

The study found that the intensity of CF amongst participants of the study is moderate. It should be noted that the mean score for women is slightly higher than it is for men.

### 3.2 Measure Equivalence Across Gender of the CFQ

Initially, we studied the internal structure of the CFQ using CFA. We found that the unidimensional structure is an adequate fit ( $\chi^2$ ; 21.81;  $p > .05$ ;  $gl = 14$ ;  $\chi^2/gl = 1.56$ ; CFI= .99; TLI= .99; SRMR= .019; RMSEA: .039 [.001 - .069]). The saturation of the items was found to be adequate –they fluctuate between  $\lambda_{(\text{item } 3)} = .78$  and  $\lambda_{(\text{item } 6)} = .93$ . Hence, they contribute significantly to the construct and allow a consistent explanation of the variance.

We then adjusted the multi-group CFA by gender (see Table 2). The structural models of the CFQ for both men and women without any restrictions were adequate. When testing for metric invariance there were no significant differences for the indicators of adjustment ( $\Delta\text{CFI}$  and  $\Delta\text{RMSEA}$ ). The differential between the indicators of adjustment was only significant between strong and strict factorial invariance ( $\Delta\chi^2 = 28.32$  and  $\Delta\text{RMSEA} = 0.23$ ). As such, we can conclude that the CFQ has strong measure invariance across gender.



**Table 2.** Measure Equivalence Across Gender of the CFQ

<i>Model</i>	$\chi^2$ ( <i>df</i> )	<i>CFI</i>	<i>RMSEA</i>	$\Delta\chi^2$ ( <i>gl</i> )	<i>p</i>	$\Delta$ <i>CFI</i>	$\Delta$ <i>RMSEA</i>
Base Model Men	11.60 (14)	.999	.001	-	-	-	-
Base Model Women	26.306 (14)	.999	.064	-	-	-	-
Configural	37.904 (28)	.999	.044	-	-	-	-
Metric	38.900 (34)	.999	.028	.995 (6)	.986	< .001	.016
Strong	74.140 (68)	.999	.022	35.241 (34)	.409	< .001	.006
Strict	102.459 (75)	.999	.045	28.319 (7)	.000	< .001	.023

Note:  $\chi^2$ = chi-square; *df*= degrees of freedom; *CFI*= Comparative Fit Index; *RMSEA*= Root Mean Square of Error

Approximation; *p*= *p*-value;  $\Delta$ = delta.

$\chi^2/df$ = 0.829 (Men);  $\chi^2/df$ = 1.879 (Women)

Table 3 shows the factorial weight of each item by gender. As can be seen in Table 3 all factorial weights for each group are greater than .50. Hence, each item is adequate for measuring the construct. The results for both groups are similar. Item 6 has the highest factorial weight for both groups ( $\lambda_{(men)}$ = .899;  $\lambda_{(women)}$ = .959). The most notable difference between saturations can be found in item 5 ( $\Delta\lambda$ = -.115). However, none of these differences are significant because the effect size is less than .20 (Dominguez-Lara & Merino-Soto, 2019).

**Table 3.** Factorial Weights and Effect Size

<i>Item</i>	$\lambda$ <i>Men</i>	$\lambda$ <i>Women</i>	<i>ES- <math>\Delta\lambda</math></i>
Item 1	.788	.877	-.048
Item 2	.865	.877	-.006
Item 3	.743	.805	-.036
Item 4	.876	.902	-.013
Item 5	.816	.932	-.059
Item 6	.899	.959	-.028
Item 7	.888	.914	-.013

Note:  $\lambda$ = Factorial Weight; *ES-  $\Delta\lambda$* = Effect Size

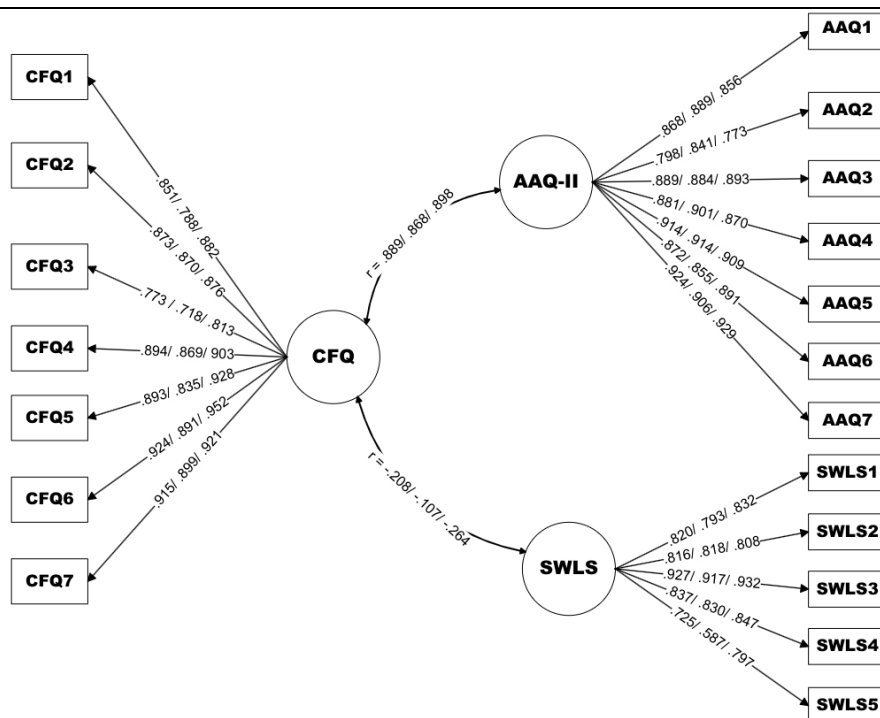
It is possible to compare the latent measurements of the CFQ by gender ( $\Delta K$ ) because the invariance of measure is strong. There were significant differences between men and women ( $\Delta K$ = -.267; *p* < .001). The results show that women have a higher tendency to CF than men.

### 3.3 Association Validity with other Variables Using Structural Equation Model (SEM)

To test convergence and divergence with other variables we used a three factor Structural Equation Model (SEM). Figure 1 shows that the fit of the model is adequate. The latent correlations of the CFQ are appropriate and correspond to the theoretical construct. The

correlation between the CFQ and the AAQ-II ( $r = .889$ ) is high and positive which shows convergence validity. On the other hand, the correlation of the CFQ with the SWLS is low and negative ( $r = -.208$ ). Hence, the CFQ and the SWLS have divergent validity. When analyzing convergence by group, we found that the CFQ has convergence validity with the AAQ-II for both men and women ( $r_{(men)} = .868$  and  $r_{(women)} = .898$ ). Likewise, the CFQ has divergence validity with the SWLS for both men and women ( $r_{(men)} = -.107$  and  $r_{(women)} = -.264$ ).

When analyzing the measurement equivalence of the three-factor model, the CFQ correlates with the AAQ-II and the SWLS, the results show that the model is adequate for each group ( $\chi^2_{(men)} = 193.3$ ;  $df = 149$ ;  $p > .05$ ;  $CFI = .999$ ;  $RMSEA = .045$ ;  $\chi^2_{(women)} = 270.1$ ;  $df = 149$ ;  $p > .05$ ;  $CFI = .998$ ;  $RMSEA = .061$ ). By increasing the restrictions, the model shows invariance at the strict level, because the indicators did not have significant changes ( $\Delta\chi^2 = 93.45$ ;  $\Delta df = 19$ ;  $p = .000$ ;  $\Delta CFI = .001$ ;  $\Delta RMSEA = .009$ ). Therefore, the latent relationships, which show convergence (AAQ-II;  $r = .889$ ) and divergence (SWLS;  $r = -.208$ ), are invariant between both groups.



$\chi^2 = 346.601$ ;  $p > .05$ ;  $df = 149$ ;  $\chi^2/df = 2.31$ ;  $CFI = .998$ ;  $TLI = .998$ ;  $SRMR = .045$ ;  $RMSEA = .060$  [.051 – .068]

Note: CFQ= Cognitive Fusion Questionnaire; AAQ-II= The Acceptance and Action Questionnaire-II; SWLS= The Satisfaction with Life Scale.

**Figure 1.** Latent Correlation Analysis of the Instruments [Total/Men/Women]

### 3.4 Internal Consistence Reliability

To test internal consistency, we used the Omega coefficient ( $\omega$ ) (see Table 5). For each group, the Omega coefficient is greater than .90 ( $\omega > .90$ ). We can conclude that the reliability of the CFQ for each group is adequate. Table 5 also includes 95% confidence intervals for the value of  $\omega$  in each group to corroborate this conclusion.

Table 5. Internal Consistency by group.

<i>Group</i>	<i><math>\omega</math></i>	<i>95% CI</i>
Total	.954	[.946 - .961]
Men	.936	[.919 - .951]
Women	.965	[.957 - .972]

**Note:**  $\omega$ = Omega; CI= Confidence Intervals.

## 4. Discussion

The objectives of this study were to establish the unidimensional factorial structure of the CFQ, to measure invariance by gender, to corroborate the validity of the correlation of the CFQ with other variables, and to establish the internal consistency of the questionnaire. As such, this study offers further validation of the CFQ with a sample of Ecuadorian university students. We found moderate CF amongst participants. Interestingly, this finding differs from other similar studies which found low levels of CF amongst college students (Flynn et al., 2018; Valencia & Falcón, 2019). This could be a consequence of the stressful circumstances that the sample experienced during and after the COVID-19 pandemic, which had a great impact on psychological health (Yao et al., 2023; Guidotti et al., 2022; Bonilla-Sierra et al., 2021). Women showed slightly higher levels of CF than men. As such, these findings are important for understanding CF. However, other studies may amplify the reasons for the difference between groups and their implications for psychological health (Campbell et al., 2021; Prowse et al., 2021). The unidimensional structure of the CFQ found in this study agrees with that of the original model (Gillanders et al., 2014), as well as with similar studies validating the CFQ in other contexts and languages (Zacharia et al., 2021; China et al., 2018; José Quintero et al., 2022; Romero-Moreno et al., 2014; Donati et al., 2021; Oppo et al., 2019). Therefore, it is confirmed that the unifactorial model is applicable to the Ecuadorian population and is a necessary contribution, because it will allow replication of research carried out in other countries that analyze the role of CF in various psychological and academic problems, specifically in university students (Krafft et al., 2019; Hekmati et al., 2023; Fooladvand, 2020). In addition, the CFQ is an instrument that will enable the evaluation of non-clinical preventive interventions aimed at the university population vulnerable to presenting psychological problems (Viskovich & Pakenham, 2020; Levin et al.,

2020; Martino et al., 2022). Supplementary research of the CFQ in the Ecuadorian context is importance in order to offer a more robust understanding of the questionnaire.

Moreover, this study found that the CFQ has strong measure invariance by gender. This implies that men and women interpret the CFQ items similarly (Wang et al., 2017). As such, any difference between these two groups should be understood as due to the particular characteristics of each group rather than to any difference in their interpretation of the scale (Putnick & Bornstein, 2016; Meuleman et al., 2022). These findings are similar to those of previous studies (Chen, 2007; Moreta-Herrera et al., 2022; Rutkowski & Svetina, 2017); including those in Spanish-speaking countries such as Colombia (Ruiz et al., 2017) and Peru (Valencia & Falcón, 2019). As such, the present study offers additional evidence of the measure invariance across gender of the CFQ. Still, additional studies, particularly in Spanish-speaking countries, are necessary in order to have a more robust understanding of the CFQ's measure invariance across gender.

On the other hand, since this study found that the latent means of the CFQ for women were significantly higher than the corresponding means for men, we can conclude that CF is higher in women than in men. Bodenlos and colleagues (2020) found similar differences in CF between men and women although using different methodologies, student's t test, without prior analysis of measurement equivalence. However, there are a few studies that found no significant difference in CF according to gender (Isazadegan & Dostalizadeh, 2020; Noureen & Malik, 2021; Chen et al., 2023). This lack of agreement between studies suggests the need for additional research to explore gender differences in CF.

When using SEM techniques, this study found that the CFQ strongly converges with the AAQ-II and diverges with the SWLS. These findings are consistent with previous research which used similar instruments to test this property (Gillanders et al., 2014; China et al., 2018; José Quintero et al., 2022; Romero-Moreno et al., 2014; Zacharia et al., 2021). Also, we found that the SEM model for testing convergence and divergence is strictly invariant for gender. However, the current study is the first to analyze convergence and divergence using SEM and evaluating its gender invariance (Deng & Yuan, 2023). Additional studies are recommended to offer a more robust understanding of this relationship.

This study found that the CFQ shows adequate reliability overall, as well as for each gender group. These findings are consistent with similar studies analyzing the CFQ (Gillanders et al., 2014; China et al., 2018; José Quintero et al., 2022; Romero-Moreno et al., 2014; Zacharia et al., 2021). As such, this study offers further evidence that the CFQ is a valuable evaluation and

interpretation instrument for assessing CF in Ecuadorian university students. Thus, it is a useful tool for identifying difficulties in a population that has concerning mental health results in various investigations (Dominguez-Lara et al., 2022; Moreta-Herrera et al., 2021; Torres et al., 2020). However, given that there is sparse psychometric research for the Ecuadorian population in general, additional research in the Ecuadorian context is necessary to further validate these findings.

Finally, we suggest that studying measure invariance by group is a valuable means of exploring and validating psychometric questionnaires. Indeed, this study verified that the CFQ shows measure invariance across gender which suggests that future studies researching the psychometric properties of the CFQ which find differences by gender can conclude that these are not caused by the measure but by intrinsic characteristics of each group.

## **5. Strengths and Limitations**

The strengths of this article lie in two main aspects: the rigorous methodological process and the data analysis. To analyze the complexity of the ordinal variables evaluated by the psychological instruments, SEM was used with the DWLS method. This methodological choice demonstrates the use of reliable and highly recommended processes for the analysis of this type of data. For these reasons, more precise and reliable results were obtained, since bias is reduced, which increases the validity and robustness of the findings of this study.

On the other hand, the limitations are the following: Since the sample used in this study was limited to Ecuadorian university students, we cannot draw generalized conclusions regarding the Ecuadorian population. In addition, a notable limitation is the lack of equality of participants in each gender, since the majority were women. This may affect the representativeness and generalization of the results for the male gender. In the same way, with the collected data it is not possible to conclude the reason for the differences found in the presence of CF between genders. We recommend the need for future research studying the psychometric properties of the CFQ in other populations such as teenagers, adults, and clinical populations, and the detailed study of the variables that generate differences in the presence of CF between genders.

## **Ethical approval**

The research project from which this work derives was reviewed and approved in its structure, content and care in ethical principles by the Research Commission of the School of Psychology of the Pontificia Universidad Católica del Ecuador Sede Ambato with number ES-045-2021.

**Informed Consent Statement**

Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement**

The data derived from this study is available to people who request it as long as it is for scientific and academic purposes and not of a commercial nature.

**Conflict of interest statement**

The authors declare that the research was conducted in the absence of any potential conflict of interest

**Author Contributions**

EMM data recollection, introduction, methodology, results, final revision; RMH introduction, results, discussion, final revision; MJB: introduction, discussion, references, translation, final revision; CJJM: methodology, data analysis, discussion, final revision; DVQ: methodology, data analysis, final revision.

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