New psychometric evidence of a bifactorial structure of the Emotional Regulation Questionnaire (ERQ) in Ecuadorian College Students

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Method Article

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Abstract

Objective: Confirm the bifactor structure of the Emotion Regulation Questionnaire (ERQ) and its reliability in a sample of Ecuadorian college students.

Method: Quantitative and instrumental study with confirmatory factor analysis using Robust Maximum Likelihood estimation.

Sample: 400 participants (62.5% women), aged 18 to 25 ($X = 21.1$; $SD = 1.95$) from two universities in Ecuador and seven different undergraduate courses.

Results: The bifactor model of the test is confirmed with an adequate adjustment χ^2= 35.99; p> .001; χ^2/df= 1.43; CFI= .98; TLI= .96; SRMR; .034 and RMSEA= .033 $CI_{95\%}$: [.033 - .052]; ω_H= .70; ω_{Hs1}= .23; ω_{Hs2}= .35. In addition, reliability is high with ω= .86 $CI_{95\%}$: [.81 - .88].

Conclusions: The ERQ is an adequate and reliable test to assess emotion regulation among Ecuadorian college students.

Introduction

Emotion regulation (ER) comprises a set of strategies (cognitive, emotional and physiological) that allow the individual to face various internal or external stimuli, managing the emotional response in order to adapt to their environment and achieve goals (Gross, 1999; Gross & John, 2003). Research in ER has grown exponentially due to the important role it plays in social adaptation and in the development of certain psychopathologies (Aldao, Nolen-Hoeksema & Schweizer, 2010), but also in the integral development of a human being (Momeñe, Jauregui & Estevez, 2017).

The Emotion Regulation Questionnaire (ERQ) (Gross & John, 2003) is used to evaluate ER, that assesses two independent regulation strategies: a) Cognitive Reappraisal (CR), which is an anticipatory strategy that allows interpretation and evaluation of context before the emotional response in order to modulate behavior when faced with a triggering stimuli; and b) Emotion suppression (ES) which allows the modulation of emotions while the individual experience them (Gross, 2007; Aldao *et al.*, 2010; Balzarotti *et al.*, 2010).

The ERQ has several translations and validations around the world, some of them present evidence of a two-factor orthogonal model (CR and ES without correlation) in Italy (Balzarotti *et al.*, 2010); Germany (Abler & Kessler, 2009); Spain (Rodríguez-Carvajal *et al.*, 2006; Cabello *et al.*, 2013); Portugal (Teixeira *et al.*, 2015); Australia and United Kingdom (Spaapen *et al.*, 2014) And USA (Preece *et al.*, 2021); while others show evidence of a two-factor oblique model (CR and ES correlated) in Sweden (Enebrink *et al.*, 2013); Peru (Gargurevich & Matos, 2010); Ecuador (Moreta-Herrera *et al.*, 2018) and Australia (Preece *et al.*, 2020). Both two-factor adjustment models (orthogonal and oblique), present an adequate internal consistency reliability as well as convergent validity when compared with other tests (health, well-being, emotional intelligence, among others).

Despite the promising results presented in these studies, several methodological errors have been found, such as in the selection of specific statistical tests that strictly comply with estimators for criterion and factorial validity as well as with internal consistency, which are quite important in the process for adaptation and validation of a test. Therefore, these errors can bias the conclusions. Thus, it is necessary to carry out new confirmatory studies, which include adequate methodological corrections taking into account the nature of data, in order to guarantee the validity of the ERQ for subsequent proper use.

Methodological implications on the validation of tests

Having tests translated, adjusted and adapted to the context in which the ERQ is applied, as well as any other test, is one of the challenges of evidence-based instrumental research. Nowadays, empirical research has focused more on social and psychic phenomena rather than on the development and validation of assessment tools. Latin America, including Ecuador, for example, is a region where advances in psychometrics and instrumental studies are scarce and limited. The use of assessment tools without proper instrumental validation, can compromise results from the beginning, due to the absence of calibration (Moreta-Herrera *et al.*, 2019), which leads to measurement errors and biases (Elosua, 2003). This can also cause errors in decision making, testing hypothesis and diagnosis (Rönkkö *et al.*, 2015).

An inadequate interpretation of the response to an item of a test (commonly answered with a Likert-type scale) is an error that results in the misuse of statistical tests during validation processes. Regardless of the number of options, their nature tends to be more categorical or ordinal rather than continuous, however, this type of data ends up receiving analysis through tests that assume normality and continuous nature, when in fact it is not (Sullivan & Artino, 2013). This error is observed in different statistical validation processes such as exploratory factor analysis (EFA), confirmatory factor analysis (CFA), construct validity and reliability, to name a few examples.

Considerations in Confirmatory Factor Analysis and Reliability

CFA is a statistical method widely used as evidence for the construct validity of a measure (Ferrando & Anguiano-Carrasco, 2010). This requires a considerable sample size (Brown, 2015), the confirmation of multivariate normality (Cain *et al.*, 2017) and the type variables (categorical, ordinal or interval) (Hair *et al.*, 2004). The treatment of data will depend on whether or not these criteria are met, using normal or robust estimators.

CFA is generally calculated with Maximum Likelihood Estimation method (ML) (Li, 2016), which assumes that the observed indicators (items) follow a continuous and multivariate normal distribution (Myung, 2003). In the case of psychological tests, this is not the most suitable method, as items usually have an ordinal nature (Gitta & Bengt, 2009) and continuous multivariate normal distribution is unlikely (Holtmann *et al.*, 2016). Therefore, CFA requires suitable estimators to these characteristics such as Diagonally

Weighted Least Squares (DWLS) method or robust estimations such as Robust Maximum Likelihood (MLR) or Weighted Least Squares with Adjusted Mean and Variance (WLSMV) (Jin & Cao, 2018). These methods, especially MLR are recommended, as it reduces biases compared to ML. This helps to obtain stronger evidence of validity, regardless the number of categories of the item and without multivariate normal distribution as long as large sample size is analyzed (n> 200) (Li, 2016).

Previous studies confirm an orthogonal two-factor model (Rodríguez-Carvajal *et al.*, 2006; Abler & Kessler, 2009; Balzarotti *et al.*, 2010; Cabello *et al.*, 2013; Spaapen *et al.*, 2014; Teixeira *et al.*, 2015; Preece *et al.*, 2021) of the ERQ (Gross & Jhon, 2003); although an alternative configuration of an oblique two-factor model is also proposed (Gargurevich & Matos, 2010; Enebrink *et al.*, 2013; Moreta-Herrera *et al.*, 2018; Preece *et al.*, 2020). The different configurations of the models in these studies are probably due to particular characteristics of the reference samples, differences in language and the estimators used in factor analysis (ML estimation is predominant in validation studies, which induces a greater measurement bias) (Jonason *et al.*, 2020; Moreta-Herrera *et al.*, 2020; Caycho-Rodríguez *et al.*, 2021).

In addition, due to the presence of moderate factor correlations in preliminary studies, it is likely that there is a third latent factor that groups all the items of the scale into a single factor, this would be explained through a bifactor model composed of a general factor (GF) and two specific factors (SF). This model represents the multidimensionality of the construct, and recognizes the uniqueness of the factors that compose it (Stefansson *et al.*, 2016).

Something similar occurs when determining reliability based on internal consistence of the ERQ, which is verified through Cronbach's alpha coefficient (α) (Sijtsma, 2009), a test that requires a significant number of cases for its analysis, as well as a continuous multivariate normal distribution. However, evidence suggests that using Cronbach's alpha is not ideal for this purpose (Trizano-Hermosilla & Alvarado, 2016), due to the ordinal nature of the items and Cronbach's alpha does not consider this aspect. In fact, its use is recommended only when the measurement scale has six or more options and normal distribution assumption is met (Elosua Oliden & Zumbo, 2008). As a result, researchers run the of underestimate or overestimate the true reliability of the measure, therefore, its use is not recommended (Ventura-León & Caycho-Rodríguez, 2017). Given this situation, it is methodologically correct to use reliability estimators according to the nature of the items, such as the omega coefficient (McDonald, 1999), which shows less bias in the assessment of reliability (Dunn *et al.*, 2014) or the ordinal coefficient alpha (Elosua Oliden & Zumbo, 2008).

Given these antecedents, there are still doubts that still need to be clarified about the best factorial fit of the ERQ, as well as other psychometric properties such as reliability, for their correct use in social research and intervention. This, especially in the Latin American and Spanish-speaking population.

Objectives and hypotheses

Based on the analysis contained in this text, the objectives of this study are a) Identify the best fit model of the ERQ (see figure 1) using Robust Maximum Likelihood estimation (MLR) in a sample of Ecuadorian college students, considering an orthogonal and oblique two-factor models as well as a bifactor model with a general factor. It is hypothesized that the bifactor model is the model that best represents the ERQ; b) Estimate the reliability based on internal consistency of the ERQ model with the best fit. It is considered that the ERQ has an optimal and adequate adjustment for the Ecuadorian college students.

Methodology

Design

This study applied a quantitative and instrumental descriptive design (Ato *et al.*, 2013) in order to confirm the model of two correlated factors of the ERQ in a sample of Ecuadorian college students through appropriate statistical tests for ordinal variables.

Participants

This study had the participation of 400 college students, aged between 18 to 25 years ($\bar{X}$= 21.1 years; s= 1.95). 62.5% are women and 37.5% men. 97.8% of the sample define themselves as mestizos and the remaining 2.3% as white and indigenous. In addition, 86% are located in urban areas and 14% in rural areas. Participants are students from two universities in Ambato, Ecuador; one of them was public (62.5%) and co-financed (37.5%), and from seven different undergraduate courses. 36.8% of the sample receive financial aid to carry out their studies, while 3.1% present academic risk due to poor performance.

Participants were selected through a non-probabilistic convenience sampling with the following inclusion criteria: a) Voluntary participation by means of a signed consent letter; b) Enrollment and regular attendance to classes; and c) Adequate mental health to carry out the psychological evaluation process.

Instruments

Emotion Regulation Questionnaire (ERQ; Gross & John, 2003) in its Spanish version (Rodríguez-Carvajal *et al.*, 2006) and adapted to Ecuadorian college students (Moreta-Herrera *et al.*, 2018). It has 10 items measured on a seven-options Likert scale, ranging from strongly disagree (1) to strongly agree (7), in which Cognitive Reappraisal and Emotion Suppression strategies are measured.

Procedure

After the permission of the authorities of the participating universities, the psychological evaluation began. All students interested in the research project were summoned to receive information about the objectives of the study and the activities they would develop. Prior to the general evaluation, a pilot test was carried out with 30 participants to know details about the evaluation time and language adaptations that could be necessary for the items of the test.

Once in the global evaluation, participants signed a letter of consent, before entering the psychological assessment, in appropriate classrooms for the process. After the evaluation, data was refined and digitized for subsequent statistical analysis and hypothesis verification. With the results achieved, the written report was prepared and approved.

Data Analysis

Data analysis was divided into three blocks. First block corresponded to preliminary analysis to know the behavior of the variables by means of measures of central tendency, dispersion and distribution. In addition, univariate normality assumption was verified due to the values of g_1 and g_2 were within the parameter ± 1.5 (Ferrando & Anguiano-Carrasco, 2010). Finally, the assumption of multivariate normality was fullfilled, this was checked through the Mardia test, when the coefficients of asymmetry and kurtosis resulted to be not significant ($p> .05$) (Mardia, 1970; Cain *et al.*, 2017).

The second block corresponded to the CFA with the RML estimator, which is reported as the most appropriate estimator considering the continuous nature of the variables and the absence of multivariate normality (Holtmann *et al.*, 2016; Jin & Cao, 2018). Three models were tested: a) an oblique two-factor model; b) an orthogonal two-factor model; and c) a bifactor model with two specific factors (SF) and a general factor (GF). The analysis verified that factor loadings were $\lambda > 0.5$ which positively contributes to explained variance (Hair *et al.*, 2004). Different adjustment levels were also analyzed: a) absolute fit indices by means of Chi-square (χ^2), normed Chi-square (χ^2/df) and the Standardized Root Mean Square Residual (SRMR); b) relative fit indices such as Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI); and c) non-centrality-based index through the Mean Square Error of Approximation (RMSEA). A model has an adequate adjustment when χ^2 is not significant ($p> .05$) or χ^2/df is less than 4; CFI and TLI are greater than 0.9 and SRMR together with RMSEA are less than 0.08 (Byrne, 2008; Ferrando & Anguiano-Carrasco, 2010; Wolf *et al.*, 2013; Brown, 2015; Mueller & Hancock, 2018). In addition, for the bifactor model, the Hierarchical Omega adjustments for the general factor (ω_H), the specific factors (ω_{Hs}) and the Common Explained Variance (ECV), were also tested. The bifactor model presented an adequate adjustment with $\omega_H >= .70$, ECV >= .70 and the $\omega_{Hs} >= .30$ (Reise *et al.*, 2013; Rodriguez *et al.*, 2016; Rodríguez-Lara & Rodríguez, 2017).

The third block included the analysis of internal consistency of the ERQ using the omega coefficient (ω, McDonald, 1999; Ventura-León & Caycho-Rodríguez, 2017), together with the confidence intervals that allow ensuring a better estimate of internal consistency (Domínguez-Lara & Merino-Soto, 2015). All data analyzes were performed using R software (R Core Team, 2019), an open access program.

Results

Preliminary Analysis

Table 1 shows that the item scores are generally concentrated in the middle of the response scale, displaying a moderate distribution. Univariate normality analysis evidences that this assumption is fulfilled based on the fact that both skewness and kurtosis scores are within the normal range (± 1.5);

while the assumption of multivariate normality is not met, due to the fact that the Mardia test shows significance for both, skewness and kurtosis.

Table 1.
Preliminary analysis of the ERQ items

Item	*X*	*SD*	*Skew*	*Kurt*
Cuando quiero incrementar mis emociones positivas (p.ej. alegría, diversión), cambio el tema sobre el que estoy pensando.	4.84	1.65	-0.79	-0.14
Guardo mis emociones para mí mismo	4.71	1.69	-0.61	-0.46
Cuando quiero reducir mis emociones negativas (p.ej. tristeza, enfado), cambio el tema sobre el que estoy pensando	5.05	1.56	-0.74	-0.21
Cuando estoy sintiendo emociones positivas, tengo cuidado de no expresarlas	3.58	1.71	0.12	-1.03
Cuando me enfrento a una situación estresante, intento pensar en ella de un modo que me ayude a mantener la calma	4.85	1.67	-0.70	-0.40
Controlo mis emociones no expresándolas	4.04	1.71	-0.12	-0.85
Cuando quiero incrementar mis emociones positivas, cambio mi manera de pensar sobre la situación	4.68	1.60	-0.65	-0.21
Controlo mis emociones cambiando mi forma de pensar sobre la situación en la que me encuentro	4.79	1.45	-0.52	-0.09
Cuando estoy sintiendo emociones negativas, me aseguro de no expresarlas	4.39	1.62	-0.30	-0.60
Cuando quiero reducir mis emociones negativas, cambio mi manera de pensar sobre la situación	4.86	1.56	-0.67	-0.13
	Mardia		**951,8*** **	**29.2***

Note: *400 observations; X: sample mean; SD: standard deviation; Skew: Skewness; Kurt: Kurtosis*

Confirmatory Factor Analysis

Table 2 shows the results of the fit indices of the three models of the ERQ evaluated in this study. The first model is the original one proposed by Gross & Jhon (2003), the second one comprises the oblique two-factor model and, finally, the third model corresponds to the bifactor model. Applying the MLR estimator, the oblique two-factor model (with a moderate latent correlation of ρ= .56) and the bifactor model of the ERQ presents an adequate adjustment as shown by absolute fit indices (χ^2, χ^2/df, SRMR), relative fit indices (CFI, TLI) and non-centrality-based index (RMSEA). The fit values for the bifactor model are better than those of the oblique two-factor model. The ANOVA function for SEM carried out by the Satorra-Bentler scaled chi-squared difference test (Satorra & Bentler, 2001), identifies the differences of adjustment of the Chi-squared and presents significant differences (p <.05) between the models, with $\chi^2_{(\text{bifactor – oblique two-factor})}$ = 59.26; df $_{(\text{bifactor – oblique two-factor})}$ = 9; p <.001, so the bifactor model is a better fit than the oblique two-factor model.

Table 2.

Confirmatory Factor Analysis of the ERQ with MLR estimation

Models	X^2	*df*	X^2/df	*CFI*	*TLI*	*SRMR*	*RMSEA*
Orthogonal two factors	154.12***	35	4.40	.83	.79	.167	.092 [.080 - .105]
Oblique two factors	99.45***	34	2.93	.91	.90	.062	.069 [.057 - .083]
Bifactor	35.99	25	1.43	.98	.96	.034	.033 [.006 - .052]

Note: *X^2: Chi square; df= degrees of freedom; X^2/df: normed Chi square; CFI: Comparative fit Index; TLI: Tucker-Lewis Index; SRMR: Standardized Mean Square Residue; RMSEA: Mean Square Error of Approximation*

Regarding the CFA of the ERQ, factor loadings of the bifactor model were tested. Figure 2 shows that the behavior of factor loadings (λ) through the general factor are more consistent, than through the specific factors of the ERQ, therefore, the general factor presents a better variance explained than the specific factors. This is confirmed with better adjustment of the ω_H as well as the ECV for the general factor when compared to the specific factors.

Reliability Analysis

Table 3 presents the omega coefficient (ω) values with their respective confidence interval of each of the ERQ factors, which report an acceptable degree of internal consistency, this is evidence that the ERQ is a reliable instrument in Ecuadorian college population. Furthermore, the intercorrelations of the ERQ factors with their overall score shows that the factors have moderate and high levels of correlation, so it is estimated that they contribute significantly to the model.

Table 3.

Analysis of reliability and intercorrelations of the ERQ

Factor	*ω IC 95%*	*CR*	*ES*	*ERQ*
Cognitive Reappraisal	,85 [,83 - ,87]	1	,303**	,713**
Emotion Suppression	,75 [,71 - ,79]		1	,624**
Global	,86 [,84 - ,88]			1

Note: *** p< ,01; ω: McDonald´s omega coefficient; CR: Cognitive Reappraisal; ES: Emotion Suppression; ERQ: Emotion Regulation Questionnaire*

Discussion

The objectives of this study were to identify the best adjust model of the ERQ, as well as its reliability in a sample of Ecuadorian college students. Regarding the CFA procedure, given the absence of multivariate normality and the continuous distribution of the observed variables (see Table 1), the use of a robust estimator was necessary (Gitta & Bengt, 2009; Holtmann et al., 2016). Therefore, Robust Maximum Likelihood estimation (MLR) was chosen since this method presents the best results in the cases indicated for its use (Li, 2016). In addition, the use of MLR is justified not only in the preliminary criteria to the CFA but also due to its recent use in similar validation processes of the ERQ (Preece et al., 2020).

CFA with MLR estimation found that the oblique two-factor and the bifactor models are optimum and consistent. Absolute Fit Indices (χ^2, χ^2/df y SRMR), Relative Fit Indices (CFI, TLI) and non-centrality-based index (RMSEA) (Byrne, 2008; Ferrando & Anguiano-Carrasco, 2010; Wolf et al., 2013; Brown, 2015; Mueller & Hancock, 2018) reflect adequate values. This confirms the good fit of the ERQ in Ecuadorian college students. These results differ from the orthogonal two-factor model proposed by Gross & Jhon (2003) and from other similar validation studies (Rodríguez-Carvajal et al., 2006; Abler & Kessler, 2009; Balzarotti et al., 2010; Cabello et al., 2013; Spaapen et al., 2014; Teixeira et al., 2015; Preece et al., 2021), since the orthogonal two-factor model did not present a relevant fit. On the other hand, results presented in this study are consistent with those presented in previous studies by Gargurevich & Matos (2010); Enebrink et al. (2013); Moreta-Herrera et al. (2018) and Preece et al. (2020).

Likewise, there is a latent interfactorial correlation in the oblique model (ρ), which allows exploring a new multidimensional model through a bifactor model, which encompasses all its items in a general factor, while respecting the uniqueness of the specific factors (Stefansson et al., 2016). This model has better factorial configuration settings (Reise et al., 2013; Rodriguez et al., 2016; Rodríguez-Lara & Rodríguez, 2017) and differs significantly from the previous model ($\Delta^2_{(\text{bifactor – oblique two–factors})} = 59.26$; $gl_{(\text{bifactor – oblique two–factors})} = 9$; $p < .001$), consequently, its use is more recommended. This is relevant in psychometric research, because it proposes a multidimensional model of which there are no previous reports. This will allow in the future, new processes of normalization of the scores considering the global result of the test, which was previously inadequate and reveals an unexplored composition this assessment tool that maximizes the interpretation of the construct "Emotion Regulation". However, since these findings do not yet have supporting evidence, they should be viewed with caution until future confirmatory studies.

Regarding reliability, it was found that both McDonald's coefficient scores, and their confidence intervals (CI) are within the acceptance parameters (Domínguez-Lara & Merino-Soto, 2015; Ventura-León & Caycho-Rodríguez, 2017), with both of the internal components (Cognitive Reappraisal and Emotion Suppression) and with the global assessment. In the context of Ecuador, these results (CFA and reliability) share similar conclusions to previous research of Moreta-Herrera et al. (2018) in psychology students. However, due to the modification of the methodology for obtaining results, it is necessary to be cautious with future comparisons because there are no similar studies that serve as a reference.

In conclusion, both CFA with RML estimation and reliability through McDonald's coefficient (1999) of the ERQ bifactor model, show adequate validation results. Thus, there is sufficient evidence of validity (Elosua, 2003) for its use in research and diagnosis in samples of Ecuadorian college students. Given the methodological variants used at the time of this analysis, new confirmatory studies are required to verify the factorial structure of the ERQ in other contexts.

Within the implications of the present study for instrumental research, the gate is open for the strengthening of this line of research in Ecuador and the region. An updated methodological framework is offered and its use is recommended for validation processes of psychological tests. In this regard, three innovations are presented: a) CFA with a robust method (MLR); b) the Omega coefficient (ω) for internal consistency with the confidence intervals; and c) a new factor configuration of the scale. The first two are recommended for an adequate analysis for continuous variables that do not present normal distribution and the third one to improve the assessment of the real reliability of a test. Finally, the results obtained in the ERQ analysis allow us to confirm that it shows a good validity in terms of factorial structure and high reliability.

Limitations And Future Research Lines

One of the main limitations of this study is related to the sample since only students from two universities in Ecuador were considered. We recommend replicating this study in the future with other types of populations such as adolescents, general population and others. It is also important to mention that this study only analyzes the factorial validity of the ERQ test, but not its equivalence of measurement for multigroup studies (culture, sex, age groups and others). Therefore, this must be considered and confirmed beforehand as a preliminary step for comparative studies.

Declarations

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Compliance with Ethical Standards: All procedures performed in studies involving human participants were in accordance with the ethical standards of the [Pontificia Universidad Católica del Ecuador Sede Ambato research committee] and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Conflicts of Interest: The authors declare they have no conflict of interest.

Informed Consent: Informed consent was obtained from all individual adult participants included in the study

Declaration of contribution

The authors Rodrigo Moreta-Herrera, Mónica Perdomo-Pérez and Diego Vaca-Quintana were in charge of the bibliographic search and the formulation of the introduction. Hernán Sánchez-Vélez, Pamela Camacho-Bonilla and Fabricio Vásquez de la Bandera for data collection and introduction and methodology. And Rodrigo Moreta-Herrera, Sergio Domínguez-Lara and Tomás Caycho-Rodríguez of the statistical management, the results, and the formulation of the discussion. All authors reviewed the final version of the text and gave their consent and approval.

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Figures

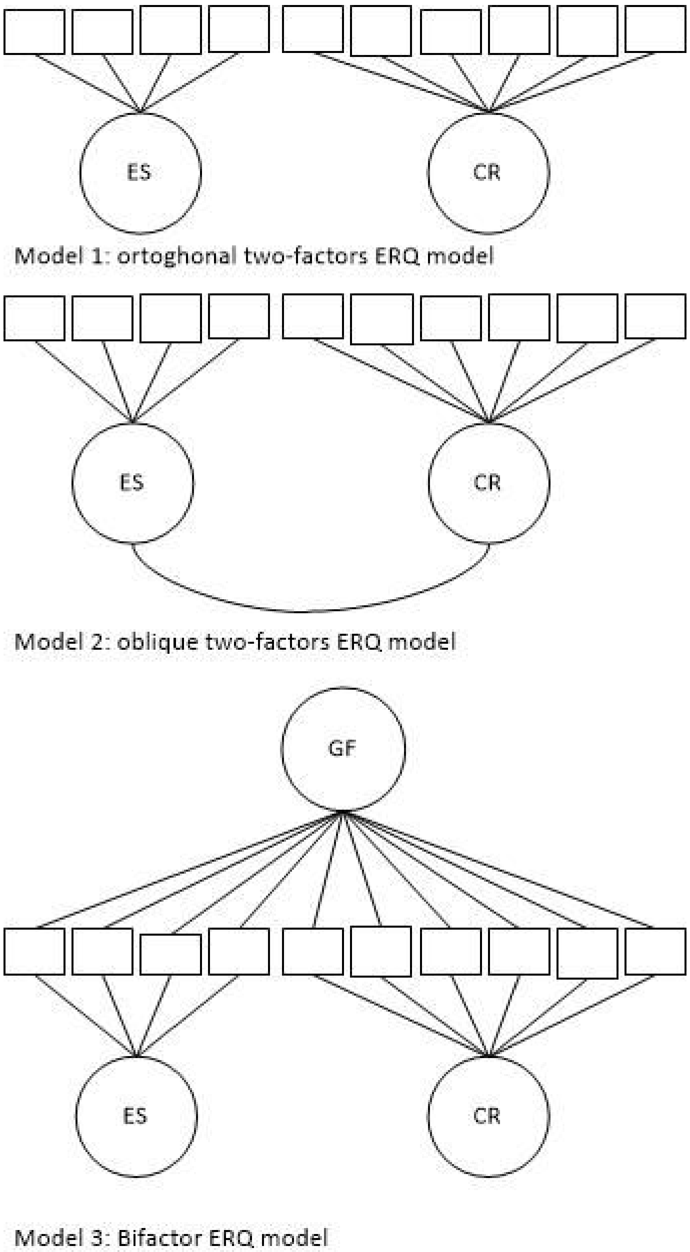

Figure 1

Different Models of the Emotion Regulation Questionnaire Evaluated in the Study

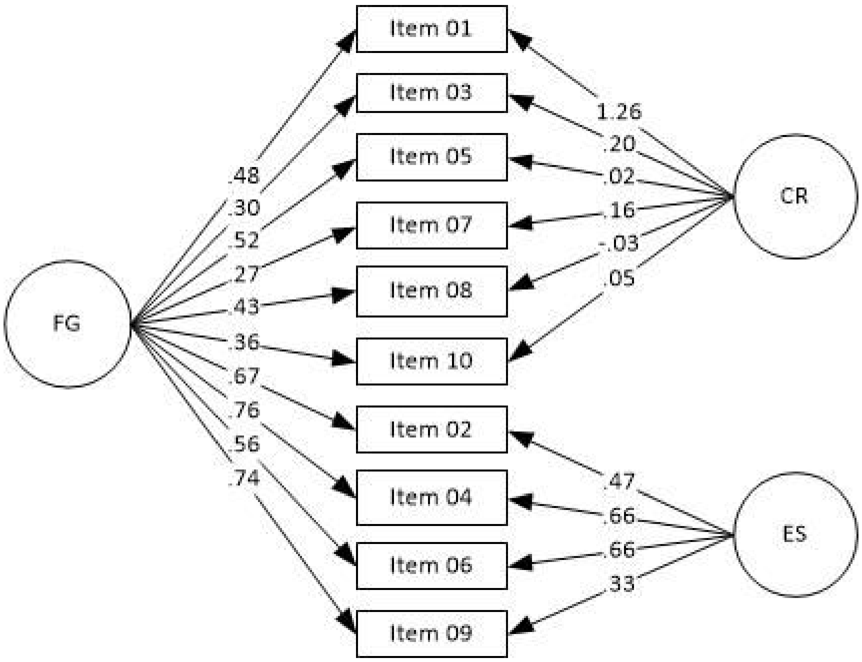

Figure 2

Bifactor model of the ERQ. Circles represent the latent variables that comprise errors and factors (Cognitive Reappraisal and Emotion Suppression), while rectangles represent the observed variables that are the test items.