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Factor Structure of the Torrance Tests of Creative Thinking Figural Form B in Spanish-Speaking Children: Measurement Invariance across Gender*

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Abstract

Based on contradictory studies regarding the factor structure of the Torrance Tests of Creative Thinking (TTCT) Figural, the objective of this study was to compare, through a Confirmatory Factor Analysis (CFA), four theoretical models that explain the operationalized creativity construct with the TTCT. We evaluated a sample of 577 Spanish-speaking school children of both genders, aged 9 to 14 years. The CFA of most satisfactory fit identified two correlated factors: (i) Innovative and (ii) Adaptive. Besides, Multi-group CFA (MGCFA) revealed that the two-factor solution was invariant (configural, metric, and structural) across gender. Finally, MANOVAs were conducted to analyze the differences in each factor and subscale according to gender, revealing significant group differences. The methodological and educational implications of the results are discussed.

Keywords: Creativity; Confirmatory Factor Analysis; Measurement Invariance; Gender

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Several methods exist for evaluating creativity. These include tests of divergent thinking, attitudes and interest inventories, personality measures, and biographical inventories (Clapham, 2004). However, the most widely used tests are those related to divergent thinking, specifically the Torrance tests. These tests attempt to evaluate individuals' capacities to produce many new and original ideas to address a problem. According to Guilford (1968), divergent thinking leads to unusual, multidirectional, and adaptive solutions; in other words, to solutions that involve a variety of responses to a stimulus rather than a single solution.

The *Torrance Test of Creative Thinking* (TTCT) is based on Guilford's Structure of Intellect model. It was first published in 1966 and was revised in 1974, 1984, 1990 and 1998. Research, experimentation, and instructional planning and the determination of students' strengths actually become TTCT original purpose (Torrance, 1974). Torrance claimed that a high score on TTCT signals a strong probability that an individual will behave in a creative manner, despite the fact that creative behavior is not proved by means of creative abilities (Torrance, Ball & Safter, 1992).

The TTCT has been used with a very large sample of evaluated subjects from pre-school up to adulthood (Torrance, 1998). Besides, the former has been used in more than 35 countries with research purposes (Kim, 2006a), it have been translated into more than 35 languages (Millar, 2002) and appears as one of the most widely used measurement of creativity (Chávez et al., 2004; Cropley, 2000; Davis, 1989, 1997; Wechsler, 1998).

The TTCT comprises two subtests, a Verbal and a Figural subtest. Each subtest has two parallel forms, A and B (Kim, 2006b; Kim et al., 2006; Torrance, 1966, 1974). The TTCT may be used individually or collectively, and each set of tests may be administered separately. The test measures four creative thinking abilities, namely (a) Fluency, (b)

Flexibility, (c) Originality, and (d) Elaboration (Torrance, 1990, in Cramond, Matthews Morgan, Bandalos & Zuo, 2005; see also Kim, 2006a; Torrance, 1990b, 1990c). *Fluency* is associated with the "capacity to give many answers on a determined area of information and at a given time" (Romo, 1997, p. 86). This characteristic may also occur in individuals who are not creative, but the fact is that all creative individuals produce many solutions indeed. *Flexibility* is the "possibility of transforming the information" (Guilford & Strom, 1978, p. 19) or the "ability to abandon old ways in the treatment of problems and carry on thoughts in different directions" (Romo, 1997, p. 78). It opposes rigidity and the incapacity to modify and change attitudes. *Originality* incorporates the concepts of 'unique' and 'new'. Romo (1997) characterized originality as follows: (a) the probability of the occurrence of something rare or different; (b) the fruit of remote associations; and (c) something of good quality for the determined environment. Originality refers to something distinct and different that evokes surprise and tends to move away from the rules. *Elaboration* is an aptitude for elaborating details or ideas and is related to fluency and flexibility (Torrance et al., 1992).

The TTCT-Figural (Form B), which was used in the current research, includes three activities. In the first activity, the subject is asked to draw a picture based on a stimulus that is provided on the test page. The second activity requires the individual to draw using ten incomplete figures and to title each of the drawings. Activity three presents circles, and the individual must draw using the circles (Kim, 2006a; Torrance et al., 1992).

With respect to the evaluated abilities, specifically in the Figural test, the first (1966) edition of the test includes the following: *Fluency, Flexibility, Originality,* and *Elaboration*. In the reviews published in 1974 and 1984, Torrance eliminated the *Flexibility* dimension and added *Abstractness of Titles* and *Resistance to Premature Closure* as gestaltic measures of individuals' capacity to remain open, admit ambiguity, and thus produce creative responses (Kim, 2006a, 2006b; Torrance et al., 1992).

Based on longitudinal studies, Torrance et al. (1992) included the following 13 criteria to measure Creative Strengths (Torrance et al., 1992, p. 5): Emotional Expressiveness; Storytelling Articulateness; Movement or Action; Expressiveness of Titles; Synthesis of Incomplete Figures; Synthesis of Lines or Circles; Unusual Visualization; Internal Visualization; Extending or Breaking Boundaries; Humor; Richness of Imagery; Colorfulness of Imagery; and Fantasy. In 1984, Torrance developed a scoring system to measure these 13 criteria (Torrance & Ball, 1984) and simplified the correction system of this test (Kim, 2006a; Cramond et al., 2005; Torrance et al., 1992).

Reliability and Validity

With respect to the reliability of the TTCT, studies have shown that the internal consistency of the test (measured using the KR-21 (Kuder-Richardson 21) and the 99th percentile as estimators of the total number of elements) oscillated between .89 and .94 and the reliability between evaluators was .90 (Torrance, 1990a, 1990b, 1998). Using the previous version of the Figural test (Form A), Ferrando et al. (2007) found a general alpha of .90. In contrast, using the new version of Form A, Clapham (2004) found a general alpha of .72 and a lower alpha on each of the scales. The studies by Ferrando (2004), López (2001), Prieto, López, Ferrándiz and Bermejo (2003), and Prieto et al. (2006) showed a satisfactory reliability coefficient (.90) for the Figural test. In Krumm and Lemos's (2011) study in Argentina, Form B of the Figural test scored a general α of .70. The study of the test-retest stability showed coefficients that varied between .50 and .93 (Kim, 2006b; Ferrando Prieto, 2006; Torrance, 1974). Treffinger (1985) suggested that, due to the complexity of creative thinking, the scores obtained for the stability of the test may be considered adequate.

Interest in creativity tests has generated various studies on the validity of the TTCT. With respect to the concurrent validity, González and Campos (1997) studied the relationship between the dimensions of the TTCT-Figural, Thurstone's spatial test of the Primary Mental

Aptitudes (PMA), and Gordon's Test (*Visual Imagery Control*). The results showed significant relationships between the scores of the TTCT and PMA and Gordon's Test, specifically in the dimensions of originality and resistance to premature closure.

With respect to the predictive validity of the TTCT, Torrance (1969, 1972, 1981a, 1981b, 2002) conducted four follow-up 7, 12, 22, and 40 years after the first administration of the test. The results indicated that TTCT scores were good predictors of creative work, creative quality, and creative motivation (see also Cramond et al., 2005; Cropley, 2000; Ferrando Prieto, 2006; Kim, 2006b; Sawyers & Canestaro, 1989; Torrance, 1966, 1981, 2002). Howieson (1981), applying the figural and verbal tests, also confirmed the predictive validity of the TTCT after 10 years. Yamada and Tam (1996) and Plucker (1999) re-analyzed the data obtained by Torrance and concluded that the TTCT index of creativity was a predictor of creative achievement in adults. In a Brazilian population, Wechsler (2006) also found an association between creative achievement and verbal and figural TTCT scores. Runco, Milar, Acar y Cramond (2010) reported a 50-year follow-up of the Torrance longitudinal study. The sample was integrated by 60 subjects that had taken part in Torrance's initial study. The authors used both the punctuations of the Weschler Intelligence Scale for Children (WISC) and four punctuations of the TTCT from the original study. They administered two tasks as criterion: (a) the Creativity Style of Life (Torrance, 2002) and (b) The Beyonder Checklist (Torrance, 1993). Runco et al. (2010) found that the punctuations of the TTCT related moderately to personal achievement rather than to public achievement. Nevertheless, the interaction intelligence and creativity concerned to public achievement but not to personal achievement. Eventually, they found that three indicators of The Beyonder Cheklist (i.e., Love of work, Tolerance of mistakes, and Minority of one) related to public achievement and just one indicator of this test (i.e., Well-roundedness) correlated with

personal achievement. As for the relation between creativity and intelligence, this study results did not support the threshold theory in the study sample.

With respect to the construct validity of the test, one of the main difficulties has been demonstrating that the dimensions proposed by Torrance are, in fact, evaluated by the TTCT. Studies have yielded contradictory evidence with respect to the dimensions evaluated by the verbal (Krumm & Lemos, 2007, 2010) and the figural tests (Almeida, Prieto, Ferrando, Oliveira & Ferrándiz, 2008; Antunes & Almeida, 2007; Baer, 1994; Clapham, 1998; Chase, 1985; Dixon, 1979; Han & Marvin, 2002; Heausler & Thompson, 1988; Hocevar, 1979a, 1979b; Hocevar & Michael, 1979; Kim 2006a, 2006b; Krumm & Lemos, 2010; Treffinger, 1985).

According to Kim et al. (2006), few studies have analyzed the latent structure of both forms of the two tests. A group of studies concluded that the TTCT is unidimensional, suggesting a general factor (Clapham, 1998). For example, Hocevar (1979a, 1979b) suggested that the TTCT only measured fluency. Similarly, Dixon (1979) concluded that the originality test scores depended on the fluency scores, whereas Abernathy Tannehill (1997, in Kim et al. 2006) found high correlation between these two dimensions and proposed that they were similar constructs. A high correlation between these dimensions was also found in Krumm and Lemos's (2011) study in Argentina. Hassan (1986) stated that there was no justification for considering the creativity measured by the TTCT to be composed of the dimensions proposed by Torrance (fluency, flexibility, originality, and elaboration). In addition, Heausler and Thompson (1988) concluded that the correlations between the factors were high enough to provide significant information and that the TTCT measured a general factor.

Studies in which exploratory factor analyses were conducted have concluded that (a) the factors are determined by the specificity of the proposed task or activity independently of the dimensions that are evaluated (Baer, 1994, 1998; Ferrando Prieto, 2006; Han & Marvin,

2002; Krumm & Lemos, 2010) and (b) on occasion, these factors identify with the evaluated cognitive processes and functions (fluency of ideas, flexibility, and originality) (Oliveira et al., 2009).

In all the cited studies, the obtained factorial structure did not correlate with the theory proposed by Torrance.

Based on confirmatory factor analyses, a group of studies have found two factors, innovative and adaptive (Kim, 2006b; Kim et al., 2006). These factors arise from the model proposed by Kirton (1976, 1978, 1989; see also Isaksen & Puccio, 1988), in which creativity is explained through a dimension that ranges from an innovative style to an adaptive style. These two styles may be separate factors (Kim, 2006b). Individuals with a more innovative style present rapid and novel responses, whereas individuals with a more adaptive style present more detailed responses and greater depth of thought. The latter individuals prefer to work on existing issues (Kim, 2006b; Kim et al., 2006; Oliveira et al., 2009; see also Puccio, Treffinger, & Talbot, 1995).

The current study

Provided that some authors suggest that the creativity construct is integrated by two factors (see e.g, Kim 2006b; Kim et al., 2006), the current study tested four different theoretical two-factor models by means of CFA in order to explain children creativity as measured by the TTCT-Figural, Form B. In addition, once being tested the model of better adjustment, it was proved whether the construct was better explained through a one-dimensional model.

The first theoretical model is based on Kim's hypothesis (2006b, see also Kim et al., 2006) regarding the conformation of the creativity construct. According to this hypothesis, the latent innovative factor comprises the abilities of fluency and originality, and the latent

adaptive factor is represented by elaboration, abstractness of titles, and creative strengths. The dimension of premature resistance to closure is part of the two factors. This model was designated “creativity construct with *resistance to premature closure* as part of the latent innovative and adaptative factors”.

Model two, is represented by the latent innovative factor, which consists of fluency, originality, and resistance to premature closure. The latent adaptative factor is composed of elaboration, abstractness of titles and creative strengths. This model was named “creativity construct with *resistance to premature closure* as part of the latent innovative factor”.

In Model three, resistance to premature closure is loaded in the adaptative factor. This model was named “creativity construct with *resistance to premature closure* as part of the latent adaptative factor”.

Finally, model four is similar to model three but it lacks the creative strengths dimension in the latent adaptative factor. The aforementioned model considered on the basis of Kim's (2006b) proposals which analysed models with and without this subscale, since his procedure of punctuation is different from that of the other subscales. This model was named “creativity construct without *creative strengths*”. The four graphic models are presented in Figure 1.

_____PLEASE INSERT FIGURE 1_____

Method

Participants

The study was conducted using an intentional, non-probabilistic sample of 577 schoolchildren, 331 (57.4%) female and 246 (42.6%) male, between the ages of 9 and 14 years (M = 10.55; DE = 1.21). The children attended fourth, fifth, and sixth grade of primary

school and seventh grade of secondary school in private and public schools of the cities Libertador San Martín, Crespo, Diamante, and Paraná of the Entre Ríos province, Argentina.

Ethical aspects

The purposes and methods of the study were explained to the school principals and permission to work with the children was requested. A letter was then sent to the parents via the children. The letter explained the objectives of the study and the types of tasks that the children would perform. It was made clear that participation was voluntary and anonymous. After parental informed consent was obtained, the TTCT-Figural, Form B, was administered to the children as a group during school hours, preferably during the first few hours of the school day or at mid-day. Trained and supervised research assistants assisted in the administration of the test.

Measures

As previously mentioned, the TTCT-Figural, Form B, was used. This test consists of three activities, each of which is completed in 10 minutes. The first activity requires the drawing of a picture based on a curved shape and the creation of a title for the drawing. This activity evaluates *originality, elaboration, and abstractness of title.* Activity two requires the individual to complete ten figures that appear as "incomplete" and to create titles for the figures; this activity evaluates *fluency, originality, elaboration, abstractness of title, and resistance to premature closure.* Activity three demands the subject to make a drawing using 36 circles such that these circles form the main part of the drawing. Activity three evaluates *fluency, originality, and elaboration* (Torrance et al., 1992).

Results

Confirmatory Factor Analysis (CFA)

CFA by means of AMOS Graphics 16.0 program (Arbuckle, 2007) was performed in order to study the latent structure of the creativity construct. The goodness of fit was estimated for the models using the χ^2 test and the following fit indices: Comparative Fit Index (CFI) and Incremental Fit Index (IFI). In addition, the root mean square error of approximation (RMSEA) was calculated for each model to determine the degree of error. The following models were tested: Model 1: "creativity construct with *resistance to premature closure* as part of the innovative and adaptative latent factors"; Model 2: "creativity construct with *resistance to premature closure* as part of the innovative latent factor; Model 3: "creativity construct with *resistance to premature closure* as part of the adaptative latent factor"; and Model 4: "creativity construct without *creative strengths"* (see Figure 1). To determine which model provided the best fit, the χ^2 test and the following fit indices were taken into account: GFI (*Goodness of Fit Index*), NFI (*Bentler-Bonett Normed Fit Index*), and CFI (*Comparative Fit Index*). In addition, the adjusted index of the root mean square error of approximation (RMSEA) was calculated for each model to assess the degree of error. Because the χ^2 obtained for all of the models was significant, the corrected χ^2 was calculated as χ^2 /gl. As shown in Table 1, the fit indices of Models 1, 3, and 4 were very good, as shown by the fact that the GFI, NFI, and CFI for all of these models had values greater than .90 and the RMSEA was lower than .08. However, Model 4 demonstrated the best fit (see Table 1 and Figure 2).

_____PLEASE INSERT TABLE 1_____

_____PLEASE INSERT FIGURE 2_____

After noticing that Model 4 best explained the creativity construct, the models were compared to determine whether their structures were better explained by a unidimensional construct or by a construct of non-correlated factors. To test the one-factor model (unidimensional construct), the correlation between the latent variables was set to 1. As the data in Table 2 show, there was no significant improvement of fit of the unidimensional model over the two-factor model. Thus, the two-factor model was retained as the best fit. Lastly, a model of non-correlated factors was tested in which the correlation between the latent variables was set to 0. This model could not be identified. These data suggest that a model of two correlated factors best explains the creativity construct.

_____PLEASE INSERT TABLE 2_____

Multigroup CFA across gender

Once the model that best explained the creativity construct in the entire sample (n = 577) was identified, the fit of the model for each group according to the child's gender (n_{boys} = 246; n_{girls} = 331) was tested. As shown in Figure 3, the two-factor model gave acceptable fit indices for both groups. Having shown that the model fits both groups, Multigroup CFA was used to verify the configural, metric, structural, and residual invariance across child gender. This analysis is conducted through a sequence of hierarchically nested models. In the first analysis (baseline model), which verifies the configural variance, all of the parameters may vary independently among the groups. In the following analysis, equality restrictions are imposed on different parameters among the groups. Non-significant differences between the nested models indicate that the restrictions may remain and, thus, invariance across the groups may be assumed. At the same time, a difference of .01 or less among the subsequent levels of invariance of the CFI was considered an indicator that the restricted parameters were invariant

(Cheung & Rensvold, 2002). Model 1, the M1 baseline model, did not present restrictions across the two groups. Because this model gave acceptable fit indices (see Table 3), it is possible to assume configural invariance among the groups, indicating that boys and girls conceptualized the creativity construct in the same manner. In Model 2 (M2), the factor loadings were restricted to being equal in both groups. As shown in Table 3, the increase in χ^2 was not significant (p = .276), the model's fit indices were adequate, and the CFI difference was equal to .00. Thus, the criterion of metric invariance between the groups may be assumed, indicating that boys and girls responded in the same manner to the indicators of each latent variable and to the relationships between these indicators with their respective factors. In Model 3 (M3), the variances and covariances of the factors were restricted to being equal between the groups. Because the increase in χ^2 was not significant (p = .060), the model's fit indices were adequate, and the CFI difference was equal to .01, the criterion of structural invariance was assumed. In Model 4 (M4), the variances and covariances of the variables were restricted to being equal between the groups. Because the model did not show a good fit to the data and the increase in χ^2 was significant, invariance in the residues could not be assumed. Nevertheless, considering the fact that the test of residual invariance is highly constrained (Chan, 1998), this aspect would become less important than the former analyses for the assessment of measurement invariance.

_____PLEASE INSERT FIGURE 3_____

_____PLEASE INSERT TABLE 3_____

Difference between the factors according to gender

After the invariance (configural, metric, and structural) between males and females was verified, MANOVA was used to test the differences in the scores obtained according to children's gender.

Innovative

MANOVA showed significant differences in the innovation factor according to gender (Hotelling's T= .043), $F(2, 574) = 12.384$; $p < .001$, partial $\eta^2 = .041$. The univariate results showed significant differences in the fluency dimension, $F(1, 575) = 24.675$; $p < .001$, partial $\eta^2 = .041$, and the originality dimension, $F(1, 575) = 10.645$; $p = .001$, partial $\eta^2 = .018$.

Adaptive

MANOVA showed significant differences in the adaptive factor according to gender (Hotelling's $T = .028$), $F(3, 573) = 5.287$; $p = .001$, partial $\eta^2 = .027$. The univariate results showed significant differences in the elaboration dimension, $F(1, 575) = 9.958$; $p = .002$, partial $\eta^2 = .017$. No significant differences were found in the abstractness of titles dimension, $F(1, 575) = 3.376$; $p = .067$, partial $\eta^2 = .006$, or in the resistance to premature closure dimension, $F(1, 575) = .050$; $p = .824$, partial $\eta^2 = .000$.

_____PLEASE INSERT TABLE 4_____

Discussion

This study was based on the studies by Kim (2006b) and Kim et al. (2006), which were derived from Kirton's theoretical proposal (1976, 1978, 1987, 1989). The current study aimed to explain the creativity construct measured by the TTCT-Figural, Form B, through two general factors, innovative and adaptative in a sample of Spanish-speaking children. The proposal of these two factors was confirmed.

CFA found that, of the four compared models, Model 4 (i.e., creativity construct without *creative strengths*) demonstrated the best fit to the data. In this model, the *Innovative* factor was composed of the fluency and originality abilities and the *Adaptive* factor was composed of the elaboration, abstractness of titles, and resistance to premature closure abilities. Regarding the innovative factor, it is not unexpected to observe that fluency and originality should integrate the same factor as they are dimensions that have a high correlation among them (Kim, 2006b, Krumm & Lemos, 2011; Chase, 1985, Heausler & Thompson, 1988). In addition, persons who have large quantity of ideas are likely to be more original (Torrance & Safter, 1999). Therefore, this factor would better relate to a style of rapid and original answers, with a preference to innovate rather than to work on current situations (Kirton, 1976). On the other hand, the adaptive factor, would be integrated by the dimensions (a) elaboration, related to the aptitude to add ideas, (b) abstractness of titles, connected to processes of synthesis and organization, with the abstract thinking and the aptitude to title what has been drawn (Torrance et al., 1992) and (c) resistance to premature closure, related with the capacity to delay closure, perform mental leaps, and produce ideas without reaching hasty conclusions (Torrance et al., 1992). Interestingly, every proposed models, and consistent with results found by Kim et al. (2006b), demonstrated that elaboration showed the weakest correlation with the adaptive factor. Nevertheless, this ability would be quite far from fluency and originality, since it relates to the adjustment and improvement of ideas, more than to the proposal of new ideas (Puccio et al., 1995).

In contrast to the results of Kim's studies (2006, 2006b), that suggest that the resistance to premature closure would be present in both the innovative and the adaptive factor, the present study revealed that the resistance to premature closure was just present in the adaptive factor and the models who placed this dimension within the innovative factor did not reveal good indices of adjustment (i.e., Model 1, Model 2). Interestingly, though the

model to explain the creativity construct from the TTCT obtained by Kim (2006b) is different from that of this investigation, in both studies the best adjustment is obtained by models that do not include creative strengths.

Model 4 was also compared with a model of a general factor. As in Kim's study (2006b), a model of two correlated factors best explained the creativity in the current study. This result demonstrates that the TTCT is not unidimensional, as proposed by various authors (Chase, 1985; Clapham, 1998; Heausler & Thompson, 1988; Hocevar, 1979a, 1979b; Hocevar & Michael, 1979; Runco & Marz, 1992; Treffinger, 1985). Our results also do not coincide with Torrance et al.'s (1992) theoretical proposal, in which the TTCT-Figural is composed of five separated abilities (i.e., fluency, originality, elaboration, resistance to premature closure and abstractness of titles) and creative strengths.

With respect to measurement invariance across gender, the results showed that Model 4 fit for both females and males. Both groups conceptualized and responded equally to the creativity construct measured by the TTCT. Regarding the comparison of the scores on the factors evaluated between males and females, significant differences were observed in the innovation and adaptation factors; girls achieved better scores in fluency, originality, and elaboration. Based on these results, it would be interesting to further explore the causes of these differences and determine whether they are actually due to differences in the degree of creativity according to gender or whether the test's characteristics may be more attractive and stimulating to girls than to boys.

Performance on the subscales was not homogenous. Both girls and boys obtained lower scores on the resistance to premature closure and abstractness of titles subscales. This could be due to evolutionary reasons, although it could also be argued that these processes are not stimulated or reinforced in formal education. Based on these data, it would be interesting for schools to add activities that increase the capacity for synthesis, organization of ideas,

openness that requires the abstractness of titles, and the resistance to premature closure to their curricular programs. Many authors state that childhood is decisive in the formation of predispositions of creative behavior; for example, De la Torre (2006, p. 319) stated that "The creative preferences of the adult have their roots in childhood; to identify them is to facilitate them". Kay-Cheng (2000) stated that the teaching of creativity has been neglected and has not received sufficient attention by researchers or teachers. Thus, it is important to train teachers, review the methods for the evaluation of learning, utilize technology tools, consider teachers' expectations of their students, and encourage teachers to promote students' creative performance (Strom & Strom, 2007; Horcas Villarreal, 2009; Cho, Chung, Choi, Suh, & Seo, 2011).

In summary, the results of this study provide clarification of the creativity construct operationalized by the TTCT. Based on a Spanish-speaking context, the study offers psychometric evidence that supports the findings reported in previous studies from other countries.

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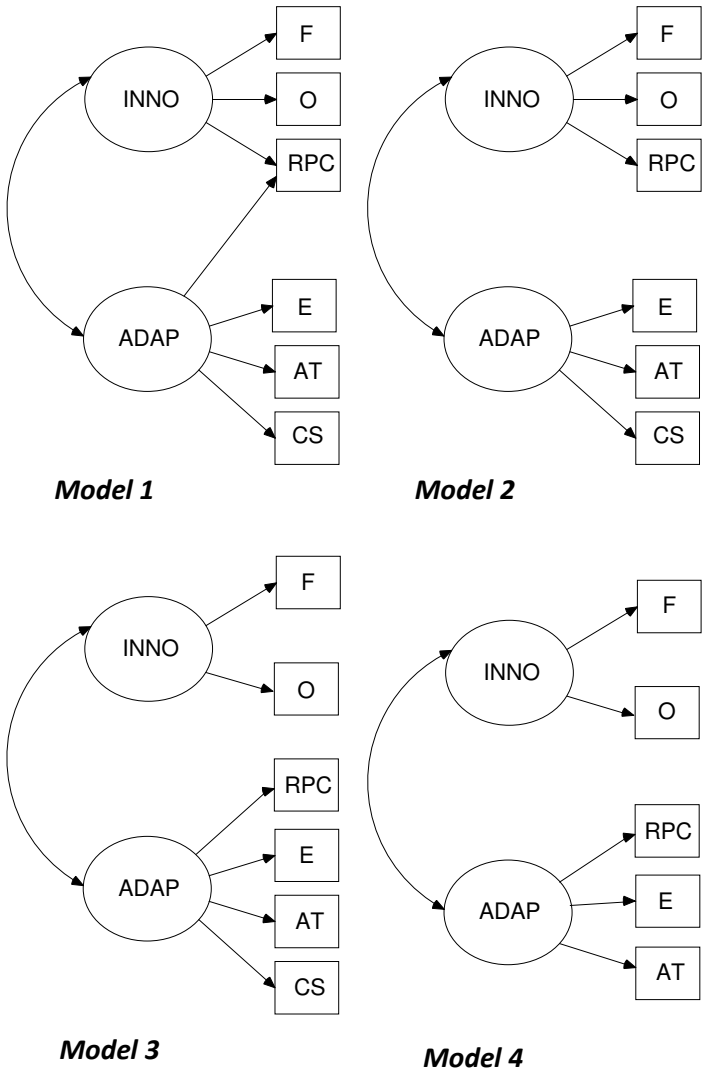


FIGURE 1. *Hypothesized Models of the creativity construct*

Note. INNO = Innovative; ADAP = Adaptive; F = Fluency; O = Originality; RPC = Resistance to premature closure; E = Elaboration; AT = Abstractness of titles; CS = Creative strengths

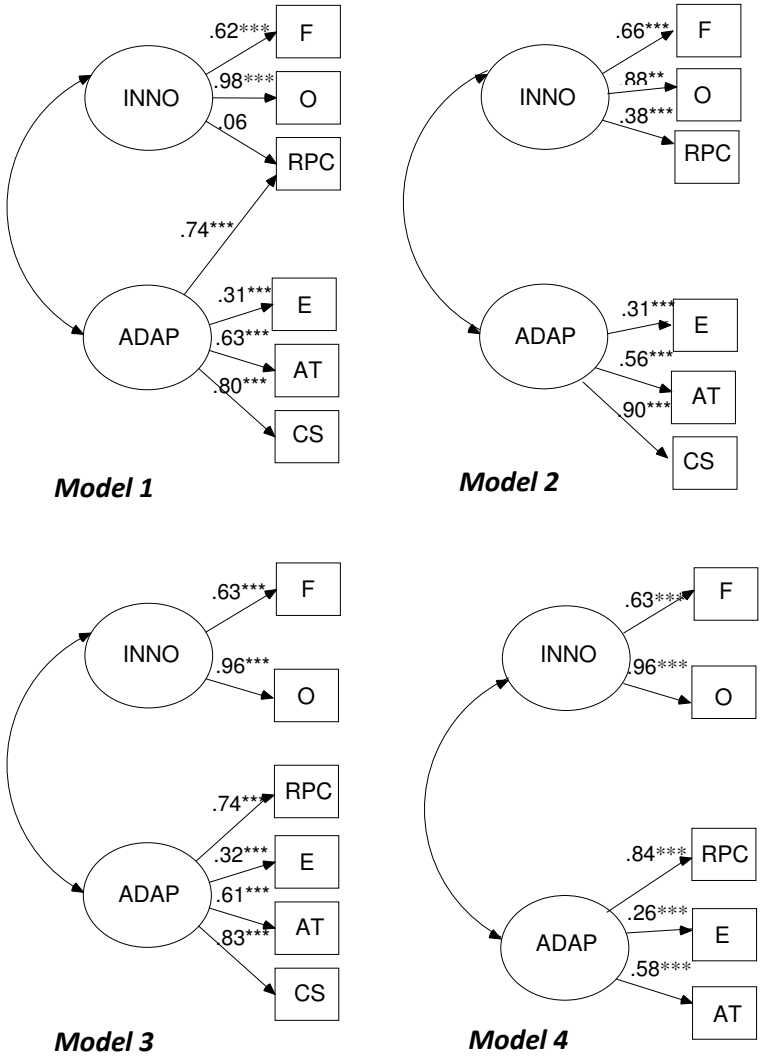


FIGURE 2. *Estimated Models of the creativity*

Note. INNO = Innovative; ADAP = Adaptive; F = Fluency; O = Originality; RPC = Resistance to premature closure; E = Elaboration; AT = Abstractness of titles; CS = Creative strengths.

TABLE 1. *Fit Indices of Models*

	Chi-Square test			Fit Indices			
Models	χ^2	*df*	χ^2/df	GFI	NFI	CFI	RMSEA
Model 1	21.45***	6	3.58	.99	.98	.98	.07
Model 2	281.32***	7	40.19	.88	.69	.69	.26
Model 3	23.44***	7	3.35	.99	.97	.98	.06
Model 4	**12.46*****	**4**	**3.12**	**.99**	**.98**	**.98**	**.06**

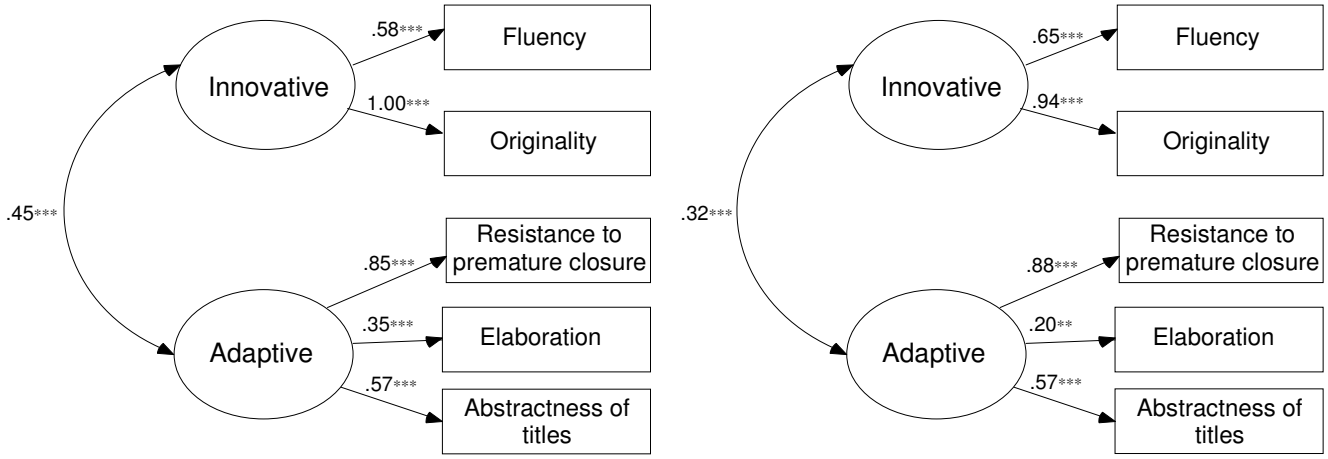
*** $p < .001$

The 'best fit model' values are presented in bold type.

TABLE 2. *Fit Indices for the Two-factor CFA Model and Reduced Model*

Models	χ^2	*df*	χ^2/df	CFI	IFI	AIC	RMSEA	$\Delta\chi^{2a}$	Δdf	*p*
1. Two-factor model	12.46	4	**3.12**	**.99**	**.99**	**34.46**	**.06**			
2. One-factor model	29.04	5	5.81	.95	.95	49.04	.09	16.58	1	< .001

[a] Indicates comparisons to the two-factor model.
Values higher than 0.95 for CIF and IFI, lower values of AIC, and RMSEA below 0.08 indicate good fit.
χ^2 difference tests indicated that the reduced model provided significantly worse fit than the two-factor model.
The non-correlated-factor model could not be identified.
The 'best fit model' values are presented in bold type.



Males: χ^2 ***= 7.14;*** **df*=4;*** χ^2/**df** ***= 1.79; p= .129; CFI = .99; IFI=.99; RMSEA= .06.***

Females: χ^2 ***= 17.44;*** **df*=8;*** χ^2/**df** ***= 2.18; p= .026; CFI = .98; IFI=.98; RMSEA= .05.***

** p < .01, *** p < .001

FIGURE 3. *Confirmatory Factor Analysis of Creativity for each group defined by gender*

TABLE 3. Measurement invariance across gender

Model (M)	χ^2	*df*	*p*	IFI	CFI	RMSEA	$\Delta\chi^{2a}$	Δdf	*p*	CFI[a]
Configural invariance (M1)	16.25	6	.012	.98	.98	.06				
Metric invariance (M2)	20.12	9	.017	.98	.98	.05	3.87	3	.276	.00
Structural invariance (M3)	27.52	12	.007	.97	.97	.05	7.40	3	.060	.01
Residual invariance (M4)	57.95	18	< .001	.92	.92	.06	30.43	6	< .001	.05

[a]. Indicates comparisons are to the previous model, M2 with M1, M3 with M2, and M4 with M3.

TABLE 4. Means and Standard Deviations of the TTCT according to gender

		Female		Male	
Factor	**Abilities**	***M***	***SD***	***M***	***SD***
Innovative	Fluency	19.44	6.94	16.60	6.59
	Originality	11.34	5.70	9.92	4.31
	Elaboration	7.07	2.79	6.34	2.74
Adaptive	Abstractness of titles	5.74	5.50	4.93	4.73
	Resistance to premature closure	5.87	4.16	5.95	4.04

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