

Chapter #2

TEST FOR CREATIVE THINKING-DRAWING PRODUCTION (TCT-DP): A REVISED FACTORIAL STRUCTURE IN AN ADULT SAMPLE

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ABSTRACT

This research aims to assess the factorial structure of the Test for Creative Thinking-Drawing Production (TCT-DP, Urban & Jellen, 1996) for a Portuguese adult sample, with 620 workers, revisiting the results obtained by Almeida, Ibérico Nogueira, and Lima (2018). Two studies were performed. In Study 1, an exploratory factor analysis (EFA) assessed the factorial structure of the TCT-DP, with three hundred and two individuals (N = 302), most of them women (55.6%), from 18 to 86 years (M = 41.1, SD = 10.7). In Study 2, a confirmatory factor analyses aimed to replicate the factorial solution identified in Study 1, with three hundred and eighteen individuals (N = 318), most of them women (56.6%), from 19 to 70 years (M = 40.6, SD = 10.1). The two-factor solution (F1- Adaptiveness; F2- Innovativeness) proposed in Study 1 had acceptable to marginal fit indices. As in the study of 2018, two factors emerged and are respectively composed by the same items. Once more, the results highlight the importance of both non-conventional and conventional thinking for the creative process, sustaining our TTT-Two Tracks of Thought model. Some of the items which belong to the Adaptiveness factor, lead us to reflect on the parental features and developmental path.

Keywords: creativity, TCT-DP, confirmatory factorial analysis.

1. INTRODUCTION

If great revolutions in science, technology, arts, or philosophy assume that creativity must be considered a Big-C creativity (Togrol, 2012), it is also true that any individual is able to reveal characteristics of imagination, divergent thinking as well as tenacity and willingness to take risks in his daily life (Guilford, 1950), specifically in his personal or professional projects, which allow, at the same time, a large and meaningful self-actualization process (Rogers, 1961/1985).

Considering the inspiring speech of Guilford to APA, in 1950, as well as the more comprehensive models which have since been developed (e.g. Sternberg & Lubart, 1996), several contexts have begun to place greater emphasis on developing and stimulating creative thinking, stressing the idea that creativity depends both on individual and context variables (Csikszentmihalyi, 1996). Furthermore, creative thinking has been relevant for those individuals and organisations that aim to achieve their different goals to solve demanding problems and be competitive, thereby achieving a lasting success (Hennessey & Amabile, 2010). Despite the importance that has been attached to creativity, organisations have not been able to promote it (Amabile, 1998). According to Halpern (2003), if we want to increase creative potential, we must value creativity in the first place.

A way of valuing creativity is to invest in developing good assessment instruments to measure creative potential. In this sense, the present study aims to contribute with the validity studies for the TCT- DP, exploring the factorial structure through a confirmatory factor analysis for Portuguese workers.

2. BACKGROUND

Jellen and Urban (1986) presented a comprehensive creativity model that supports the figurative Test for Creative Thinking - Drawing Production (TCT-DP) that aims to evaluate six components (three cognitive, three personal) that influence each other and are responsible for creative performance. The cognitive-type includes different aspects of Divergent Thinking (elaboration, originality, flexibility, fluency, problem sensitivity), General Knowledge Base (evaluation, reasoning and logical thinking, analysing and synthesis thinking, memory network, broad perception), and Specific Knowledge Base and Specific Skills (acquisition and mastery of specific knowledge and skills for specific areas of creative thinking and acting). The personal-type components include several types (sub-categories) of Focusing/Task Commitment (topic/object/product focusing, selectivity, steadfastness and persistence, concentration), Motives (need for novelty, playfulness, curiosity, drive for knowledge, communication, self-actualization, devotion, need for control), and Openness to/Tolerance of Ambiguity (openness to experiences, readiness to take risks, adaptation and resistance, non-conformism, relaxation, humour).

According to Urban and Jellen (1996), creativity means that people can come up with or developing an original product/idea, as a solution to a problem. In order for it to be presented to other individuals, the solution goes through a process of exploration and sifting information, an unusual combination of the information real and imagined, and a composite summary of a solution in a gestalt form.

The debate about methods used to measure creativity has raised one very important question related to the underlying construct of creative assessment methods/tools. If some authors (e.g. Clapham, 1998) suggests its unidimensionality, Guilford (1956) and Torrance (1988) traditionally consider the multidimensionality of divergent thinking, others (Ibérico Nogueira, Almeida, & Lima, 2017; Kim, 2006), despite having used different creative assessment instruments, support the two-dimensionality of divergent thinking, arguing the importance of both conventional and non-conventional ways of thinking for the creative process.

Furthermore, the existence of these two factorial dimensions raises another question about the relationship between them. The dichotomy between divergent and convergent thinking is considered a fake dichotomy, by Runco (2007), since developing new ideas, by the divergent way of thinking, inevitably demands an evaluation and selection of the best and most appropriate ones, by the convergent way of thinking. This idea of complementarity is also accepted by several authors, since the 1950s (Guilford, 1950, 1956) until more recently (e.g., Finke, Ward, & Smith, 1992; Halpern, 2003; Jaarsveld, Lachmann, & Leeuwen, 2012; Shavinina, 2001).

Some authors have been carrying out validity studies with TCT-DP, questioning the relevance of some quotation criteria or even suggesting additional quotation criteria (e.g. Kālis, Roke, & Krumina, 2013). However, outside Portugal, to the best of our knowledge, no analysis of the factorial structure of the TCT-DP, based on confirmatory factor analyses, has been developed.

The study undertaken by Ibérico Nogueira et al. (2017) was the first to test the factorial structure of the TCT-DP in Portugal, through a confirmatory approach, with 969 university students, most of them women (55%), with the age range from 17 to 63 years ($M = 24.8$, $SD = 5.77$). Another study by Ibérico Nogueira, Almeida, and Lima (2018) also tested the factorial structure of TCT-DP, using confirmatory analysis, for 4326 students (51.6% female) and with the age range from 6 to 18 years ($M = 10.73$, $SD = 2.96$), over the 12 years of compulsory education. Furthermore, Almeida, Ibérico Nogueira, and Lima (2018) tested the factorial structure of TCT-DP for 883 Portuguese workers, mainly women (60%), between 18 and 65 years old ($M = 41.1$; $SD = 11.2$). The aforementioned studies had a two-factor structure: the non-conventional thinking, referred to as Innovativeness, and the conventional thinking, referred to as Adaptiveness. Moreover, there was a correlation between both factors, suggesting the need and complementarity of both ways of thinking while looking for a creative solution.

However, for the study using Portuguese workers, it was found that the Adaptiveness factor, includes some of the criteria usually considered as a reflection of the unconventional way of thinking. In fact, the Adaptiveness factor either encompasses the Cn (Continuations) and Cm (Completions) criteria traditionally viewed as performed by most conventional people, as the Bfd (Boundary-breaking being fragment dependent) and Bfi (Boundary-breaking being fragment-independent) usually attributed to unconventional people that are more prone to break boundaries. Regarding the studies by Ibérico Nogueira et al. (2017, 2018) with university students and school and college age students, both the Boundary-breaking criteria (fragment-dependent and fragment-independent) belong to the Innovativeness factor.

The present study aims to assess the factorial structure of the TCT-DP, using a confirmatory approach, this time, with another Portuguese working sample of 620 participants, to clarify the structure previously obtained with Portuguese workers.

3. METHOD

Testing the factorial structure of the TCT-DP, a two-step approach was used. The sample gave rise to two groups. In study 1, the first group ($N = 302$) was used for an exploratory approach aiming to investigate the factorial structure of the TCT-DP. In Study 2, the second group ($N = 318$) was used, aiming to replicate, through a confirmatory approach, the factorial structure observed in Study 1.

The instruments and procedure were the same for both studies.

After scoring is complete, the data were recorded to Excel and analysed using the Statistical Package for Social Sciences (SPSS) for Windows, version 21.0 (Study 1) and the AMOS software, version 18 (Study 2).

3.1. Study 1

3.1.1. Sample

This study involved a convenience sample of 302 Portuguese workers, most of them women (55.6%), with an undergraduate degree (74.8%) and aged from 18 to 86 years ($M = 41.1$, $SD = 10.7$).

3.1.2. Instruments

Urban and Jellen (1996) developed the Test for Creative Thinking-Drawing Production (TCT-DP), with the aim of assessing the creative potential of individuals from ages five. In the test a sheet of paper with six fragments, different in design and geometric

in form and composition are presented within a big square frame (five fragments) and outside that frame (one fragment). People are asked to complete the drawing, using the fragments they want. TCT-DP and its characteristics, evaluation criteria and advantages are broadly presented by the authors and collaborators (Dollinger, Urban, & James, 2004; Urban, 1991). Originally there were 14 evaluation criteria: Cn (Continuations), Cm (Completions), New elements (Nee), Connections with lines (Cl), Connections to theme (Cth), Boundary-breaking being fragment dependent (Bfd), Boundary-breaking being fragment-independent (Bfi), Perspective (Pe), Humour (Hu), Unconventionality (Uca- Unconventionality manipulation, Ucb- Unconventionality abstract, Ucc- Unconventionality symbol, and Ucd- Unconventionality non stereotypical utilisation of the given fragments) and Speed (Sp). The scores for the first nine criteria ranges from 0 to 9, and the scores for the unconventional criteria ranges from 0 to 3, according to the instructions in the manual. In the present study carried out by other authors (Sayed & Mohamed, 2013), the criterion Speed (Sp) was not used because of the failure to systematically create a control for this variable. The total score for Unconventionality, Uct, represents the sum of the four unconventionalities. The TCT-DP (Urban & Jellen, 1996) has two forms (A and B) in that Form B is a 180° rotation of Form A. In the present study, the option to exclusively use Form A is because previous research indicated that there were no significant differences between the results of Forms A and B (Almeida, Ibérico Nogueira, Bahia, & Urban, 2007).

Urban and Jellen (1996), by themselves or in collaboration with other authors, refer good internal consistency levels for TCT-DP (Cronbach's alpha values greater than .87), high levels of interrater reliability (.95, on average, between trained ratters), and parallel forms reliability (between .64 and .77). Other authors have found good psychometric qualities for the Portuguese population, namely with adult Portuguese workers (Ibérico Nogueira et al., 2017).

After performing the TCT-DP drawing, a sociodemographic questionnaire was also administered.

3.1.3. Procedure

In October 2018, the authors recruited some assistant researchers who were involved in an intensive training program on how to apply and interpret the TCT-DP. Between October 2018 and February 2019, directors of small, medium and large secondary and tertiary sector companies, both public and private, were contacted, via telephone, e-mail or in person. After permission to assess either leaders or employees was granted, the authors explained the study's objectives, methods and confidentiality and withdrawal policies. The test was conducted within the working environment, following the informed consent procedure.

3.1.4. Results

To assess the factorial structure of the scale, an exploratory factor analysis (EFA) was performed. A principal axis factoring (PAF) was used as the extraction method with a varimax rotation. To determine the number of factors to be extracted in the final solution the authors use Horn's parallel analysis and the interpretability of the solution. The cut-off used for factor loading was .30.

A Kaiser-Meyer-Olkin (KMO = 0.71) and Bartlett's Test of Sphericity, $\chi^2(45) = 612$, $p < .001$, indicated the sampling adequacy for the analysis. Three components had eigenvalues greater than the Kaiser criterion of 1, which accounted for 55.3% of the variance. Additionally, a parallel analysis (100 datasets; IC 95%) indicated the extraction of

two factors. A second PAF was conducted, fixing the extraction of two factors. The two factors explained 44.6% of the variance. The first factor was referred to as Adaptiveness or Conventional thinking, which explained 29.3% of the variance and retained four items (Cn- Continuations, Cm- Completions, Bfd- Boundary-breaking being fragment dependent and Bfi- Boundary-breaking being fragment-independent), with factor loadings that ranged from .72 to .50 (Cronbach alpha = 0.72). The second factor, referred to as Innovativeness or Non-conventional thinking, explained 15.3% of the variance and retained six items (Nee- New elements, Hu- Humor/emotionality, Cth- Connections to Theme, Uct- Unconventionality A, B, C and D, Pe- Perspective and Cl- Connections with lines) with factor loadings that ranged between .62 and .30 (Cronbach alpha = 0.63).

Table 1.
Rotated factor loadings.

	<i>1</i>	<i>2</i>
<i>Cn</i>	0.85	<i>0.05</i>
<i>Cm</i>	0.78	<i>0.11</i>
<i>Bfd</i>	0.52	<i>0.18</i>
<i>Bfi</i>	0.36	<i>0.24</i>
<i>Nee</i>	<i>0.05</i>	0.62
<i>Hu</i>	<i>0.15</i>	0.51
<i>Cth</i>	<i>0.26</i>	0.51
<i>Uct</i>	<i>0.13</i>	0.43
<i>Pe</i>	<i>0.02</i>	0.38
<i>Cl</i>	<i>0.21</i>	0.30

3.2. Study 2

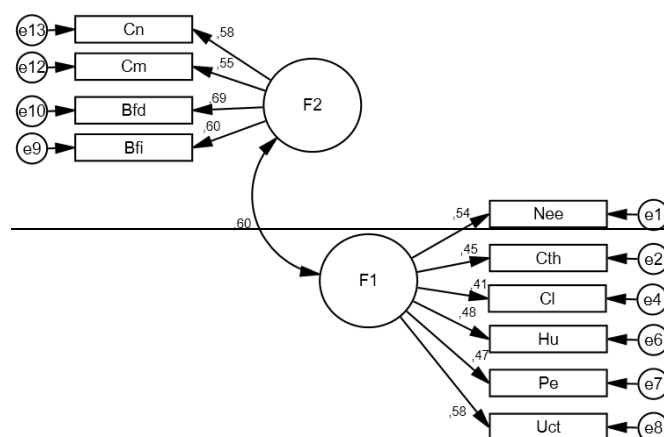
3.2.1. Participants

In the second study, 318 Portuguese workers participated, most of them women (56.6%) and with an undergraduate degree (79.9%), with the age range from 19 to 70 years (M = 40.6, SD = 10.1).

3.2.2. Results

The confirmatory factor analyses aim to replicate the factorial solution identified in Study 1. The estimation method used was the Maximum Likelihood Estimation (MLE) using the variance-covariance matrix, and the missing cases were replaced by the mean. The two-factor solution (F1, Conventional; F2, Non-conventional) proposed in Study 1 had acceptable to marginal fit indices: $\chi^2 = 127.8$, $df = 34$, $\chi^2/df = 3.76$, GFI = .93, CFI = .83, RMSEA = .093, CI 90% [.076, .0111], ECVI = 0.54. All the factor loadings are statistically significant ($p < 0,05$). Both factors had acceptable values of Cronbach's alpha (F1, $\alpha = .69$; F2, $\alpha = .63$). In addition, there is a correlation between Factors 1 and 2 ($r = 0.60$).

Figure 1.
Factorial structure of the TCT-DP.



4. FUTURE RESEARCH DIRECTIONS

Some limitations must be considered despite the importance that studies on the factorial structure of TCT-DP may have on its validity. It would have been important to have considered the moderating effect of the size of the companies, their public or private character and the job function of the participants. Since this study was carried out with working adults, using a convenience sample, it is not possible to generalize the results to the rest of the working Portuguese population. Other validation studies will be conducted with other specific population groups (e.g. samples with different types of leadership and different types and levels of education) using confirmatory factor analysis. In the future, it will be important to clarify both the importance of the developmental path in risk-taking behavior, leading to the hypothesis that risk-taking can be more easily assumed in middle-aged adults, as well as the effect of interaction between parenting practices and the developmental path of individuals. Regarding the concurrent validity, several studies should assess the relationship between the TCT-DP and other creative thinking assessment instruments. The relation between creative thinking and personality and cognitive dimensions, the moderating effect of self-esteem in creativity, the effect of the organisation's leadership on creativity, constitute some of the ongoing Portuguese studies. Furthermore, another study is being developed to test the efficacy of a creative potential promotion program in private schools.

5. CONCLUSION/DISCUSSION

This study is one of multiple studies that began in Portugal, intending to test the factorial structure of TCT-DP, through a confirmatory factor analysis. Those studies have considered both the population of the different years of compulsory schooling (Ibérico Nogueira et al., 2018), the university students (Ibérico Nogueira et al., 2017) and the Portuguese workers (Almeida, et al., 2018). Attention should be drawn to the fact that the six-factor structure, originally identified by the authors of the TCT-DP (Urban & Jellen, 1996), was obtained by an exploratory factor analysis based on both forms A and B (not

only on Form A) and jointly on pre-school age, school age and adults. Furthermore, the studies carried out by the authors included the Speed criterion, which was excluded in the present study.

The aim of this study is to clarify the factorial structure of the TCT-DP for Portuguese workers, comparing it to the first factorial structure analysis study with Portuguese workers, since there have not been, until now, other studies in other countries with a confirmatory factor analysis of the TCT-DP. Using a confirmatory factor analysis, Study 2 replicates the factorial structure of Study 1. Two factors were obtained. The Innovativeness factor includes the items related to the unconventional way of thinking (Uct- sum of the four unconventionality criteria), New elements (Nee), Humor (Hu), Perspective (Pe), Connections to theme (Cth) and Connections with lines (Cl). The second factor, Adaptiveness, includes more conventional items such as Continuations (Cn) and Completions (Cm), as well the Bfd (Boundary-breaking being fragment-dependent) and Bfi (Boundary-breaking being fragment-independent), considered as evidence of the willingness to take risks. This two-factor solution supports the two-factor solution of the previous study with a worker sample (Almeida et al., 2018), in which the exactly same items for each factor were found.

Both the present and the previous Portuguese study found a two-factor solution, Innovativeness and Adaptiveness, as well a correlation between them, which suggests that both forms of thinking seem inseparable, in spite of the fact that they can occur at different stages of the creative process, as Finke, Ward, and Smith (1992), Jaarsveld, Lachmann and Leeuwen (2012) or Runco (2007), highlighted. However, in the previous study of 2018, with Portuguese workers, the inclusion in the Adaptiveness factor of those items that involve risk taking, was somewhat puzzling. In fact, Bfd (Boundary-breaking being fragment-dependent) and Bfi (Boundary-breaking being fragment-independent) criteria, traditionally represent the willingness to take risks, since the individual must overcome the boundaries of the large square and still pay attention and elaborate from the outside fragment. These kinds of behaviour supposedly ought to be present in the most creative people. The confirmation, with the present study, of this factorial structure, led us to rethink its importance. If creativity demands several cognitive dimensions and personality characteristics, it is needed to raise the possibility that, nowadays, risk-taking can be a feature present in most individuals, regardless of their levels of creativity. Eventually, considering the parental and educational practices that characterise current Portuguese culture, individuals are less criticised for being uncompliant. On the other hand, considering the developmental path of individuals, the suggestion that it is easier for middle-aged adults to take risks needs to be taken into account. In addition, the effect of interaction between parenting practices and the developmental path of individuals should be considered.

Aiming at strengthening its construct validity for Portuguese workers, the present study confirmed the two-factor solution as well as the items that belong to each one of the factors previously found. Thus, TCT-DP allows a global index of creative thinking as well as an index for each dimension (Adaptiveness and Innovativeness), enabling a better characterisation for each individual.

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