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INVESTIGATING THE RELATIONSHIP BETWEEN CREATIVITY AND INTELLIGENCE AMONG DIFFERENT AGE GROUPS

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Abstract:
The relationship between creativity and intelligence has been extensively investigated, but without consensus. As a contribution to this discussion, the study examined the relationship between the constructs in different age groups. In study 1, 151 elementary school students aged 6 to 13 years took the Children's Figural Creativity Test (TCFI) and the Children's Nonverbal Reasoning Test (TNVRI). Among the total scores on the two instruments, a significant but weak correlation was found ($r_s = 0.252$), with a small effect size, although other significant correlations were found between specific test factors. As part of study 2, 184 university students aged 20 to 35 years responded to the Figural Creativity Test Adolescent and Adult Version (TCF-AA) and the Battery of Reasoning Tests (BPR-5). Results revealed no significant correlation between the total scores of the instruments, with weak correlations observed between specific measures. According to the results, relationships between the constructs differ based on age and instrument used, not being significant in adults and significant in children. This supports the contention that creativity and intelligence, while related, are distinct concepts.

Keywords: assessment; psychological tests; cognitive aspects

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1. Background

In recent years, the recognition of creativity as an essential skill of the 21st century has led to a variety of proposals for evaluating and analyzing the dimensions that constitute this construct (Thornhill-Miller *et al.*, 2023), becoming a topic of interest among researchers, educators, and policymakers (Nakano *et al.*, 2022). In recent years, creativity has also gained prominence due to the recognition that, manifested as high potential, this construct can characterize what is called creative giftedness (Renzulli, 2014). In addition to intellectual giftedness, which is characterized by high intelligence, we have two main areas in which this phenomenon manifests itself (Alshamsi, 2024).

In current conceptions, creativity is defined as a multifaceted construct, characterized by the ability to generate new ideas or solutions that do not simply reproduce what already exists but also are original, feasible, useful, and appropriate to the task and context (Plucker *et al.*, 2004). It is a skill that enables one to solve problems in an innovative, adaptive, and appropriate manner (Breit *et al.*, 2022).

Among the constructs related to creativity, intelligence stands out. Both constructs are believed to be fundamental to individuals' success in their personal, professional, and academic lives (Kim, 2005). Since intelligence and creativity are the source of the greatest human discoveries and inventions, knowledge about the association between these constructs can be used to update psychological theories about individual differences as well as improve educational practices (Gerwig *et al.*, 2021). Additionally, it is important to emphasize that the ability to use cognitive processes to understand, reason, and solve concrete situations is recognized as key to citizenship by the Organisation for Economic Co-operation and Development (2014). In this way, intelligence and creativity are both essential skills for the 21st century (Kupers *et al.*, 2019).

The apparent overlap between the constructs has prompted decades of psychometric research focused on understanding their relationship (Silvia, 2015). The findings of this research have led to the development of diverse theoretical perspectives and contradictory empirical evidence on the relationship between creativity and intelligence (Gerwig *et al.*, 2021). However, several questions remain regarding the nature of this relationship (Plucker & Esping, 2015), including questions regarding whether intelligence affects creativity through general or specific skills (e.g., spatial and verbal reasoning) (Frith *et al.*, 2021). The authors point out that although numerous studies have examined this relationship, there is still a gap in empirical research, since both constructs have numerous conceptualizations, compromising the generalizability of the findings.

A lack of conclusive and consistent findings leads to questions about the relationship between the constructs and contexts (Udin & Sohel, 2018), which consider sample characteristics, instruments used, operationalization, and measurement (Karwowski *et al.*, 2016). Thus, the relationship will vary depending on the type of creativity being evaluated (Jauk *et al.*, 2013).

According to the literature review, there are three main approaches. A threshold theory, which is the most popular, indicates that creativity requires a moderate level of intelligence (Karwowski *et al.*, 2016). Therefore, this theory predicts that there is a correlation between creativity and intelligence in sample groups with low to medium IQs, and no correlation in groups with high IQs (equal to or above 120). The correlation would be weakened above this value, becoming insignificant (for example: Jauk *et al.*, 2013; Karwowski *et al.*, 2016; Shi *et al.*, 2017). Research has demonstrated that high intellectual capacity by itself is not a sufficient condition for high creativity (Akhtar & Kartika, 2019). The inconsistent results of this study have led different researchers to challenge the hypothesis (Breit *et al.*, 2022; Kim, 2005; Plucker & Esping, 2015; Preckel *et al.*, 2006; Weiss *et al.*, 2020). The weakness of this hypothesis is further exacerbated by the fact that the samples investigated often consist of very few individuals with very high abilities, the population most relevant to investigating the hypothesis at hand (Breit *et al.*, 2022). There is a growing body of evidence suggesting that the threshold effect may be an artifact of inadequate analysis methods or sample limitations, based on recent reviews using large samples and modern statistical methods (Karwowski *et al.*, 2020). These studies suggest abandoning theory in favor of a linear or field-dependent relationship (Weiss *et al.*, 2020).

The second perspective suggests that creativity and intelligence are distinct skills (Aguirre & Conners, 2010), so that intelligence alone is not sufficient for creativity (Uddin *et al.*, 2022). From this perspective, it is understood that these two constructs can manifest themselves independently, such that a person with a high intellectual level does not necessarily exhibit high creativity, just as creative individuals do not necessarily demonstrate above-average levels of intelligence (Sternberg, 2001). This means that highly intelligent individuals may exhibit different levels of creativity; hence, the constructs may be viewed as conceptually independent (Karwowski *et al.*, 2016; Kim, 2006; Rindermann & Neubauer, 2004). As evidence of their findings, researchers cite studies that demonstrate high creativity in subjects with low IQ levels (Nogueira & Pereira, 2008) or studies in which correlations are not significant (Russo, 2004).

A third perspective suggests that these constructs are related, but of a low magnitude. Based on this approach, it would not be possible to observe high levels of creativity in individuals with low intelligence (Breit *et al.*, 2022). The results of various studies have indicated that there may be some relationship between the constructs. According to Kim (2005), who conducted a meta-analysis of 21 studies involving 45,880 participants, the average correlation coefficient between creativity and intelligence is low (r = .174), suggesting weak associations between the constructs. Based on the belief that the studies cited in the meta-analysis were outdated and did not reflect current intelligence thinking, Gerwig *et al.* (2002) conducted a reanalysis of 112 studies involving 34.610 participants and 849 correlation coefficients. The authors found a significant positive value of r = .25. However, this relation depends on the type of creativity and intelligence measured, so different results are obtained depending on the measure used and the population studied (Nakano & Brito, 2013).

Due to the importance of creativity in the development of human potential and the theoretical and empirical inconsistencies regarding its relationship with intelligence, this study aimed to assess the relationship between the two constructs across different age groups. Since there is no consensus on the relationship between creativity and intelligence, even after numerous studies have been conducted (Nakano & Brito, 2013), two empirical, exploratory, descriptive and quantitative studies were conducted. Both studies examined the relationship between creativity and intelligence in a sample of children and adolescents, and second, in a sample of adults. Taking the viewpoint that these are distinct constructs, it was hypothesized that low-magnitude values would be found. Furthermore, in both studies, a cluster analysis was conducted to estimate the number of profiles present in the samples and identify patterns within them. Cases were categorized based on similarity to enable a better understanding of the relationship between data, in this case, measures of creativity and intelligence.

2. Study 1: The Relationship between Creativity and Intelligence in Children and Adolescents

2.1 Participants

In this study, 151 participants were evaluated, aged between 6 and 13 years (M = 10.2 years, SD = 4.3), 53.0% of the sample being female. The children and adolescents were elementary school students (2nd grade = 18; 3rd grade = 19; 4th grade = 19; 5th grade = 17; 6th grade = 20; 7th grade = 30; 8th grade = 28), from public (63.8%) and private (34.5%) schools located in southeastern Brazil.

2.2 Instruments

2.2.1 Figure Creativity Test for Children (TCFI) (Nakano *et al.*, 2011)

Based on Torrance's figural test, this instrument consists of three activities in which incomplete stimuli are presented and must be responded to by drawing. This assessment is recommended for students in the second to ninth grades of elementary school. As part of the test, 12 creative characteristics are scored based on the drawings produced for the evaluation of figural creativity: fluency (number of relevant ideas), flexibility (different categories of ideas), elaboration (increasing the details of the basic drawing), originality (unusual ideas), expression of emotions (representation of feelings through drawings or titles), fantasy (the presence of imaginary beings, fairy tales, or scientific fiction), movement (expressing movement in our design or title), uncommon perspective (designs made at angles that are not used), internal perspective (internal view of objects as shown through transparency), use of context (the creation of an environment or design), expanding boundaries (expanding stimuli before completing the drawing) and abstracting titles (going beyond the obvious description of the drawing). The characteristics are categorized into four factors: (1) Idea Enrichment, (2) Emotionality, (3) Creative Preparation, and (4) Cognitive Aspects.

2.2.2. Test of Nonverbal Reasoning in Children - TNVRI (Pasquali, 2005)

This test assesses general intelligence (or fluid intelligence) in children aged 5 to 13 without requiring them to read or speak in any language. There are 58 reasoning items that are based on visual problems. Each of the presented drawings (representing silhouettes of objects or abstract designs) requires the examinee to find the missing piece. As a result of its correction, performance is estimated in two factors: Factor 1 = abstract analogical reasoning and Factor 2 = concrete analogical reasoning, along with a general factor (global analogical reasoning).

2.3 Procedures

In accordance with the Research Ethics Committee's approval, the study was conducted. Following the presentation of the study's objectives, the parents or guardians who authorized the students' participation signed the Informed Consent Form (ICF), and the examinees themselves signed the Informed Assent Form (IAS). Participants were asked to answer the creativity test (due to the controlled response time) first and then to complete the TNVRI test at a predetermined time and date. Collectively, the applications were completed in the classroom in 2025.

2.4 Data Analysis

Each instrument was scored according to the instructions in the manual, resulting in raw factor scores and a total score for each test. The JASP program was used to perform all statistical analyses. The first step was to estimate descriptive statistics (mean, standard deviation, minimum and maximum scores). Afterward, Spearman's correlation test was used to compare the results of the two instruments. Based on the Shapiro-Wilk test, a non-parametric approach was chosen due to the non-normality of the data distribution.
The correlation values have been interpreted according to the parameters determined by Cohen (1988): (1) correlations between .10 and .30 are considered weak, (2) between .30 and .50 are considered moderate, and (3) above .50 are considered strong. Fisher's z-score was used to calculate the effect size. In terms of interpretation, up to 0.20 is considered negligible, from 0.20 to 0.49 is considered small, from 0.50 to 0.79 is considered moderate, and above 0.80 is considered large.

To estimate the students' profile and explore intragroup variability, cluster analysis was applied, using the hierarchical method, which was recommended for the analysis of smaller datasets (Haldiki *et al.*, 2001). The purpose of this method is to reveal natural clusters within a dataset that would otherwise not be evident (IBM, 2026). The variables included in the analysis were the scores on factors 1 and 2 of the TNVRI as well as the scores on all four factors of the TCFI. A total score on each instrument was excluded from the analysis since it would affect the interpretation of the results.

2.5 Results

The first step was to estimate descriptive statistics for each measurement in both instruments. A summary of the results can be found in Table 1.

Table 1: Descriptive Statistics for TCFI (creativity test) and TNVRI (intelligence test)

Test	Measure	Mean	Standard Deviation	Minimum	Maximum
TNVRI	Factor 1 - Abstract analogical reasoning	33.20	8.24	6	44
	Factor 2 - Concrete analogical reasoning	12.88	0.42	10	13
	Total Punctuation	**45.92**	**8.07**	**19**	**55**
TCFI	Factor 1 - Idea Enrichment	51.70	26.88	6	143
	Factor 2 - Emocionality	4.06	5.46	0	25
	Factor 3 - Creative Preparation	6.94	5.90	0	28
	Factor 4 - Cognitive Aspects	50.69	16.47	9	86
	Total Punctuation	**112.32**	**44.86**	**7**	**259**

According to the data, scores differ significantly between participants when comparing minimum and maximum scores. As a next step, Spearman's correlation and the effect size were calculated to determine the relationship between the measurements. Table 2 presents the results.

Table 2: Spearman's Correlation and Effect Size Between TCFI and TNVRI

Measure	Statistics	Factor 1 Abstract analogical reasoning	Factor 2 Concrete analogical reasoning	Total TNVRI
Factor 1 - Idea enrichment	r_s	.328***	.034	.293***
	Fisher's z	.340	.034	.301
Factor 2 - Emotionality	r_s	.058	.024	.094
	Fisher's z	.340	.034	.301
Factor 3 - Creative Preparation	r_s	.153	.093	.180*
	Fisher's z	.154	.094	.800
Factor 4 - Cognitive Aspects	r_s	.091	.048	.094
	Fisher's z	.091	.048	.094
Total TCFI	$\boldsymbol{r_s}$	**.268*** **	**.033**	**.252** **
	Fisher's z	**.275**	**.033**	**.258**

*$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$.

The results indicated that there were significant correlations between the measurements, ranging from $r_s = 0.180$ to $r_s = 0.328$. A r_s value of 0.252 was found between the total TNVRI score and the total TCFI score, a value considered weak with a small effect size. There were also significant correlations between specific factors.

The TNVRI factor 1 – abstract analogical reasoning showed a significant correlation with the TCFI factor 1 – idea enrichment (moderate with a small effect size) and the total TCFI score (weak with a small effect). There was no significant correlation between factor 2 and any of the measures in the creativity test. Lastly, the total TNVRI score showed a weak but significant correlation with factor 1 (idea enrichment), with a small effect size.

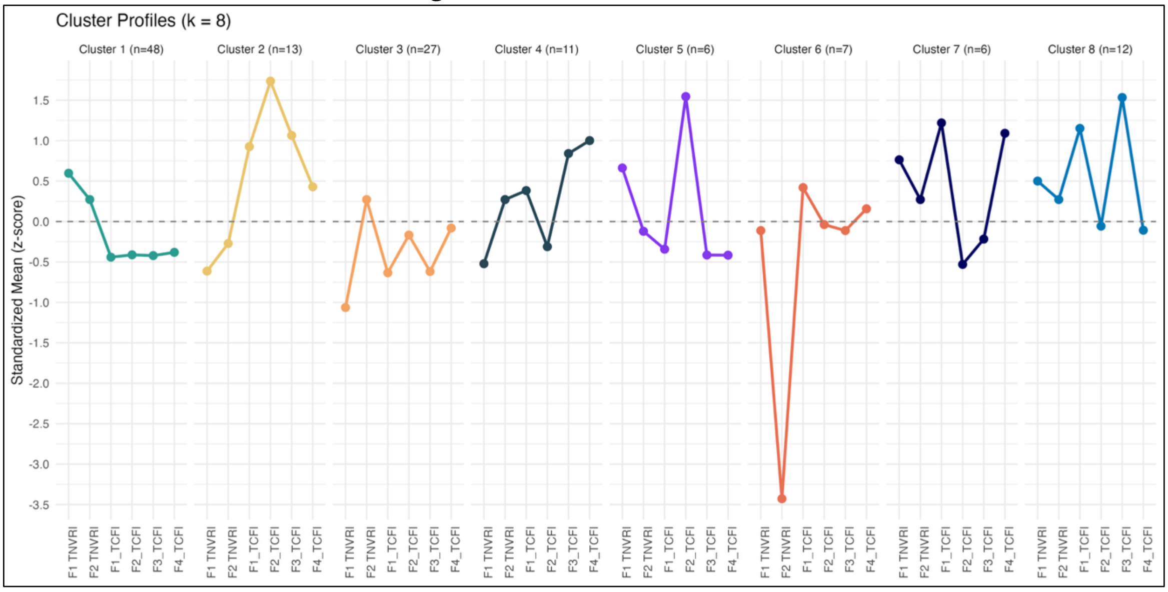
In the next step, cluster analysis was performed, revealing the presence of eight distinct profiles, with six to 48 individuals in each profile. Table 3 presents the mean values for each cluster in each measurement, expressed as z-scores (standard deviations).

Table 3: Means for Each Cluster and Measure

Measure	F1 TCFI	F2 TCFI	F3 TCFI	F4 TCFI	F1 TNVRI	F2 TNVRI
Cluster 1	-0.441	-0.412	-0.421	-0.381	0.597	0.272
Cluster 2	0.926	1.736	1.065	0.430	-0.613	-0.272
Cluster 3	-0.634	-0.167	-0.618	-0.080	-1.063	0.272
Cluster 4	0.383	-0.311	0.841	1.001	-0.522	0.272
Cluster 5	-0.342	1.546	-0.414	-0.416	0.662	-0.121
Cluster 6	0.420	-0.037	-0.112	0.157	-0.112	-3.428
Cluster 7	1.220	-0.530	-0.217	1.091	0.764	0.272
Cluster 8	1.151	-0.057	1.534	-0.108	0.501	0.272

As a result, Figure 1 was developed to illustrate the profiles found. The results of the creativity and intelligence tests for each group can be viewed. As a result of the analysis of the data, three very distinct groups can be identified. There are 48 students in profile 1 (*n* = 48) who demonstrate above-average intelligence (intelligent students). As for the second profile (*n* = 13), we have students who exhibit above-average creativity (creative students). In turn, cluster 8 (*n* = 12) indicates that students demonstrate above-average performance in both creativity and intelligence (intelligent and creative students). It is noteworthy that no profiles of students with intelligence or creativity below average were identified.

Figure 1: Identified Clusters



Note: F1 TNVRI = abstract analogical reasoning, F2 TNVRI = concrete analogical reasoning, F1 TCFI = idea enrichment, F2 TCFI = emotionality, F3 TCFI = creative preparation, F4 TCFI = cognitive aspects.

The remaining clusters have irregular profiles. Students in the third cluster (*n* = 27) show below-average performance in both creativity and intelligence, except for intelligence factor 2 (concrete analogical reasoning), which is slightly above average. Group 4 (*n* = 11) includes individuals with above-average performance in intelligence and creativity, but low performance in intelligence factor 1 (abstract analogical reasoning) and creativity factor 2 (emotionality). In group 5 (*n* = 6), respondents perform well on factor 1 of the TNVRI (abstract analogical reasoning) and factor 2 of the TCFI (emotionality), but poorly on other measures. In cluster 6 (*n* = 7), results are average for all measures, except for factor 2 of the TNVRI, which is extremely low (concrete analogical reasoning). As indicated by cluster 7 (*n* = 6), the measures indicate above-average results except for creativity factors 2 and 3, which are below average (emotionality and creative preparation, respectively). It is interesting to note that no group had all measurements below average.

3. Study 2: Relationship between Creativity and Intelligence in Adults

3.1 Participants

The convenience sample consisted of 184 university students, 102 of whom were females (55.4%), aged 20 to 35 years (M = 23.0 years; SD = 3.4). They attended a private educational institution located in São Paulo state.

3.2 Instruments

3.2.1 Figural Creativity Test - Version for Teenagers and Adults (Nakano, 2025)

The test is composed of two activities. First, the subject is asked to respond, in the form of drawings, to ten incomplete stimuli. During the second activity, a stimulus is repeated 30 times, and the respondent is required to provide as many answers as possible. Suitable for individuals aged 14 to 87. This instrument evaluates 12 characteristics in total, including (1) Fluency, (2) Flexibility, (3) Elaboration, (4) Originality, (5) Expression of Emotion, (6) Fantasy, (7) Movement, (8) Unusual Perspective, (2009) Internal Perspective, (10), Use of Context, (11) Extension of Limits, and (12) Expressive Titles. The characteristics are grouped into four factors: Factor 1 - Elaboration, Factor 2 - External Aspects, Factor 3 - Cognitive Aspects, Factor 4 - Emotional Aspects, along with a General Factor that represents the total punctuation. As a result, it is possible to identify the areas of an individual's creative potential that are stronger and weaker.

3.2.2 Battery of Reasoning Tests 5 – BPR-5 (Almeida & Primi, 2000)

In this study, form B was used, which is recommended for use with high school or university students. Five subtests comprise the battery: (1) Abstract Reasoning (AR) (25 items) involving analogies with geometric figures, (2) Verbal Reasoning (VR) test consisting of 25 items involving analogies between words, (3) Numerical Reasoning (NR) consisting of 20 items in which the individual must identify the two numbers that complete a linear or alternating series of numbers, (4) Spatial Reasoning (SR) consists of 20 items that require students to analyze different faces and determine what type of movement represents the last cube of a series of three-dimensional cubes, (5) Mechanical reasoning (MR) test consists of 25 items containing figures related to practical physics and mechanics from which the student must select the answer that is most appropriate. A total score is calculated by adding the scores from each of the five subtests.

3.3 Procedures

The application was completed in two sessions. In the first session, participants signed the Informed Consent Form and completed the VR, AR, and MR subtests of the BPR-5. During the second session, the SR, MR, and TCF-AA subtests were administered.

3.4 Data Analysis

JASP was used to analyze the data. A descriptive analysis (mean, standard deviation, minimum, and maximum scores) was conducted to estimate the outcome on the four dimensions and the overall creativity factor, as well as on the five dimensions of the BPR and its overall score consisting of the sum of the scores on the five subtests. Similarly to the previous study, the data were analyzed using cluster analysis.

Because the distribution of the data did not exhibit normality, the non-parametric Spearman test (r_s) was used to assess the correlation between the total test scores and the factors that make up the instruments. Interpretation of the results was based on the following parameters: correlations below .10 are considered weak, between .30 and .50 are considered moderate, above .50 are considered strong (Cohen, 1988). Fisher's z-score was used to measure the effect size. In terms of interpretation, up to 0.20 is considered negligible; from 0.20 to 0.49 is considered small; from 0.50 to 0.79 is considered moderate; and above 0.80 is considered large (Cohen, 1988).

3.5 Results

Initially, descriptive statistics were computed on the TCF-AA and BPR-5 scores. Table 4 presents the results.

Table 4: Descriptive Statistics of the Dimensions of the Creativity Test and Reasoning Battery

Instrument	Dimension	Mean	Standard Deviation	Minimum	Maximum
Figural Creativity Test	F1 - Elaboration	45.90	17.64	6	86
	F2 - External aspects	7.47	6.09	0	45
	F3 - Cognitive aspects	48.13	12.47	12	78
	F4 - Emotional aspects	1.51	2.03	0	14
	Creativity total	**103.90**	**28.04**	**37**	**179**
Battery of Reasoning Tests	VR - Verbal reasoning	17.23	3.43	5	23
	AR - Abstract reasoning	17.32	3.14	2	23
	MR - Mechanical reasoning	12.14	4.07	3	22
	SR - Spatial reasoning	11.89	4.24	2	22
	NR - Numerical reasoning	12.58	4.16	3	20
	Reasoning total	**71.16**	**12.96**	**40**	**96**

A wide range of results can be observed, as evidenced by the difference between the minimum and maximum scores for each factor, as well as the standard deviation value. As a next step, Spearman's correlation was calculated to estimate the relationship between the constructs. According to the results, four statistically significant correlations were identified. Table 5 presents the results.

Table 5: Spearman's Correlation Between Creativity and Reasoning Tests

Dimension	**Statistic**	**F1**	**F2**	**F3**	**F4**	**Creativity total**
Abstract Reasoning	r_s	.040	-.026	.059	-.102	.062
	Fisher's z	.040	-.026	.059	-.103	.062
Verbal Reasoning	r_s	.088	.220*	.272**	-.102	.220*
	Fisher's z	.089	.223	.279	-.103	.233
Spacial Reasoning	r_s	-.076	.017	.090	-.195	.007
	Fisher's z	-.076	.017	.090	-.198	.007
Numeric Reasoning	r_s	.163	.173	.133	-.190	.224*
	Fisher's z	.165	.173	.134	-.192	.228
Mechanic Reasoning	r_s	-.103	.086	-.021	-.022	-.061
	Fisher's z	-.103	.086	-.021	-.022	.061
Intelligence Total	$\boldsymbol{r_s}$	**.053**	**.145**	**.141**	**-.298**	**.142**
	Fisher's z	**.053**	**.146**	**.142**	**-.298**	**.143**

Note: r_s = Spearman's correlation; Fisher's z = effect size; F1 = idea enrichment; F2 = external aspects; F3 = cognitive aspects; F4 = emotional aspects; *$p \leq 0,05$; **$p \leq 0,01$; ***$p \leq 0,001$.

Results indicated that the verbal reasoning measure was most closely related to creativity, demonstrating a positive correlation with factors 2 (external aspects), 3 (cognitive aspects), and the total score. All three cases have a small effect size. In addition to the correlations presented, numerical reasoning was also positively and significantly related to the total creativity score, albeit with a small effect size. An interesting finding was that none of the measures of creativity showed a significant correlation with the overall intelligence score.

An analysis of clusters was performed next, which revealed the existence of five profiles. Table 6 presents the descriptive statistics for each profile, as measured by z-scores (standard deviation).

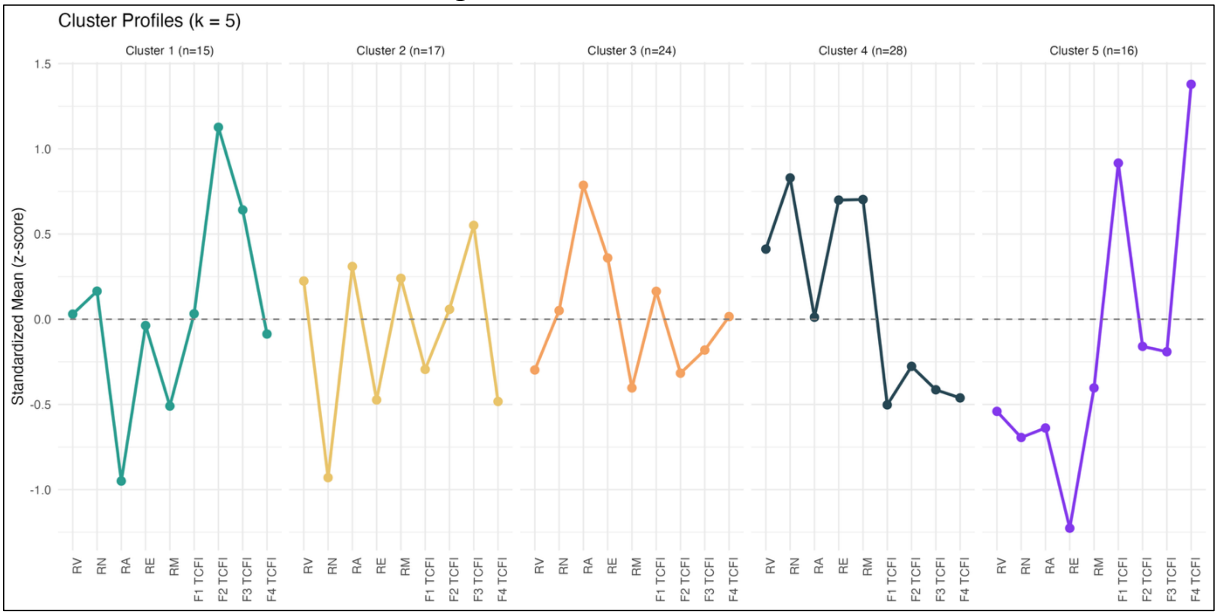
Table 6: Means by Each Cluster and Measure

Cluster	**AR**	**VR**	**SR**	**NR**	**MR**	**F1**	**F2**	**F3**	**F4**
Cluster 1	-0.949	0.030	-0.037	0.165	-0.509	0.032	1.126	0.641	-0.087
Cluster 2	0.310	0.224	-0.473	-0.929	0.240	-0.294	0.058	0.551	-0.482
Cluster 3	0.786	-0.298	0.360	0.051	-0.403	0.164	-0.317	-0.181	0.016
Cluster 4	0.012	0.412	0.699	0.829	0.703	-0.502	-0.276	-0.414	-0.462
Cluster 5	-0.638	-0.541	-1.226	-0.694	-0.403	0.916	-0.159	-0.191	1.379

Note: AR = abstract reasoning, VR = verbal reasoning, SR = spatial reasoning, NR = numerical reasoning, MR = mechanical reasoning; F1 – idea enrichment; F2 = external aspects; F3 = cognitive aspects; F4 = emotional aspects.

Figure 2 was then created to illustrate the profiles identified. This tool allows you to see how each group performed on measures of creativity and intelligence.

Figure 2: Identified Clusters



Note: RV = verbal reasoning; RN = numerical reasoning, RA = abstract reasoning, RE = spatial reasoning, RM = mechanical reasoning; F1 – idea enrichment; F2 = external aspects; F3 = cognitive aspects; F4 = emotional aspects.

Cluster 4 (*n* = 28) is comprised of individuals who have an above-average intelligence score (intelligent students). There are 16 members of Cluster 5 (*n* = 16) who possess above-average creativity (creative students). There is a mixed result in the other three clusters. For example, cluster 1 (*n* = 15) shows high creativity, especially in factors 2 and 3, but below-average results in NR and MR. The third cluster (*n* = 17) presents a profile of intelligence and creativity strengths and weaknesses, exhibiting substantial fluctuations depending on the measure used. In addition, cluster 3 (*n* = 24) shows high results in RA, but low results in MR, factor 2 and factor 3.

4. Discussion

This study examined the relationship between creativity and intelligence using samples of children and adolescents (Study 1) and adults (Study 2). According to several studies found in the scientific literature, the results of the study varied depending on the age group examined and the instruments used (Karwowiski *et al*., 2016; Nusrat *et al*., 2018). This confirms the idea that the type of creativity and intelligence assessed, the measures used, and the population investigated will influence the relationship (Nakano & Brito, 2013).

Based on the results of the children's sample, a low, positive, and significant correlation was observed between the total scores of the two instruments (r_s = .252). There was a moderately significant correlation between Factor 1 (abstract analogical reasoning) and Factor 1 (elaboration), as well as a weak correlation between the same factor of the intelligence test and the total score of the TCFI. The effect size is classified as small in both cases. There was no significant correlation between factor 2 (concrete analogical reasoning) and any of the creativity measures. Moreover, the total TNVRI score was found to be significantly and positively correlated, but with weak magnitudes and small effect sizes, with factor 1 (elaboration) and factor 3 (creative preparation), with the latter exhibiting a weak magnitude but a large effect size.

According to the results of the study with adults, there were no significant correlations between the total scores on the two instruments, but only between specific measures. Among these are verbal reasoning with total creativity, factor 3 (cognitive aspects) and factor 2 (external aspects), all of which are of small magnitude. The numerical reasoning and total creativity scores also showed a significant, albeit small, correlation.

In the hypothesis examined, it was expected that the constructs would show some level of positive and significant relationship, but that the value would be low (less than r = 0.20), given that the constructs were considered different but related. In the sample of children, this result was confirmed, but not in the sample of adults. The result of study 1 (r_s = .25) is like the value reported by Kim (2005) (r_s = .17) and the value of r_s = .25, pointed by Gerwig *et al.* (2002) after extensive literature review. However, some considerations must be considered.

According to the TNVRI's manual (Pasquali, 2005), Factor 1 = abstract analogical reasoning assesses the ability to identify relationships and patterns between abstract figures, as well as to solve novel problems that involve the induction of concepts and analogies. It is possible to contextualize the findings by analyzing this definition, since creativity involves solving new problems and involves the use of analogies and metaphors (Wechsler, 2004).

Furthermore, the instruments consist of visual stimuli; in the case of the TNVRI, the items consist of drawings in which the respondent must identify the alternative that completes the drawing, while in the case of the TCFI, a stimulus is presented that must be completed as a drawing. As a result of this similarity in task type, the correlation between subjects' performance on the two instruments was higher than expected but still considered low by the interpretation criteria adopted (Valentini & Laros, 2012).

Studies previously conducted with the TCFI demonstrated higher correlation values (r_s= .47) when comparing performance on this instrument with performance on the Human Figure Drawing test (Nakano, 2012). The high value was justified by the similarity between the tasks, since both tasks require respondents to create drawings. In comparison with other types of intelligence tests, most notably batteries that assess different types of cognitive abilities, the TCFI had a lower correlation value. In their study, Nakano and Brito (2013) compared the TCFI performance with that of the Battery of Children's Reasoning Tests and found a correlation coefficient of r_s = .22. It is interesting to note that the intelligence assessment test used in this study and the cited study is the same, although the version (adult or child) differs. The correlation results were equal.

The results of study 2 indicate that there was no correlation between the overall intelligence score and the total creativity score. A similar result was reported by Chiodi *et al.* (2011a, 2011b) who also compared participants' performance on a figural creativity test with an intelligence assessment battery, namely, the standard version and the expanded version of the Woodcock Johnson III battery, found no significant differences between the constructs. This result may be explained by the fact that the BPR-5 assesses different cognitive abilities, such as fluid intelligence, crystallized intelligence, and specific skills. An example would be inductive reasoning (in the RA subtest), vocabulary and verbal comprehension (in the RV subtest), quantitative ability (in the RN subtest), visual processing (in the RE subtest), and practical knowledge of mechanics (in the RM subtest). An interesting finding was that verbal and numerical reasoning subtests were correlated with creativity in general. As with the study presented here, Chiodi's *et al.* (2011a, 2011b) results were explained by the fact that the intelligence battery consists of different cognitive abilities, as well as the small number of participants.

Despite expectations, the correlation between the total score in creativity and the verbal reasoning subtest was significant. The result was not hypothesized since this subtest assesses what is called crystallized intelligence, and creativity is considered to be a skill related to fluid intelligence in the Cattell-Horn-Carroll model (McGrew, 2009), which is commonly used in intelligence assessment. Basically, fluid intelligence is the ability to solve new problems for which there is no readily available memorized information and for which new knowledge must be created (Primi *et al.*, 2024). Often, this type of intelligence involves creating new solutions to problems, incorporating knowledge into new situations -- a characteristic commonly associated with creativity. Nonetheless, it is important to emphasize that the VR subtest also showed a significant correlation with the "cognitive aspects" factor of the TCFI, which is not surprising since both measure cognitive abilities.

In addition, the correlation between the RN subtest and the TCFI can be justified since it assesses fluid intelligence directly. According to CHC model, creativity is specifically correlated with retrieval by association fluency (Gr) (Nakano & Primi, 2024), which incorporates tests of divergent thinking and idea generation (associative fluency, originality, and word fluency), which are frequently used to assess creativity (Nusbaum & Silvia, 2011). This type of skill is not assessed in the BPR-5.

Moreover, cluster analysis revealed the existence of different profiles resulting from the combination of aspects related to intelligence and creativity. In some cases, these differences become clearer (for example, when intelligence is high and creativity is low, or when both abilities are strong or weak). In this way, it was possible to demonstrate empirically that creativity and intelligence can manifest themselves independently of one another.

Based on the results found in the two studies, we are able to confirm that "intelligence and creativity can be considered separate constructs, but related to one another" (Nakano, 2012, p. 154), which is consistent with the perspective that holds the constructs to have some relationship, but only to a limited extent (Kim, 2005). Thus, despite their differences, the constructs share common aspects, as evidenced in some of the studies published in the scientific literature (Aguirre & Conners, 2010; Colom, 2008; Nakano & Primi, 2024; Russo, 2004; Sternberg & O'Hara, 2000).

Overall, the results of this study contribute to the discussion on the relationship between creativity and intelligence, as they demonstrate that other factors, such as age group, instruments, type of creativity and intelligence assessed, and theoretical models employed, can influence it as well. While consensus on this relationship remains far from being reached, the contributions of such studies support the conclusion that individual differences can only be discovered when intelligence and creativity are examined together (Lynch & Kaufmann, 2019; Wechsler *et al.*, 2010).

5. Conclusion

This study aimed to contribute to the discussion about the relationship between intelligence and creativity, considering the lack of consensus in the scientific literature on this topic. The existence of significant correlations between different measures of each construct partially confirmed the hypothesis, according to which the constructs are distinct but related skills. The children's sample showed this finding, and the adult sample showed significant relationships only when specific factors of the instruments were compared.

The empirically found result can add data to studies that have been conducted on the subject, thus contributing to both the discussion of how creativity and intelligence are interconnected, as well as the understanding of the factors that influence this relationship. Among the studies, the age range and type of intelligence and creativity assessed resulted in different findings.

However, despite the relevance of the data, generalizing the results should be done with caution due to some limitations of the study. Among these questions were those regarding the sample profile (mainly female participants in both studies, with university students in the adult study, all from one region in Brazil). Considering this characterization, we recommend that caution be exercised in interpreting the results, since this profile may not necessarily reflect the characteristics of the Brazilian population. The choice of instruments and the theoretical model underpinning them can also have an impact on the results. Therefore, although the research contributes to the discussion regarding the relationship between creativity and intelligence, it is recommended that future studies expand the sample diversity and the measures used to confirm the findings.

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Conflict of Interest Statement

The authors declare no conflicts of interest.

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