Cognitive profile in low, medium and high creative students

Mercedes Ferrando, Rosario Bermejo, Marta Sainz, Carmen Ferrándiz, María Dolores Prieto, Gloria Soto

Facultad de Educación, University of Murcia

Spain

Correspondence: Mercedes Ferrando Prieto. University of Murcia, Facultad de Educación, Campus de Espinardo 30100. Murcia (Spain). Teléfono: +34 868 88 8196. E-mail: mferran@um.es

Abstract

Introduction. The aim of the present work is to advance in the study of creativity-intelligence relationship looking into the students' cognitive profiles. It is hypothetized that, if creative ideas emerge as result of connecting distant concepts, and a balanced cognitive profile (without signiticant differences between ability levels) can facilitate these distant conections; Then, creative individuals would be characterized by a balanced and flat cognitive profile; lacking valleys and peacks. It is hypothesised that, if creativity occurs as a result of relating distant concepts, a more balanced profile among cognitive abilities –a flat profile – could facilitate a loose relationship between concepts. Therefore, creative individuals would present a cognitive profile with less peaks and troughs.

Method. 679 secondary students, aged between 12 and 17 years old (M = 13.86, SD = 1.25), took part in this study. The TTCT and the DAT-5 were used to assess participants' creativity and cognitive profile, respectively. Students were divided into three groups: those with low, average and high creativity. The cognitive profile of each group was analyzed searching for peaks.

Results. Results point out that, contrary to our hypothesis, the cognitive profile of creative individuals is not different from their non-creative peers.

Discussion and conclusions. It is possible that the hypothesis of a flatter cognitive profile of highly creative students does not work for a normal population, since students with lower intelligence also tend to show lower creativity. This hypothesis may be useful to explain diferences in creativity in students with medium-high intelligence.

Keywords: Creativity, cognitive profile analysis, intelligence, threshold theory.

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Resumen

Introducción. El objetivo de este trabajo es avanzar en el estudio de la relación entre creatividad e inteligencia, estudiando las relaciones que puedan darse entre la creatividad de los alumnos y sus capacidades creativas. Se formula la hipótesis siguiente: si las ideas creativas surgen de la conexión de conceptos distantes, y un perfil cognitivo equilibrado (sin grandes diferencias entre las distintas habilidades) puede facilitar esa conexión debil de conceptos; entonces, los alumnos creativos se caracterizaran por tener un perfil cognitivo equilibrado con menos picos y valles; esto es, un perfil plano o mesetario.

Método. En este studio participaron 679 alumnos de Educación Secundaria Obligatoria, de edades comprendidas entre los 12 y los 17 años (M = 13.86; DT = 1.25). Se utilizaron los siguientes instrumentos TTCT y el DAT-5. Los alumnos fueron divididos en tres grupos según el nivel de creatividad: bajo, medio y alto. El perfil cognitivo de cada grupo se analizó en busca de picos.

Resultados. Los resultados indican que, contrariamente a nuestra hipótesis, el perfil cognitivo de los alumnos creativos no es diferente al de sus compañeros no creativos.

Discusión y conclusiones. Cabe la posibilidad de que la hipotesis del perfil plano de los alumnos creativos no se confirme en una población normal, ya que los alumnos poco inteligentes tieneden a mostrar poca creatividad. La hipotesis sería útil para explicar las diferencias en creatividad entre alumnos de medio-alto nivel intellectual.

Palabras Clave: Creatividad, análisis de perfiles cognitivos, inteligencia. Teoría del umbral.

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Introduction

The present work aims to contribute to the study of the relationship between intelligence and creativity. The relationship between these two constructs have been studied in terms of correlations among them (i.e. Ferrando, Prieto, Ferrándiz, Sánchez, 2005; Getzels, & Jackson, 1962; Hocevar, 1980; Kim, 2006; Mednick & Andrews, 1967; Sen & Hagtvet, 1993), prediction of one over the other (i.e. Batey, Furnham, & Safiullinab, 2010; Furnham, & Bachtiar, 2008; Schubert, 1973; Silvia, 2008; Silvia, & Beaty, 2012) and in terms of individual differences between students of higher versus lower creativity or intelligence (i.e. Getzels, & Jackson, 1962; Preckel, Holling, & Wiese, 2006; Runco, & Albert, 1986). Taking a step further Nushaum and Silvia (2011) have proposed a new way of looking into the problem of creativity-intelligence relationship using structural equation modelling. Their study found that individual differences in fluid intelligence (Gf) significantly predicted creativity, and this effect was partly explained by the influence of Gf on executive switching (number of different categories used, i.e. flexibility) during the task.

The results form the empirical studies about the relationship between creativity and intelligence have lead researchers to speculate about five different ways in which both costructs are related between them: from being totally unrelated, to being the same construct (for a revision see Batey & Furnham, 2006; Kim, Cramond & VanTassel-Baska, 2010; Sternberg & O´Hara, 1999). One of the five ways both constructs could be related is overlapping each other, according to this perspective the relationship between them is weaker when for higher IQ scores. This is known as the threshold theory (Guilford & Hoepfner, 1966; Torrance, 1962). This theory states that students that are creative do have a minimum degree of intelligence, while intelligent pupils are not always creative. Recent studies have failed to verify this theory (Ferrando, Prieto, Ferrandiz & Sánchez, 2005; Kim, 2005; Naderi & Abdullah, 2010; Preckel, Holling & Wiese 2006; Runco & Albert, 1986). As afirmed by Nushaum and Silvia "Contemporary creativity research views intelligence and creativity as distinct traits that are only modestly related" (2011:36-37).

Nevertheless, even with all this empirical data that inform us about the specific range of IQ in which the relationship between intelligence and creativity is stronger, or to what degree intelligence will predict creativity; we still having a little knowledge and understanting of what defines and characterizes creative students in terms of cognitive abilities. The research seems to have become stagnated in this debate and few alternatives are being investigated.

The present study takes a step forward and changes the approach in the study of intelligence-creativity relationship, proposing a new research question: how does the cognitive profile of creative students differ from non-creative students? This paper is not interested in whether creative students show higher or lower intelligence (IQ), but to know if there is a specific cognitive pattern in terms of flatness.

Why look into the cognitive profile of students?

There are two reasons to start looking into the cognitive profiles rather than focusing on individual scores in each cognitive ability. On the one hand, for the last two decades educational and cognitive psychologists have widely admitted that intelligence is multifaceted, thus not limited to an IQ and thus, it can’t be accurately represented by a “g” factor (Sternberg, 1985; Gardner 1983, 1993). While these theories are being commonly accepted we are still looking into a general intelligence factor and its correlation with creativity.

On the other hand, it is important to consider Mendick’s (1962) theory about creative ideas generation, which states that original ideas come from unusual associations that are facilitated by flat “associative hierarchies”. Mendick’s theory has been tested in terms of knowledge structure (Hunter & Ligon, 2008; Runco, 2007; Weisberg, 2006), but not in terms of abilities structure. In this paper, it is hypothesized that having a similar level of ability in different areas should facilitate moving across them, thus transferring knowledge from one to another. A similar level of capability in different areas would ensure that these areas works together when solving a task, rather than working separately according to the student’s strength (Castello & Batlle, 1998). Therefore, creative individuals will be characterized by having a more balanced profile among cognitive abilities; this means a flat or even profile. On the contrary, non-creative students will show a cognitive profile characterized by the presence of significant differences between their strengths and weaknesses, thus a profile with peaks and troughs.

Although our research question seems simple, no previous studies have been found following this approach, except for an unpublished master thesis submitted by Mercader Navarro (2012), in which the hypothesis of a flat profile of creative students was partially confirmed.

Aims and hypothesis

The aim of this work is to study the relationship between creativity and intelligence, specifically how intelligence abilities are configured in the creative individual's profile versus. non-creative individuals. Our aim is not to study their level of intelligence but rather the unevenness (troughs and peaks) of their cognitive profiles. The hypothesis are:

1. Students with high versus low creativity will differ not just in the level of their cognitive abilities, but rather in the way these abilities are configured in their cognitive profiles.

2. More creative persons present a flat (even) cognitive profile, which is balanced and characterized by lack of peaks and troughs (uneven profile).

Method

Participants

A total of 679 secondary students, aged between 12 and 17 years old (*M* = 13.86, SD = 1.25) took part in this study, of which 316 were boys. Participants were attending different secondary schools in the regions of Murcia and Alicante (Spain). The participants' normative percentile scores for the DAT-5 subtests swing from 44.16 in spatial reasoning to 59.75 in speed and perceptual precision, thus this sample is within the mean scores of the normal population.

Instruments

To assess creativity the subtest "parallel lines" of the *Torrance Test of Creative thinking* (TTCT, Torrance, 1974) adapted to the Spanish culture by Prieto, López, Ferrándiz, and Bermejo (2003) was used. It this task student are asked to make as many different drawings as they can using 30 pairs of parallel lines. This is a figurative test aimed to assess the four main components of creativity: fluency (the amount of ideas given), flexibility (how many different categories are used by the student); originality (the uniqueness of their answers) and elaboration (the amount of details added to communicate and idea). The test allows us to obtaining a total creativity score by adding the scores of the four components. The test has to be scored by at least 2 different ratters, in total 10 different ratters participated in the scoring of the test.

The obtained reliability of this test assessed though alfa of Cronbach and inter-class correlation coefficient. The more reliable dimension was fluidity (which ranked from α = 1 to α = .82, and from ICC = 1 to ICC = .70) and the least reliable was elaboration (which ranked from α = .92 to α = .67; and from ICC = .85 to ICC= .47). Similar results were found in other studies (Almeida, Prieto, Ferrando, Oliveira, & Ferrandiz, 2007; Ferrando, Ferrándiz, Bermejo, Parra, Sánchez, & Prieto, 2007; Ferrando, Ferrándiz, Prieto, Bermejo, & Sainz, 2008).

To assess students' cognitive profile the *Differential Aptitude Test* (DAT-5, Bennett, Seashore, & Wesman, 2000) was used. This battery is composed of seven subtests: verbal reasoning, calculus, abstract reasoning, spatial relationships, mechanical reasoning, speed and perceptive precision, as well as spelling and language. The first five are more aimed at assessing reasoning while the last two assess aspects of perceptual and motor skills. The reported reliability of this test in the Spanish version published by TEA ediciones range from .75 to .92 depending on the scale and concrete age range. Also an adequate internal consistency is reported in the manual with low to moderate correlations between scales that are higher only for the cases of both verbal reasoning and academic attitude, and academic attitude and numerical reasoning (Bennett, *et al*., 2000).

Procedure

Teachers and parents were informed of the aims of the research. Participation in this study was voluntary. The tests were administered during school hours following the authors' instructions. Testing took 2 sessions in different days to avoid students' tyreness. The first session started early in the morning. Students complemented the first half of the DAT-5, did a little break and took the test parallel lines. During the second session students did finish the DAT-5.

Data analysis

In order to facilitate the data analysis, scores on the variables measured by DAT-5 were transformed into the same scale, thus all variables had a maximum 100[1]. The students are grouped depending on their creativity level following Almeida & Freire (2003) grouping procedure, thus three groups emerged: students with low creativity (those who score below

[1] The transformation was made as follow: the highest score in the variable was equal to 100, then by a rule of 3 all other scores were re-calculated.

percentile 25); students with average creativity (those who scored between 25 and 75 percentile) and students with high creativity (who scored above percentile 75).

Students' scores on creativity ranged from 0 to 144 with a mean of 64.76 and a standard deviation of 29.61. Percentile 25 was established on a score of 45.87 and percentile 75 was established on a score of 85.50. Following, the cognitive profile of each group was analyzed searching for peaks using a test of repeated measures.

Results

Descriptive statistics

Table 1 and Figure 1 show the mean scores obtained by each group of students. For the three groups of students the highest score is found in mechanical reasoning and the lowest score is found in memory. Students with average creativity score higher than their peers in almost all variables except for speed and perceptual precision, in which the highly creative students overcome their peers. Students with low creativity score lower than their peers in all variables except for spelling, where highly creative students have the lowest score. The Figure of mean scores do not show different patterns of cognitive abilities depending on creativity level, although standard deviation scores inform that the highly creative group show a wider variability in their scores.

Table 1: Descriptive statistical for cognitive abilities scores by groups (low, average and high creativity)

	Low creativity (n=152)		Average creativity (n=295)		High creativity (n=145)		TOTAL SAMPLE (N=679)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1. Verbal R.	51,87	17,56	53,92	15,81	53,48	14,57	53,28	15,99
2. Numerical R.	44,43	17,73	47,92	16,81	50,32	17,26	47,61	17,26
3. Abstract R.	52,27	22,52	54,83	22,24	53,09	21,29	53,75	22,07
4. Mechanical R.	56,91	15,32	59,29	14,94	58,78	14,00	58,55	14,83
5. Spatial R.	43,89	20,78	47,01	20,70	44,42	19,22	45,57	20,39
6. Spelling	55,31	15,80	55,62	16,12	55,04	15,61	55,39	15,89
7. Speed	49,36	13,28	52,26	13,28	56,27	12,64	52,50	13,33
8. Memory	29,99	11,12	31,59	10,69	31,81	9,62	31,23	10,56

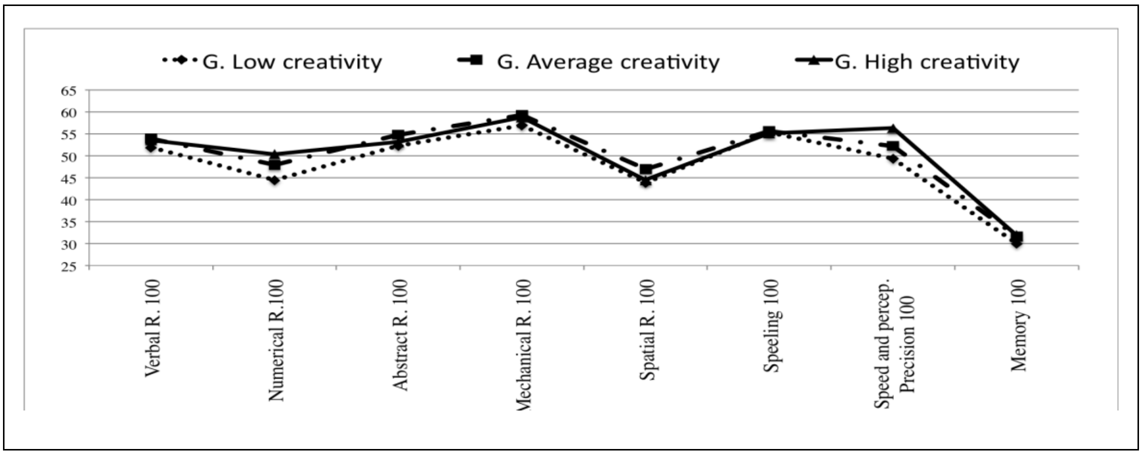

Figure 1: **Mean scores of different students' group in cognitive abilities (Verbal reasoning, Numerical reasoning, Abstract reasoning, Mechanical reasoning, Spatial reasoning, Speed and perceptual precision, Memory)**

Correlation between variables and differences in cognitive abilities depending on creativity level

Table 2 shows the correlation between creativity and variables of DAT-5. The correlations between creativity and cognitive abilities swing from -.001 for abstract reasoning to .167 for speed and perceptive precision. Only two of the correlations were statistically significant: numerical reasoning (r = .097; p = .015) and speed and perceptive precision (r = .167; p < .001). When analyzed whether statistically significant differences exist in intelligence depending on students' creativity level, it was found that such differences exist only for numerical reasoning and for speed and perceptive precision (Table 2). Post hoc analysis indicated that differences in speed and perceptive precision are statistically significant between the three groups, whereas scores difference on abstract reasoning are statistically significant between students with low versus high creativity.

Table 2: **Correlations between creativity and cognitive abilities variables and results of mean differences test between low, medium and high creative students.**

	Correlation with Creativity	ANOVAs
1. Verbal R.	-.002	F(2, 635) = .542; *p*=.582
2. Numerical R.	.097*	F(2, 624) = 3.834; *p* = .022 (a)
3. Abstract R.	-.001	F(2, 634) = .848, *p*= .429
4. Mechanical R.	.041	F(2, 625) = .98; *p* = .376
5. Spatial R.	.018	F(2, 623) = 1.125: *p*= .325
6. Spelling	-.006	F(2, 633) = .025; *p*= .976
7. Speed	.167**	F(2, 617) =11,221; *p*<.001 (b)
8. Memory	.057	F(2, 620) = .891; *p* = .411

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).
(a) The differences were statistically significant between the low and the high creative students groups
(b) The differences were statistically significant between all groups.

Analysis of the cognitive abilities profiles: flatness and peaks

Finally we study whether there are differences on cognitive abilities configuration depending on students' creativity level. In order to analyze the flatness of the participants' cognitive profile a repeated measured test was used. Each group's specific profile of cognitive abilities was studied separately. When using repeated measures is important to have all the variables in the same scale, thus variables were transformed so that maximum score was 100 as explained in the data analysis section.

The Multivariable tests indicated that none of the three groups of students presented a flat profile, and that the differences between the scores on different cognitive abilities were statistically significant. The values for the low creativity students group were Wilks lambda = .138; F(145, 7) = 129.03; p < .001 η^2 = .862. For the group of students with average creativity the results were Wilks lambda = .149; F(288, 7) = 235.39; p < .001; η^2 = .851. And for the high creativity students group the results were Wilks lambda = .147; F(138, 7) = 114.126; p < .001; η^2= .853. In order to know where those differences were found, a post hoc analysis was conducted using the comparison of main effects. The significance level of post hoc analysis is shown in Table 3. When analysing the differences between pairs of variables, the three groups have similar results, low creativity students significantly differ in 22 pairs of variables, students with average creativity significantly differ in 23 pairs of variables and highly creative students differ in 21 pair of variables.

Table 3: ***Significant level of Post hoc analysis of mean differences between cognitive abilities by creativity level group***

		Low creativity (n=152)	**Average creativity (n=295)**	**High creativity (n=145)**
1. Verbal R.	2. Numerical R.	<.001	<.001	0,023
	3. Abstract R.	0,802	0,379	0,781
	4. Mechanical R.	<.001	<.001	<.001
	5. Spatial R.	<.001	<.001	<.001
	6. Spelling	0,01	0,073	0,216
	7. Speed	0,078	0,112	0,042
	8. Memory	<.001	<.001	<.001
2. Numerical R.	3. Abstract R.	<.001	<.001	0,093
	4. Mechanical R.	<.001	<.001	<.001
	5. Spatial R.	0,738	0,444	<.001
	6. Spelling	<.001	<.001	0,001
	7. Speed	<.001	<.001	<.001
	8. Memory	<.001	<.001	<.001
3. Abstract R.	4. Mechanical R.	0,002	<.001	0,001
	5. Spatial R.	<.001	<.001	<.001
	6. Spelling	0,101	0,513	0,256
	7. Speed	0,073	0,035	0,08
	8. Memory	<.001	<.001	<.001
4. Mechanical R.	5. Spatial R.	<.001	<.001	<.001
	6. Spelling	0,282	0,001	0,021
	7. Speed	<.001	<.001	0,097
	8. Memory	<.001	<.001	0
5. Spatial R.	6. Spelling	<.001	<.001	<.001
	7. Speed	0,001	<.001	<.001
	8. Memory	<.001	<.001	<.001
6. Spelling	7. Speed	<.001	<.001	0,407
	8. Memory	<.001	<.001	<.001
7. Speed	8. Memory	<.001	<.001	<.001
Number of total pairs that are statistically significant different		*22 pairs*	*23 pairs*	*21 pairs*

Discussion and Conclusions

This study has aimed to shed some light on the question of what makes creative thinking happen. According to the data of our study it could be said that the correlation between intelligence and creativity is low. This correlation is statistically significant only with the variables speed and perceptual precision and numerical reasoning; furthermore, these results in general point out the no existence of statistically significant differences in cognitive abilities between students with high, low and average creativity. These data indicate that the threshold theory is not confirmed: creativity and intelligence are shown to be independent constructs, which agree with others authors (Ferrando, *et al*., 2005; Kim, 2005; Naderi & Abdullah, 2010; Preckel, *et al*., 2006; Runco & Albert, 1986).

Our hypothesis is that creative students are not defined by an IQ score, but rather by a profile configuration of their cognitive abilities. Nevertheless, the results of this study do not support the hypothesis of a flatter cognitive profile of more creative students. Why? There could be a simple answer: the hypothesis has been erroneously referred. Nevertheless there are some limitations to this study that should be taken into account.

Among its limitations, is the fact that creativity has been assessed by means of a traditional task (TTCT, Torrance, 1974). It is debatable whether using psychometric procedures could accurately identify creativity, and there is a concern that creativity is wider than the four main dimensions identified by Guilford (1950). Authors like Amabile (1983) and Sternberg (Chart, Grigorenko, & Sternberg, 2008; Sternberg, 2010; Sternberg, et al., 2004) propose the use of more holistic testing that relies more on the ratter's criteria rather than on a rigid set of parameters. Another limitation is that to conduct the ANOVA for repeated measures the variables need to be on the same scale, thus the variables were transformed. It is possible that other tasks designed to score within the same range would obtain different results.

Finally, we have to highlight that even if the flatter hypothesis could not be confirmed, this study has its strength in proposing a new way of looking into the intelligence-creativity relationship, offering a new approach that may explain such relationship. Even if in this first study the hypothesis failed, future research should test it again using other creativity tasks, (that may include in addition to divergent thinking tasks, self-report or teachers' reports on students' creativity) or limiting the sample to medium and high intelligence students, as it is possible that the flatter profile hypothesis would only explain creativity differences specifically among those with high cognitive potential. It is known that low intelligence students tend to show lower creativity, but the question of why intelligent students not always show high creativity is still open.

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References

Almeida, L. S., & Freire, T. (2003). *Metodologia da Investigação em Psicologia e Educação.* Braga: Psiquilíbrios.

Almeida, L., Prieto, M. D., Ferrando, M., Oliveira, E., & Ferrándiz, C. (2007). Torrance Test of Creative Thinking: the question of its construct validity. *Thinking Skills and Creativity, 3,* 53-58.

Amabile, T. (1983). The Social Psycholoy of ceativity: A cmponential conceptualization. *Journal of Personality and Social Psychology, 45*(2), 357-376.

Batey, M., & Furnham, A. (2006). Creativity, intelligence, and personality: A critical review of the scattered literature. *Genetic, Social, and General Psychology Monographs*, 132, 355−429.

Batey, M., Furnham, A., & Safiullinab, S. (2010). Intelligence, general knowledge and personality as predictors of creativity. *Learning and Individual Differences*, *20*(5), 532–535.

Bennett, G. Seashore, G., & Wesman, A. (2000). *DAT-5, Test de Aptitudes Diferenciales*. Madrid: TEA Ediciones.

Castelló, A., & Batlle, C. (1998). Aspectos teóricos e instrumentales en la identificación del alumno superdotado y talentoso. Propuesta de un protocolo. *FAISCA, 6,* 26-66.

Chart, H., Grigorenko, E. L., & Sternberg, R. J. (2008). Identification: The Aurora Battery. In J. A. Plucker y C. M. Callahan (Eds.), *Critical issues and practices in gifted education* (pp. 345-365). Waco, TX: Prufrock Press.

Ferrando, M., Ferrándiz, C., Bermejo, M.R., Parra, J., Sánchez, C., & Prieto, M.D. (2007). Estructura Interna y Baremación del test de Pensamiento Creativo de Torrance. *Psicothema*, *19*(3), 489-496.

Ferrando, M., Ferrándiz, C., Prieto, M.D., Bermejo, M.R., & Sainz, M. (2008). Creativity in gifted & talented children. *The International Journal of Creativity* and Problem Solving, 18(2), 35-47.

Ferrando, M., Prieto, M.D., Ferrándiz, C., & Sánchez, C. (2005) Inteligencia y creatividad. *Electronic Journal of Research in Educational Psychology (7)*, 21-49.

Furnham, A., Bachtiar, V. (2008). Personality and intelligence as predictors of creativity. *Personality and Individual Differences*, *45*(7), 613–617.

Gardner, H. (1983). *Frames of mind. The theory of multiples intelligences.* New York: Basic Books. (Traducción castellano, Estructuras de la mente. La teoría de las inteligencias múltiples. México: Fondo de Cultura Económica, 1987. Última Edición 2001).

Gardner, H. (1993). Creating minds: An anatomy of creativity. New York: Basic Books. (Traducción castellano Mentes creativas: Una anatomía de la creatividad. Barcelona: Paidós, 2002).

Getzels, J. W., &. Jackson, P. W. (1962) *Creativity and intelligence. Explorations with Gifted Students.* New York: John Wiley & Sons, Inc.

Guilford, J. P. (1950). Creativity. *The American Psychologist, 5,* 444-454.

Guilford, J. P., & Hoepfner, R. (1971). *The analysis of intelligence*. New York, NY: McGraw-Hill.

Hocevar, D. (1980). Intelligence, divergent thinking, and creativity. *Intelligence. 4* (1), 25-40.

Hunter, S. T., & Ligon, G. S. (2008) Applying multiple kowledge sructures in creative Thought effects on idea generation and problem-solving. *Creativity Research Journal, 20*(2) 137-154.

Kim, K. H. (2005). Can only intelligence people be creative? *The Journal of Secondary Gifted Education, 2/3,* 57-66.

Kim, K. H. (2006) Can only intelligent people be creative? A meta-analysis. *The Journal of Secondary Gifted Education XVI* (2/3), 57–66.

Kim, K. H., Cramond, B., & VanTassel-Baska, J. (2010). The relationship between creativity and intelligence. In J. C. Kaufman, & R. J. Sternberg (Eds.), *The Cambridge handbook of creativity* (pp. 395−412). New York, NY: Cambridge University Press.

Mednick, M. T., & Andrews, F. M. (1967). Creative thinking and level of intelligence. *The Journal of Creative Behavior, 1*(4), 428–431.

Mednick, S. A. (1962). The associative basis of the creative process. *Psychological Review, 69,* 220–232.

Mercader, M. (2012). *Un estudio de la relación entre la inteligencia y la creatividad: perfil cognitivo de los alumnos de alta, media y baja creatividad*. Unpublished Master Thesis. Universidad de Murcia.

Naderi, N., & Abdullah, A. (2010). Creativity as a predictor of intelligence among undergraduate students, *Journal of American Science, 6*, 86-90.

Nusbaum, E. C., & Silvia, P. J. (2011). Are intelligence and creativity really so different? Fluid intelligence, executive processes, and strategy use in divergent thinking. *Intelligence, 39,* 36–45.

Preckel, F., Holling, H. & Wiese, M. (2006). Intelligence and creativity in gifted and non-gifted students: an investigation of threshold theory. *Personality and Individual Differences, 40,* 159-170.

Preckel, F., Holling, H., & Wiese, M. (2006). Intelligence and creativity in gifted and non–gifted students: An investigation of threshold theory. *Personality and Individual Differences*, *40*, 159–170.

Prieto, M. D., López, O., Ferrándiz, C., & Bermejo, R. (2003). Adaptación de la prueba figurativa del test de pensamiento creativo de Torrance en una muestra de alumnos de los primeros niveles educativos. *Revista de Investigación Psicoeducativa, 21*(1), 201-213.

Runco, M. A. (2007). *Creativity*. San Diego, CA: Academic Press.

Runco, M. A., & Albert, R. S. (1986). The threshold theory regarding creativity and intelligence: an empirical test with gifted and nongifted children. *Creative Child and Adult Quarterly 11*(4), 212-218.

Schubert. D. S. P. (1973) Intelligence as necessary but not sufficient for creativity. *The Journal of Genetic Psychology: Research and Theory on Human Development, 122,* 45-47.

Sen, A., & hagtvet, K. (1993) correlations among creativity, intelligence, personality, and academic achievement. *Perceptual and Motor Skills. 77,* 497-498.

Silvia, P. J., & Beaty, R. E. (2012). Making creative metaphors: the importance of fluid intelligence for creative thought. *Intelligence, 40(4),* 343-351.

Stemberg, R. J. The Rainbow Project Collaborators, & University of Michigan Business School Project Collaborators (2004). Theory-Based University Admissions Testing for a New Millennium. *Educational Psychologist, 59*(3), 185-198.

Sternberg, R. J. (1985). *Beyond IQ: A Triarchic Theory of Human Intelligence.* (D. d. Brower, Trad.) New York: Cambridge University Press. (Traducción castellano, 1990. Más allá del C.I. Bilbao: DDB).

Sternberg, R. J. (2010). Assessment of gifted students for identification purposes: New techniques for a new millennium. *Learning and Individual Differences, 20*, 327–336.

Sternberg, R. J., & O'Hara, L. A. (1999). Creativity and intelligence. In: Sternberg, R. J., Editor, 1999. *Handbook of creativity (*pp. 251–272) Cambridge University Press, Cambridge: England.

Torrance, E. P. (1962). *Guiding creative talent*. Englewood Cliffs: Prentice Hall.

Torrance, E. P. (1974). *The Torrance Tests of Creative Thinking - Norms-Technical Manual Research Edition - Verbal Tests, Forms A and B - Figural Tests, Forms A and B*. Princeton NJ: Personnel Press.

Weisberg, R. W. (2006). *Creativity: Understanding innovation in problem solving, science, invention, and the arts*. Hoboken, NJ: Wiley.

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