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How creative potential is related to metacognition

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The primary objective of this study was to investigate the possible links between metacognition and narrative (or verbal) and graphic creative potential as well as the contribution of the former variable to creativity. The second objective was to study the effect of gender on these variables. This study was conducted with 360 men and women students from the Public University of Navarra enrolled in applied sociology, social work, and specialising in infant and primary education. Participants were given the Adult Creative Imagination Test and the Creative Metacognition Scale during their regular school schedule and during a single session. The results showed that the relationships between the assessed variables were significant and positive. Furthermore, metacognition moderately predicted narrative creativity; thus, cognitive processes do not operate in isolation because they affect and are affected by other factors. The findings also revealed that students obtained different results with regard to verbal and graphic creativity, and men and women differed only in narrative creative potential. The most important conclusion to be drawn from this research is that creative and metacognitive skills should be explicitly involved in higher education to stimulate the creative potential of future professionals.
Key words: Narrative and graphic creative potential, metacognition, self-regulation, originality, gender.

Cómo el potencial creativo se relaciona con la metacognición. Este estudio tuvo como objetivo principal investigar los vínculos que puedan existir entre el potencial creativo narrativo o verbal y gráfico y la metacognición, así como la contribución de esta última variable a la predicción de la creatividad; como objetivo secundario se investigó el efecto del género en las variables mencionadas. El trabajo se llevó a cabo con 360 estudiantes de la Universidad Pública de Navarra matriculados en los grados de sociología aplicada, trabajo social y maestro en educación infantil y primaria, de ambos sexos, a quienes se les administró, en horario regular de clase y en una única sesión, la Prueba de Imaginación Creativa para adultos y la Escala de Metacognición Creativa. Los resultados mostraron que las relaciones entre las variables evaluadas fueron estadísticamente significativas y positivas y que la metacognición predijo moderadamente la creatividad narrativa, lo que significa que los procesos cognitivos no funcionan aislados, pues afectan y son afectados. También revelaron que los estudiantes obtuvieron resultados distintos en creatividad verbal y gráfica y que el género los diferenció sólo en el potencial creativo narrativo. La conclusión más relevante que puede extraerse de la investigación sugiere que en la Educación Superior convendría intervenir explícitamente en las habilidades creativas y metacognitivas para estimular el potencial creativo de los futuros profesionales.
Palabras clave: Potencial creativo narrativo y gráfico, metacognición, autorregulación, originalidad, género.

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For the most part, the scientific community recognises that divergent thinking tests reliably assess creative potential and therefore assumes that these tests are valid, useful, and predict the future performances of creative people (Runco, 1999; Runco & Acar, 2012). In addition, previous authors have stressed the transcendence of this type of thinking and consider it an important, even necessary, component for creativity (Kaufman, Plucker & Baer, 2008). Normally, divergent thinking tests measure fluency, flexibility, originality, and elaboration; however, creative potential is predicted more accurately when more dimensions are evaluated. A creative person should develop numerous ideas across different categories that are new, infrequent, or developed in sufficient detail. High scores on these tests do not guarantee real creative achievements; rather, they indicate the existence of a potential that could be expressed at any time.

The notion of divergent thinking is attributed to Guilford (1950, 1968) who theoretically and empirically associated divergent production with the creative potential. Research has endorsed this interpretation and developed (based on the creativity tests of Guilford himself) numerous tests (for example, the Torrance Tests of Creative Thinking is one of the most popular tests.) The recently published Adult Test of Creative Imaginative that was used in this study was also inspired by elements of Guilford's SOI battery, e.g., the "use of objects" and "consequences" (Artola *et al.*, 2012).

Different cognitive models have described creativity as a constant oscillation between divergent and convergent thinking (Bink & Marsh, 2000; Finke, Ward & Smith, 1992; Prager, 2012). The whole brain is involved in both dimensions: the right hemisphere is responsible for imaginative and synthetic processes, and the left hemisphere is responsible for analytical, logical, and evaluative processes. The right hemisphere acts primarily at the beginning of the creative process when the situation is somewhat disorganised, and the problem is not well defined (Jaarsveld & van Leeuwen, 2005), whereas the left hemisphere mediates the vetting of generated ideas as well as the planning, monitoring, and evaluation of the creative product (Partridge & Rowe, 2002; Runco, 2007). Both hemispheres are needed to integrate unconscious and conscious experiences to be appropriately applied to works of art or science (Brandoni & Anderson, 2009; Snyder, Bossomaier & Mitchell, 2004). Convergent and divergent thinking represent two stages required in ideation and creative problem solving, and these processes work in synergy because they do not function as antagonistic dimensions (Khandwalla, 1993; Runco, 1994).

The balance that must exist between the two types of thinking for creativity to arise has encouraged the study of creativity's connections to other cognitive constructs. In this regard, the current study examines the potential cognitive relationships with metacognition, given that this variable is essential in the creative process, and its effect has not been investigated to the same extent as that mediated by intelligence (Sternberg & Williams, 1996). Therefore, creative thinking is conceived as a metacognitive process

supported by the awareness of a person with the ability to regulate a creative sequence. The combination of the knowledge of one's own cognition and action control as well as of its evaluation and personal effort is assumed to result in creation (Feldhusen, 1995; Mokhtari & Reichard, 2002; Pesut, 1990).

Although associations between creativity and metacognition have been suspected, such a connection has yet to be discovered because certain stages of the creative process (e.g., incubation) are detached from reflection. Incubation is partially improvised, and many moments of inspiration that occur during that stage occur under circumstances in which the participant is separated from active metacognition (as might happen when one walks, drives, or so forth). If an idea is generated within these scenarios, then the process has just begun; metacognition will now intervene because it is a substantial ingredient of creative thinking (Sternberg & Williams, 1996).

Metacognition involves two essential components: the knowledge of cognition and the regulation of cognition and action. The first, which is essentially introspective, refers to the knowledge of one's own cognitive processes, task demands, and the procedures necessary to perform a task. The second, which is dynamic and intentional, involves the regulation of the important moments of any cognitive activity that involves the following: a) prior planning (e.g., predicting outcomes, clarifying goals, setting a sequence, or anticipating difficulties); b) monitoring execution (e.g., coordinating time and effort, closely following the development of an activity, and controlling mood); and c) evaluating implementation (e.g., assessing the process, achievements, mistakes, and the applicability of what was learned). Constant monitoring by the person and the effort deployed across the three activity stages (i.e., before, during, and after) form the core of regulation, which guides problem solving and creation. Furthermore, regulation contributes to the effectiveness of thought and behaviour in an attempt to transform an incomplete situation into a more comprehensive but completely novel one (Brown, 1987; Davidson & Sternberg, 1998; Flavell, 1979; Lawson, 2006; Pesut, 1990; Schraw & Moshman, 1995).

In fact, for any creative action to be successful, relevant prior knowledge must be consciously selected and combined, the idea generated must be questioned, and a plan of work must be implemented (among other aspects). Moreover, verification must be monitored, and the strategies applied must be flexibly adjusted. Finally, the original product must be evaluated, transferred to other situations, and given maximum exposure. All these functions are metacognitive in nature, and their use will likely enhance creation. Hence, metacognition is more like convergent thinking than it is divergent thinking; however, these qualities always intervene in creative problem solving (Jausovec, 1994). According to Schraw (1998), metacognition enhances creativity and self-efficacy.

One issue that has generated much debate is whether creativity is a domain-general or domain-specific construct. Those that propose the former argue that creative people in one area tend to be creative in other areas (Baer & Kaufman, 2005; Plucker, 2004, 2005). On the contrary, those who argue the latter claim that people specialise and become isolated in a limited scope; thus, if they are creative in one area, then they might not be so in another (Sawyer, 2006; Silvia, Kaufman & Pretz, 2009; Weisberg, 2006). However, hybrid positions also exist because other researchers estimate that some skills are common to all creative individuals (e.g., ideation), whereas others are specific to certain domains (e.g., verbal fluency) (Plucker & Beghetto, 2004). Because the current sample is composed of freshmen seeking a social science degree who have yet to be influenced by the specificity of their profession, and given that the selected test assesses both verbal and graphic creative potentials, the specific skills of participants and their profiles were explored; however, a domain-general explanation of creativity was indirectly favoured because the sample was relatively homogeneous.

In summary, sufficient theoretical and empirical evidence exists to affirm that the activation of the creative potential requires metacognition; however, little research has been conducted regarding this issue. Therefore, based on the above principles, the current study examined the following: a) the existing relationships between creative potential and creative metacognition; b) the ability of metacognition to predict creative performance; and c) the differences between verbal and graphic creativity and between men and women with regard to the study variables. From a practical standpoint, the evaluation of the creative potential of college students might be useful to detect people with creative talents able to construct original interpretations from everyday experience and discern when they should present themselves as original, unconventional, or conform to the status quo. Determining whether creative participants are aware of their own thinking and able to regulate their ideational activity might also be interesting.

METHOD

Participants

The sample consisted of 360 students from the Public University of Navarre; 98 were men, and 262 were women aged between 18 and 23 years enrolled in their first degree course in applied sociology, social work, and specialising in infant and primary education. The selection of participants respected the voluntary participation of all groups.

Measurements

Test of Creative Imagination. Artola *et al.* (2012) designed the Adult Test of Creative Imagination to assess narrative, graphic, and overall creativity. It consists of

four games: the first three assess verbal creativity, and the fourth one assesses graphic creativity. This test can be administered in approximately 45 minutes. In Game 1, participants are shown a drawing of a street scene and must write anything that could happen in that scenario; Game 2 adapts Guilford's Test (the uses of a brick) by responding to the possible uses for a rubber tube; Game 3 presents an unlikely situation ("What if people never stopped growing?") so that participants might express unconventional ideas that they would most likely not express in more formal situations; and finally, Game 4 was inspired by specific items of the Torrance test in which participants must complete and title four drawings from provided lines. This test generates two partial scores. One is associated with narrative creativity (i.e., fluency, flexibility, and originality), and the other is associated with graphic creativity (i.e., originality, elaboration, special details, and title). This test also has a total score (the sum of the partial scores) that indicates the overall creative potential that participants show in conducting the tasks. The Cronbach's alpha coefficient referenced in the manual is highly satisfactory (.83) as was the coefficient obtained with regard to the study sample (.85). For more information on the psychometric test analyses, consult the manual (Artola *et al.*, 2012).

Creative Metacognition Scale. The researchers designed the Creative Metacognition Scale after reviewing the relevant literature on metacognition (Brown, 1987; Schraw & Dennison, 1994; Sigler & Tallent-Eunnels, 2006; Thomas, 2003) and creativity (Feldhusen, 1995; Mokhtari & Reichard, 2002; Pesut, 1990). This scale assesses the two dimensions of metacognition: knowledge of cognition (KC) and regulation of cognition (RC). In other words, it assesses the knowledge that participants have about their creative processes, the requirements and demands of creation, their control over these processes, and the behaviours involved in the creative task. This scale consists of 24 items: a) 12 items measure knowledge of cognition, including personal knowledge (Pkn, 4 items: e.g., "I recognise my strengths and weaknesses while performing a creative task"), task demand knowledge (Tdk, 4 items: e.g., "I try to describe the proposed task in my own words"), and working strategy knowledge (Wsk, 4 items: e.g., I provide examples to better understand the information received"); and b) 12 items measure the regulation of cognition including planning (Pla, 4 items: e.g., "I wonder about the information I need before starting a task"), monitoring (Mon, 4 items: e.g., "I stop performing a task when I am not sure about what is being done"), and evaluation (Eva, 4 items: e.g., "I review the results of my creative actions"). Responses to the items were categorised using a Likert scale that ranged from 1 (does not correspond at all with a manner of thinking and acting) to 5 (greatly corresponds). The maximum possible score on the scale is 120. Participants who obtain between 1 and 40 points are considered to have low creative metacognition; those who obtain between 41 and 80 points are considered to have medium metacognition; and those who obtain

between 81 and 120 points are considered to have high metacognition. This approach was also used to interpret the results of the two dimensions and their respective subscales. The Cronbach's alpha reliability coefficients for the total scale and subscales were the following: .87 (total scale), .85 (knowledge of cognition), .76 (personal knowledge), .78 (task demand knowledge), .80 (working strategy knowledge), .85 (regulation of cognition), .79 (planning), .77 (monitoring), and .79 (evaluation).

Procedure

After being informed about the research objectives and the desirability of truthful responses, the participants completed two assessments during a 1.5-hour session with a few minutes of rest between tests. First, the Creative Imagination Test was administered, followed by the Creative Metacognition Scale. The researchers administered these tests to groups of approximately 25 participants during the regular school schedule and in an atmosphere of curiosity, acceptance, and collaboration. Confidentiality regarding the treatment of data was guaranteed to participants, and they were offered the possibility of knowing the results of their individual tests.

Data Analyses

To analyse the collected data, calculations were first performed with regard to the general descriptive data of the variables, and correlations were obtained between the subscales and total scores of the Adult Test of Creative Imagination and the Creative Metacognition Scale. Next, a linear regression model was applied to determine the predictive power of metacognition on creativity. Finally, Student's *t*-tests for dependent and independent samples were used to detect differences between narrative and graphic creative potentials as well as between genders, respectively. All tests were analysed using SPSS Version 21.0.

RESULTS

The results of this study are provided in three sections: a) the descriptive statistics of the study variables as well as the correlation between creative potential and creative metacognition; b) the estimates of the contribution of metacognition with regard to predicting creative performance; and c) the differences associated with creative potential and gender.

1. Descriptive statistics and the correlation between creative potential and metacognition

Table 1 shows the means and standard deviations of creativity and metacognition. The highest creative skill averages were obtained the special details

subfactor (87th percentile), which indicates that students showed sufficient skill when adding original aspects to their responses (e.g., sensation of movement, three dimensions, symmetry, and so on), followed by the fluency subfactor (55th percentile). The lowest performance was for flexibility (25th percentile); participants' ideas were not varied or belong to different categories. In addition, the full creative potential of the sample (i.e., their ability to transform, combine, and establish new relationships among elements) was normal (48th percentile).

The sample tended to positively evaluate themselves (approximately the high middle option) with regard to metacognitive skills. Overall, participants' abilities to realise their own cognitive processes and regulate the stages of creative actions were normative.

Table 1. Means and standard deviations of creative potential and metacognition (*N*=360)

Variables	*M* RS/Pc(*)	*SD*
Fluency	47.51/55	9.48
Flexibility	24.91/25	6.90
Narrative originality	15.50/40	5.25
Narrative creative potential	87.91/45	18.71
Graphic originality	3.75/40	1.47
Elaboration	2.28/35	1.62
Special details	2.20/87	1.39
Title	3.34/40	1.50
Graphic creative potential	11.68/53	3.73
Total creative potential	99.59/48	20.22
Personal knowledge	14.03	1.61
Task demand knowledge	14.43	1.81
Working strategy knowledge	13.69	2.08
Knowledge of cognition	42.16	4.71
Planning	13.15	1.75
Monitoring	13.60	1.47
Evaluation	13.44	1.70
Regulation of cognition	40.19	4.25
Total creative metacognition	82.35	7.68

(*) RS/Pc = Raw Scores/Percentiles

The Pearson's correlation coefficients of the analysed parameters are shown in table 2. These statistics revealed significant positive and moderate relationships between the components of narrative creative potential and the components of creative metacognition, ranging from *r*=.23 to *r*=.64. The correlations between the components of graphic creative potential and the components of creative metacognition were also significant and positive; however, they showed lower scores and their extreme values were *r*=.12 (working strategy knowledge and special details) and *r*=.42 (total creative metacognition and graphic creative potential). These data suggest that metacognitive functions were more present when participants tried to create a verbal product rather than a graphical one. The highest correlation was observed between total creative potential and total creative metacognition (*r*=.66). This finding supports the inference

that creativity and metacognition have common elements and influenced each other. For example, when an idea is generated, it must be evaluated by metacognition and (perhaps) eventually improved.

Table 2. Correlations between creative potential and creative metacognition (*N*=360)

	Pkn	Tdk	Wsk	KC	Pla	Mon	Eva	RC	TCM
Flu	.50**	.45**	.48**	.55**	.44**	.43**	.49**	.53**	.63**
Fle	.30**	.29**	.35**	.36**	.31**	.23**	.34**	.34**	.41**
Nor	.47**	.42**	.49**	.54**	.46**	.36**	.44**	.49**	.59**
NCP	.49**	.45**	.51**	.57**	.47**	.41**	.50**	.53**	.64**
Gor	.32**	.29**	.30**	.35**	.30**	.27**	.30**	.33**	.40**
Ela	.19**	.18**	.20**	.22**	.18**	.18**	.19**	.21**	.25**
Sde	.13*	.16**	.12*	.15**	.19**	.18**	.14**	.16**	.17**
Tit	.18**	.15**	.19**	.20**	.14**	.12*	.13*	.15**	.21**
GCP	.31**	.31**	.33**	.37**	.29**	.30**	.30**	.34**	.42**
TCP	.51**	.48**	.53**	.59**	.48**	.43**	.52**	.55**	.66**

* $p < .05$; ** $p < .01$

Note. Flu = Fluency, Fle = Flexibility, Nor = Narrative originality, NCP = Narrative creative potential, Gor = Graphic originality, Ela = Elaboration, Sde = Special details, Tit = Title, GCP = Graphic creative potential, TCP = Total creative potencial, Pkn = Personal knowledge, Tdk = Task demand knowledge, Wsk = Working strategy knowledge, KC = Knowledge of cognition, Pla = Planning, Mon = Monitoring, Eva = Evaluation, RC = Regulation of cognition, TCM = Total creative metacognición.

2. Metacognition as a predictor of creative potential

A simple linear regression analysis was performed in which creative metacognition was used to predict narrative, graphic, and total creative potentials. Table 3 shows that creative metacognition had different predictive capacities with regard to these creative potentials, as the coefficients of determination (R^2) indicate; specifically, the percentage of variance that metacognition explained (adjusted termination coefficients) for the above creative potentials were 40%, 17%, and 45%, respectively. The difference between the narrative and graphic potential percentages suggests that metacognition played a greater role in former activities than the latter activities; however, the three dependent variables had non-zero coefficients associated with the critical level of each *t*-test. Therefore, the predictive power of metacognition was significant for all dependent variables.

Table 3. Linear regression using creative metacognition to predict narrative, graphic, and total creative potentials (*N*=360)

Variables			Unstandardised coefficients		Typified coefficients		
	R^2	ΔR^2	B	ET	B	*t*	*p*
NCP	.41	.40	1.56	.10	.64	15.77	.000
GCP	.17	.17	.20	.03	.42	8.69	.000
TCP	.45	.45	1.76	.10	.67	17.05	.000

Note. NCP = Narrative creative potential; GCP= Graphic creative potential; TCP = Total creative potential.

3. Differences with regard to creative potential and gender

Student's *t* test for dependent samples revealed a significant difference between the narrative and graphic creative potentials. The mean of the former potential (45th percentile; *M*=87.91, *SD*=18.71; raw scores) was significantly lower than the mean of the latter [50th percentile; *M*=11.68, *SD*=3.73; raw scores; $t_{(359)}$=80.96], which suggests that the group would have more difficulty elaborating multiple, varied, and original ideas when faced with verbal content tasks; however, both types of creativity were within the normal range.

The gender analyses are shown in table 4. This table shows that the only significant differences favoured women with regard to their narrative and full creative potentials; metacognitive skills did not vary with regard to participant gender.

Table 4. Gender differences among the variables

Variables	Gender	*N*	*M*	*SD*	*t*	*df*	*p*
NCP	Man	98	82.18	16.08	-10.96	358	.000
	Woman	262	103.22	16.56			
GCP	Man	98	11.70	3.23	.17	358	.863
	Woman	262	11.62	3.90			
TCP	Man	98	93.88	17.50	-9.86	358	.000
	Woman	262	114.85	19.10			
KC	Man	98	41.94	4.84	.53	358	.594
	Woman	262	42.24	4.66			
RC	Man	98	40.18	4.28	-.03	358	.973
	Woman	262	40.25	4.20			
TCM	Man	98	82.14	7.73	.31	358	.758
	Woman	262	82.42	7.68			

Note. NCP = Narrative creative potential; GCP = Graphic creative potential; TCP = Total creative potential; KC = Knowleged of cognition; RC = Regulation of cognition; TCM = Total creative metacognition.

DISCUSSION

The results associated with the first question (i.e., the relationship between creative potential and creative metacognition) indicate that these variables shared commonalities and that improvement in one might positively affect the other. That is, creative actions might benefit from metacognitive skills (and vice versa) with regard to the knowledge of one's own cognition and the regulation of the creative process. Thus, the more reflective moments of creativity might contribute to metacognitive knowledge. The significant positive correlations between the different subscales of creative potential and creative metacognition suggest that these variables support each other especially with regard to narrative creative potential. These results are consistent with Feldhusen (1995), Mokhtari & Reichard (2002), Pesut (1990), and Sternberg & Williams (1996) who argued that metacognition is an important ingredient of creative thinking because many of the functions that must be conducted in creation are metacognitive in nature.

In addition, metacognition appears to play a modest role in creative performance, especially with regard to narrative creative potential. This finding means that metacognition contributes to the establishment of a set of circumstances and an innovative flow that encourages creative performance while trying to regulate the cognitive and dispositional aspects involved in the creative process. Activities associated with a task that demands creativity such as planning, conducting, monitoring flexibly adjusting one's understanding, implementing, checking one's progress, and evaluating achievements might encourage the development of definitive answers with regard to the imaginative test used in the study. A certain level of metacognition most likely needs to be developed for creativity. This capacity leads to the generation of new ideas by combining, changing, or applying existing concepts to imagine or invent something new. As Pesut (1990) stated, creativity is a metacognitive process in the sense that it requires particular thought processes and regulates them via planning, monitoring, and evaluation operations.

The second question concerned whether metacognition is able to partially predict creative potential. In other words: how much of the total variability of creativity can be explained by metacognition? The predictive ability of metacognition in this study was significant, albeit inconsistent, reaching a moderate value (approximately 40%) with regard to the narrative and full creative potentials and a low value (17%) for the graphic creative potential. Metacognition most likely has a greater effect on the development of verbal compared with graphic creativity. This finding might be because other variables are involved in graphic creativity (e.g., certain spatial strategies). These findings might support the current theory that convergent thinking (which is similar to metacognition) is present in creativity, especially the verbal type (Bink & Marsch, 2000; Finke *et al.*, 1992; Prager, 2012).

Regarding the differences between narrative and graphic creative potential in the current study, the scores for the latter were significantly greater than those for the former, although both were fairly close to the 50th percentile. With regard to the third question, the academic level of the students (i.e., the first year of college) and their area of study (social science) might explain the reason why these differences were not larger. Baer & Plucker (2005) and Plucker (2004, 2005) defended the presence of skills common to all creative people; thus, it is not surprising that our students had similar results with regard to the two types of creativity.

In addition, in terms of the differences in creativity and metacognition associated with gender, women were more creative at verbal tasks than men, and this trend was reflected in their total creativity score. This result is contrary to those of the authors who have found that men score higher in graphic creativity (DeMoss, Milich & DeMers, 1993). Men and women did not differ with regard to their knowledge of

cognition or their regulation of action; therefore, sociocultural and individual characteristics as well as the type of tests applied most likely lead to gender differences.

This research has specific limitations that must be taken into account when interpreting the findings. First, the fact that creative metacognition was assessed using an instrument developed *ad hoc* is slightly problematic because its psychometric values are only preliminary. Furthermore, self-reports often lead participants to overestimate their abilities, and their scores might regress towards the mean. Second, the participants in this study were not randomly selected; therefore, the data cannot be generalised to other populations.

Finally, the current research has the following implications: a) at the theoretical level, additional deep investigation of the nature of the relationship between creative potential and creative metacognition would be helpful; b) at the methodological level, diverse samples should improve the psychometric characteristics of the Creative Metacognition Scale used in this study; and c) finally, at the practical level, raising the awareness of the university community regarding the importance of strategies that stimulate metacognitive factors to develop creativity would be interesting. Given the rapid social and economic changes that are occurring, professionals must think thoughtfully and creatively when faced with the many problems that can arise.

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