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Assessing interactions between cognition, emotion, and motivation in creativity: The construction and validation of EDICOS

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ABSTRACT

There is increasing evidence suggesting that individual differences in creativity reflect particular combinations of thinking styles, affective dispositions, and motivational preferences. Unfortunately, available performance tests and self-report inventories assess these factors in isolation, which calls for a more systematic measurement of the interactions between cognition, emotion, and motivation. The aim of the present study was to develop a questionnaire that allows for the assessment of individual differences in divergent and convergent creativity, as well as the identification of particular cognitive/affective/motivational associations.

The questionnaire (EDICOS: The Emotion/motivation-related Divergent and Convergent thinking styles Scale) was validated in a sample of 887 higher education students. The internal structure, internal consistency, and temporal stability of the instrument were examined, as well as its external validity. The results of exploratory and confirmatory factor analyses revealed a four-factor structure (convergent–unpleasant, convergent–preventive, divergent–pleasant, and divergent–proactive styles). These dimensions showed adequate internal consistency and temporal stability. The study also provided external validation data based on the relationship of the mentioned emotion/motivation-related creativity styles with thinking styles, affective styles, personality, gender, and academic domain. Overall, the obtained psychometric properties of EDICOS justify its future use for assessing individual differences in emotional and motivational creativity.

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1. Introduction

A large body of theoretical and empirical research has been performed to gain a deeper understanding of human creativity from several perspectives, including neurological, procedural, personal, cognitive, or contextual approaches (Hennessey &

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Amabile, 2010; Runco, 2014; Sternberg & Lubart, 1999). Although finding a unified definition of creativity is difficult, Runco and Jaeger (2012) suggested a standard definition including both originality and effectiveness as criteria for measuring a creative product. Meanwhile, Simonton (2008) considered creativity as an interaction between the abilities (process) and external pressures (context) of a person that generates a result (product) that is useful, new and noticeable for a specific context. From a dynamic perspective, creativity is understood as the interaction between thinking styles, affective dispositions, and motivational preferences (Baas, De Dreu, & Nijstad, 2011; Bledow, Rosing, & Frese, 2013).

In the following, we will discuss the available evidence for the relevance of these cognitive, emotional and motivational factors, and then suggest a new method to assess individual differences in creativity. In particular, we will report about the construction and validation of EDICOS, a questionnaire to identify interactions between creative-thinking, affective and motivational styles.

1.1. Cognition

Research on creative-thinking styles have become an important topic as cognitive psychologists recognized that there are, in fact, consistent individual differences in the ways people experience, organize, and process information to solve problems creatively (Martinsen & Kaufmann, 1999). Various researchers (Epstein, Pacini, Denes-Raj, & Heier, 1996; Kirton, 1976; Martinsen, 1997) proposed a bipolar dimension from familiarity seeking and rule-oriented cognitive strategies in problem solving (dependent, reflexive, adaptive, assimilator or convergent style) to novelty seeking and set-breaking cognitive strategies (independent, impulsive, innovator, explorer or divergent style). On the one hand, individuals with a convergent style are motivated to make mental effort and they prefer to define and approach problems within existing frameworks, structures and rules (they are resourceful, efficient, organized, and resistant to changes). While on the other hand, people with a divergent style prefer to make a creative effort and to solve problems using new frameworks (they are autonomous, flexible, open to changes and insightful) (Houtz et al., 2003).

1.2. Emotion

The emotion literature consistently identifies different affective styles, commonly in terms of the quality and intensity of dispositional mood and emotional reactions to similar incentives and challenges (Davidson, 1999). Two dominant dimensions emerge in studies of affective structure (Russell & Carroll, 1999): Positive affect reflects the extent to which a person feels enthusiastic and pleasurable engaged; while negative affect reflects distress and unpleasurable engagement that subsumes a variety of aversive mood states, including anger, contempt, disgust, guilt, fear, and nervousness. To account for the frequent observation that mood activation and mood valence jointly influence aspects of creativity, Dreu, Baas, and Nijstad (2008) proposed a *dual pathway model*. On the one hand, positive mood facilitates the first path to creativity by enabling cognitive flexibility and by leading people to feel less constrained, to experience the situation as unproblematic, and to act in a more generative way (Akbari Chermahini & Hommel, 2012b; Amabile, Barsade, Mueller, & Staw, 2005; Hirt, Devers, & McCrea, 2008; Isen, 2002; Isen, Daubman, & Nowicki, 1987). On the other hand, negative mood facilitates the second path by calling for perseverance and effort toward generating effective solutions to a problematic situation (De Dreu et al., 2008; George & Zhou, 2002, 2007; Kaufmann, 2003). The model suggests that mood activation determines the likelihood of creativity, while valence determines the routes by which creativity comes about (flexibility route or perseverance route). Following the *mood as information model*, positive moods inform people that the environment is safe, thereby prompting looser information processing, more expansive divergent thinking, novelty seeking, and playfulness (Russ & Schafer, 2006). In contrast, negative moods inform people that the environment is problematic, thereby promoting a detail-oriented, analytic approach to understanding the nature of the problem, reduced reliance on preexisting schemas or scripts, and greater effort to improve matters (Schwarz, 2011).

1.3. Motivation

Regarding the relationship between motivation and creativity, goal orientation has been proposed as a potential moderator of the effects of mood on creativity (De Dreu et al., 2008; Icekson, Roskes, & Moran, 2014; Payne, Youngcourt, & Beaubien, 2007; Roskes, De Dreu, & Nijstad, 2012). Different theories related to regulatory focus, goal orientation, and motivation of individuals outline the ways in which people attempt to achieve the presence of positive outcomes (approach orientation) or preserve the absence of negative outcomes (avoidance orientation). These theories suggest that individuals may differ in stable orientations (Elliot & Thrash, 2010). Research on the approach–avoidance distinction (Higgins, 2014) revealed that the motivation system associated with an approach orientation is more relevant in the promotion of creativity. Approach orientation is further divided into two types of orientation (proactive and preventive) that might impact creativity in different ways (Higgins, 1997, 2014; Molden, Lee, & Higgins, 2008). On the one hand, proactive orientation implies an intrinsic interest in acquiring new knowledge and skills to cope with the challenges and obstacles of creative process engagement (difficult tasks, setbacks or failures). Individuals with high proactive orientation view creative effort as a means to improve themselves. On the other hand, individuals with high preventive orientation are extrinsically motivated to ensure successful

performance (Pekrun, Elliot, & Maier, 2006) and they tend to work using established strategies, to seek favorable judgments from others and to evaluate performance by normative standards (Baas et al., 2011).

1.4. Personality

Theory and research on both personality traits and creativity emphasize on the uniqueness of the individual. Based on a meta-analysis conducted by Feist (1998), creative people seem to be less conventional, more open to new experiences, more self-confident, ambitious, dominant, hostile, and impulsive. The literature on personality and creativity suggests a profile of characteristics associated with creative individuals that may influence the development of particular creativity styles (e.g., Baas, Roskes, Slihte, Nijstad, & De Dreu, 2013; Chamorro-Premuzic & Reichenbacher, 2008; Feist, 2010). For example, Batey, Furnham, and Safiullina (2010) suggested that approach-related traits such as openness to experience and extraversion are positively correlated with a more divergent style because they are linked to enhanced cognitive flexibility. In contrast, avoidance-related traits such as conscientiousness and neuroticism have been shown to correlate with a convergent style because they are linked to enhanced cognitive perseverance (Prabhu, Sutton, & Sauser, 2008; Runco, 2014).

1.5. Gender

Research on gender differences in creative-thinking styles and motivation to creativity showed a consistent lack of gender effects (Baer & Kaufman, 2008). With regard to emotional experience, there is evidence showing that women generally report more sadness, fear, anxiety, shame, and guilt (Shields, 2000), but less pride (Plant, Hyde, Keltner, & Devine, 2000) than men. These findings are in line with others showing that women experience unpleasant emotions (concern, frustration, anxiety) more frequently than men, while men tend to experience pleasant emotions (pleasure, happiness, fascination, satisfaction) more frequently than women (Simon & Nath, 2004). In general, women have less efficient emotional adjustment and higher rates of anxiety than men (Aparicio, Rosset, Díaz, & Uclés, 2009), whereas men have better emotional balance than women (Dhillon, Cumming, & Cumming, 2000). Thus, one would expect gender differences in the self-perception of emotional experiences but not in cognitive and motivational styles of creativity.

1.6. Academic domain

A growing body of evidence suggests that creativity could be domain specific (Baer, 2010). In fact, there are cognitive processes, ways of conceptualizing and solving problems, personality or motivational attributes, and work habits or styles that vary widely from domain to domain (Kaufman & Baer, 2005). For example, students of Education Sciences (e.g., Early Childhood Education) and of Health Sciences (e.g., Nursing) have been found to be more sensitive to emotions, i.e., to show higher levels of sensitivity and emotion expressiveness as well as greater interest in internal life (Feist, 1998). Sheldon (1994) has shown that students of mentioned domains are more able to manage their emotions than students of technical domains. According to Petocz and Reid (2001), in domains related to Mathematics or Computer Sciences it is more common to teach technical contents rather than to develop students' creative and emotional skills. Finally, students of domains related to Business and Sociocultural Services (e.g., Administration and Finance, Tourism) are encouraged to actively use creative processes: Defining their own areas of need, determining a project that would support their learning and assessing the quality of their own learning outcomes (Reid & Petocz, 2004). Along the same lines, Sánchez-Ruiz, Hernández-Torrano, Pérez-Gonzalez, Batey, and Petrides (2011) found that emotional self-efficacy and personality traits associated to creativity varied across domains, being Art students those who obtained higher scores on both aspects. Therefore, one would expect differences between students of different domains in emotion/motivation-related convergent and divergent thinking styles.

1.7. Assessing individual differences

To summarize our introduction so far, there are reasons to assume that a creative person can be understood in terms of a dynamic interaction between particular creative-thinking styles (divergent vs. convergent), affective styles (pleasant vs. unpleasant), and motivational systems (proactive vs. preventive). Some of the most often used self-report instruments to measure one of these three groups of factors are the Kirton Adaptation-Innovation test (KAI; Bobic, Davis, & Cunningham, 1999); the Positive and Negative Affect Scales (PANAS; Watson, Clark, & Tellegen, 1988); and the Behavioural Inhibition and Behavioural Activation Scales (BIS/BAS; Carver & White, 1994). However, even though these instruments are certainly useful, they often reflect a rather restricted theoretical orientation and focus on just one of the apparently larger set of factors. To date, there is no instrument that allows for the simultaneous assessment of cognitive, emotional, and motivational self-perceived styles related to creativity. In response to this deficit, the aim of this study was to develop a self-report instrument doing this; which we will refer to as EDICOS. In order to test its psychometric properties, its dimensionality was examined in a large sample of higher education students. Its reliability was analyzed in terms of internal consistency and temporal stability. Relationships between the dimensions of EDICOS and other measures of creative-thinking styles, affective styles, personality, gender, and academic domain were explored in order to obtain additional external validation data that could be used in future studies.

2. Method

2.1. Participants

The sample consisted of 887 subjects (523 women and 364 men) aged between 18 and 32 years old ($M_{\text{age}} = 21.48$; $SD = 3.28$). Participants were students at vocational training centers (47.9%) and universities (52.1%) located in the Autonomous Community of the Basque Country (northern Spain). The sampling design employed was a non-probability convenience sampling, but we attempted to balance gender, education type (vocational or university), and academic domain. In terms of their academic domain, 30.6% chose to specialize in Education Sciences (Primary Education, Early Childhood Education, Pedagogy, Social Education, and Philosophy); 25.4% in Technical Sciences (Automation and Industrial Robotics, Industrial Mechanic and Electronic, Construction and Civil works, Environmental Chemistry, Telecommunications and Computer Sciences, Occupational Risk Prevention, etc.); 22.8% in Health Sciences (Psychology, Medicine, and Oral Hygiene); and 21.2% in Business and Sociocultural Services (Administration and Finance, Tourism and Event Management, Trade and Marketing, Social Work, Animation of Physical and Sporting Activities, and Jewelry).

Following the ethical guidelines of the Ethics Committee for Human Research of the University of the Basque Country (UPV/EHU), we selected those students who wanted to participate in this study voluntarily. Informed consent was collected from the students themselves and the corresponding school authorities.

2.2. Instruments

2.2.1. *The Emotion/motivation-related Divergent and Convergent thinking styles Scale (EDICOS)*

EDICOS is a 30-item self-report questionnaire that provides information about consistent individual differences in emotional and motivational reactions to divergent and convergent thinking. As a result of the factor analyses performed in this study, EDICOS is composed by four factors: (a) Convergent–unpleasant style (e.g., “*Cuando tengo que pensar de mucho suelo sentirme algo tenso/a*”/“When I have to think a lot I feel some tension”), (b) Convergent–preventive style (e.g., “*Considero interesante reflexionar sobre los problemas*”/“I consider interesting to reflect on problems”), (c) Divergent–pleasant style (e.g., “*Cuando tengo que proponer ideas originales suelo sentirme alegre*”/“When I have to propose original ideas, I tend to feel cheerful”), and (d) Divergent–proactive style (e.g., “*Me interesa participar en retos originales*”/“I am interested in participating in original challenges”). Items are answered in a 6-point Likert scale, with options ranging from 1 (strongly disagree) to 6 (strongly agree). Participants are classified along a continuum ranging from those that combine emotional and motivational styles to improve creative thinking processes (high scores on the four dimensions of EDICOS) to those that do not combine emotional/motivational and creative styles effectively (low scores on the four dimensions of EDICOS). The specifications for the formulation of the initial items of EDICOS are shown in [Appendix 1](#). All the items are presented in [Appendix 2](#).

2.2.2. *A reduced Spanish version of the Need for Cognition Scale (NC; Falces, Briñol, Sierra, Becerra, & Alier, 2001)*

The reduced Spanish NC measures the extent to which individuals are motivated to think. Confirmatory factor analysis supports a two factor structure composed by: A positive factor related to the tendency to make mental effort (preference for cognition: e.g., “*Me atraen más los problemas muy complejos que los sencillos*”/“I am more attracted by highly complex problems than by simple ones”); and a negative factor related to the tendency to avoid and reject situations requiring sustained mental effort (avoidance of cognition: e.g., “*Prefiero pensar el mínimo necesario en cada caso*”/“I prefer to think the minimum necessary in each case”). The NC has 18 items (9 items per subscale) with options ranging from 1 (totally disagree) to 5 (totally agree). Thus, individuals are classified along a continuum ranging from high scores on the NC scale (individuals having fun performing cognitive activities) to low scores on the NC scale (individuals avoiding thinking except when it is required by the situational demands). The NC showed adequate psychometric properties in the original version with Cronbach's alpha values of .83 (preference for cognition) and .74 (avoidance of cognition). In the present study preference and avoidance dimensions presented adequate internal consistency with Cronbach's alpha values of .84 and .76, respectively.

2.2.3. *The questionnaire of cognitive strategies for creativity (QREATEGIAS; Alfonso, 2000)*

QREATEGIAS is a 16-item self-report questionnaire that serves to measure the cognitive strategies for creativity with four factors called creative effort (7 items), creative use of sensorial information (5 items), overcoming resistance (2 items), and search for new perspectives (2 items). In this study we used the creative effort dimension to measure the tendency to strive for new and different ideas (e.g., “*Me esfuerzo por tener ideas novedosas y creativas*”/“I make an effort to have new and creative ideas”). The 7 items were answered on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). High scores on the creative effort dimension reflect the ability to maintain the cognitive effort in exercises requiring divergent thinking; whereas low scores on the same dimension reflect the reluctance and opposition to take part in divergent-thinking tasks. QREATEGIAS presented appropriate psychometric properties in the original version, being the Cronbach's alpha values of .83, .81, .78, and .79, respectively. In this study, creative effort also showed adequate internal consistency: $\alpha = .80$.

2.2.4. *Spanish version of the Positive and Negative Affect Scale (Robles & Páez, 2003)*

The Spanish PANAS is a self-perception questionnaire with two main factors called positive affect and negative affect. Positive affect (PA) is a dimension of enthusiasm, activation, and alert. High scores on PA reflect a state of high energy, full

concentration and pleasurable engagement, whereas low positive affect is characterized by sadness and lethargy. Negative affect (NA) is a general dimension of subjective distress and unpleasant engagement. High scores on NA subsume a variety of aversive mood states (such as anger, contempt, disgust, fear, and nervousness), while low NA reflects a state of calmness and serenity. The Spanish PANAS consists of two 10-item scales with options ranging from 1 (very little or nothing) to 5 (extremely). The instrument presented appropriate psychometric properties in the original version, and showed adequate internal consistency both in the original research (PA, $\alpha = .85$; NA, $\alpha = .81$) and in the present research (PA, $\alpha = .76$; NA, $\alpha = .82$).

2.2.5. A reduced Spanish version of the NEO–Five Factor Inventory (Costa & McCrae, 1999)

Personality was measured using 48 items of the Spanish NEO–FFI grouped in four dimensions (12 items per dimension): Neuroticism (e.g., “*A menudo me siento inferior a las demás personas*”/“I often feel less than other people”); extraversion (e.g., “*Disfruto mucho hablando con la gente*”/“I really enjoy talking with people”); openness (e.g., “*Tengo mucha fantasía*”/“I have a lot of imagination”); and conscientiousness (e.g., “*Soy eficiente y eficaz en mi trabajo*”/“I am efficient and effective in my work”). The items were answered on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Individuals scoring high in neuroticism experience psychological distress and perceive having dissatisfactions with life; whereas low neuroticism is characterized by emotional stability. People high in extraversion prefer to do most things in groups of people and to experience strong positive feelings like joy or excitement; whereas people low in extraversion are quite introverted, reserved, serious, retiring, and loners. Individuals obtaining high scores in openness have a variety of intellectual interests and they prefer doing activities requiring flexibility, risk, and new experiences; whereas those low in openness prefer the familiar and conventional plans, and have little need for variety. Finally, people who score high in conscientiousness are self-disciplined and they tend to set goals for their lives; while individuals low in this range are relatively careless, neglectful and unreliable, and they have little need for achievement, placing personal interests or pleasure before work concerns.

The psychometric properties obtained in the original study were adequate, with Cronbach’s alpha values of .82, .81, .76, and .81, respectively. In this study, Cronbach’s alpha values for the four dimensions ranged between .79 and .84.

2.3. Development procedure

EDICOS, a questionnaire to identify simultaneously specific creative-thinking, affective and motivational styles, was developed based on the Standards for Educational and Psychological Testing (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 1999) using the phases described by Carretero-Dios and Meléndez (2005, 2007), also by Muñiz and Fonseca-Pedrero (2009).

2.3.1. Conceptual delimitation of the construct

The EDICO (Emotion/motivation-related Divergent and Convergent thinking) model (see Soroa, Aritzeta, & Balluerka, 2015) was used as the framework for defining the construct, developing items, and validating the instrument. The theoretical model is based on assumptions from mood–creativity research (De Dreu et al., 2008; Davis, 2009; To, Fisher, Ashkanasy, & Rowe, 2012) and theories related to creative-thinking, emotion, and motivation (Akbari Chermahini & Hommel, 2012a; Baas et al., 2011; Carver & White, 1994; Martinsen & Kaufmann, 1999).

Emotion/motivation-related Divergent and Convergent thinking is understood as a combination of affective and motivational styles that aim to improve divergent and convergent thinking processes.

2.3.2. Generation of initial pool of items

Since item generation is one of the most crucial stages in the instrument construction process (Downing & Haladyna, 2006; Schmeiser & Welch, 2006), the initial pool of items was developed based on recommendations regarding items’ characteristics proposed by Muñiz, Fidalgo, García-Cueto, Martínez, & Moreno (2005): Representation, relevance, diversity, clarity, simplicity, and comprehension. Specifically, the initial pool of 40 items was developed following the EDICO theoretical model (Soroa et al., 2015), as well as in response to the definition of the construct (see Section 2.3.1), and to the elements proposed in the specification table (see Appendix 1).

In accordance with scientific literature, it was decided that these statements should evaluate emotional divergent/convergent thinking divided into four categories: (1) Convergent–unpleasant style (tendency to feel unpleasant moods while thinking in a convergent way), (2) Convergent–preventive style (tendency to prevent failure while thinking in a convergent way), (3) Divergent–pleasant style (tendency to feel pleasant moods while thinking in a divergent way), and (4) Divergent–proactive style (tendency to act proactively while thinking in a divergent way).

2.3.3. Content validity study

Once the initial battery of items was created, a panel of experts evaluated them in order to provide evidence that these items were relevant to the construct and representative to each dimension. The group of 11 experts (4 women and 7 men) participating in the study consisted of seven doctors of Psychology from different knowledge specialties (1 from Behavioural Sciences Methodology; 2 from Basic Psychological Processes; 3 from Developmental Psychology and Education; 1 from Personality, Assessment and Psychological Treatment) and two full professors of Basic Psychology. Of all of the participants, 36.6% were considered to be experts in the field of creativity and 45.5% were experts in the field of emotions or emotional

intelligence. The other two participants had professional experience in the field of group creativity in organizations and higher education centers.

The suitability of the items was evaluated using a 4-option Likert scale (1 = unsuitable, 2 = barely suitable, 3 = fairly suitable, and 4 = very suitable). Based on the data provided by the experts, we selected the proposals that were considered to be 'fairly suitable' or 'very suitable' (average scores equal or higher than 3 points). The main criteria employed for assigning each of the propositions to one of the four theoretical dimensions was the following: At least 75% of the experts placed an item in a specific category. Thus, the distribution of items by category was as follows: 'Convergent–unpleasant' (COU) with 10 items, 'convergent–preventive' (COPRE) with 10 items, 'divergent–pleasant' (DIP) with 8 items, and finally, 'divergent–proactive' (DIPRO) with 12 items.

Once the battery of 40 items was created and revised by the experts, a focus group was conducted with 15 participants ($M_{\text{age}} = 22.38$; $SD = 3.14$). This group consisted of 3 Psychology pre-doctoral students, 3 university students, 5 vocational training students, and 4 young individuals who had finished their studies and were looking for jobs.

Based on the analysis of the data provided by the experts and the participants in the focus group, a number of changes were made in EDICOS. First, to improve the level of understanding of the items included in the "divergent–proactive" and "convergent–preventive" dimensions, behavioral verbs were replaced by motivational verbs. For example, we changed "I am able to take any risk when I need to achieve original challenges" to "I am interested in participating in original challenges". Second, with the aim of increasing the level of clarity and simplicity of the items, quantitative terms that could potentially confuse participants were avoided; for example, "several projects at the same time", "modify ideas again and again until you find the most original one", or "find a unique decision that meets various requirements". Third, in order to increase the diversity of emotional wording included in the "divergent–pleasant" and "convergent–unpleasant" dimensions, general mood states were added to the already existing discrete specific emotions. Besides, taking into account the age of the target population, it was considered important to avoid exciting or activating words such as "excitement", "internet", or "conflicts". Finally, the information included in parenthesis was eliminated to avoid differences between individuals depending on their specific experiences related to each example.

2.3.4. Pilot study

This preliminary version was applied to a sample of 139 higher education students between the ages of 18 and 23 ($M_{\text{age}} = 21.12$; $SD = 2.13$), and a series of qualitative analyses were conducted as part of this pilot study. This phase led to the reformulation of the items included in the "divergent–pleasant" and "convergent–unpleasant" dimensions by changing the word order; first writing the cognitive component of the statement followed by the affective component. For example, we changed "I feel joy when I have to participate in an original challenge" to "When participating in an original challenge, I feel joy". A number of quantitative analyses were also carried out in order to select the items that would comprise EDICOS. Items with homogeneity indexes higher than .40 in the corresponding dimension were selected. In summary, the quantitative and qualitative analyses of the pilot study suggested the elimination of 10 items and the reformulation of 15 items.

The 30-item version derived from the pilot phase was used as a reference for empirical validation phase. Thus, EDICOS along with the other questionnaires required for its validation (NC, QREATEGIAS, PANAS, and NEO-FFI; see Section 2.2) was administered to a large sample of participants ($N = 887$). Each data collection lasted one hour and was carried out by two researchers in the usual classrooms of the participants during school days and times. The study followed the ethical guidelines of the Spanish Psychological Society and was approved by the Ethics Committee for Human Research of the University of the Basque Country.

2.4. Data analysis

Data analyses were conducted using SPSS v22.0. First, the dimensionality of EDICOS was explored using an exhaustive cross-validation procedure (Refaeilzadeh, Tang, & Liu 2009) by randomly dividing the total sample into two subsamples. The first subsample (to which we refer to as *exploratory subsample*) was used to explore the dimensionality of EDICOS and consisted of 389 participants (62.2% women and 37.8% men) with a mean age of 21.17 ($SD = 3.01$). The second sample (the *validation subsample*) was used to test the previous model and consisted of 498 participants with a mean age of 21.7 ($SD = 3.47$), of which 56.4% were women. An exploratory factor analysis was performed on the exploratory subsample using the principal axis factoring procedure with orthogonal rotation to extract the underlying structure of the participants' responses to the 30 items. The Parallel Analysis (Velicer, 1976) procedure was used to determine the number of components. Then, a confirmatory factor analysis was performed in the validation subsample to determine whether the structure was replicable using SPSS Amos v20.0 (Arbuckle, 2011). The following goodness-of-fit indices were used: χ^2/df (chi-square likelihood ratio statistic), CFI (comparative fit index), TLI (Tucker Lewis index), RMSEA (root mean square error of approximation), and SRMR (standardized root mean square residual). First, we calculated an absolute fit index expressed by the quotient of the chi-squared statistic over the degrees of freedom (chi-square/df). A ratio of less than 5 was suggested to indicate reasonable goodness of fit (Wheaton, Muthen, Alwin, & Summers, 1977). Also, two comparative indices (CFI and TLI) and two residual fit indices (SRMR and RMSEA) were used. Values equal or higher than .95 for CFI and TLI, equal or lower than .08 for SMRS, and below .06 for RMSEA were considered indicative of a good fit (Schreiber, Nora, Stage, Barlow, & King, 2006).

Internal consistency of the resulting dimensions was evaluated using Cronbach's alpha. The temporal stability of the EDICOS dimensions was evaluated using the test-retest procedure, administering the instrument once again in a smaller

Table 1
Correlations between the dimensions of EDICOS.

	Convergent–unpleasant	Convergent–preventive	Divergent–pleasant
Convergent–preventive	.01		
Divergent–pleasant	–.20*	.18*	
Divergent–proactive	.01	.28*	.57*

* $p < .01$.

convenient subsample (46 female and 35 male) one month after the first data collection. Then, to obtain evidence of validity, Pearson coefficients were used to analyze the correlations between the sub-scales of EDICOS and other sub-scales related to need for cognition (NC; Falces, Briñol, Sierra, Becerra, & Alier, 2001), creative effort (QREATEGIAS; Alfonso, 2000), positive and negative affects (PANAS; Robles & Páez, 2003), and personality (NEO–FFI; Costa & McCrae, 1999). In addition, a Student's t -test was also calculated to examine differences between women and men in emotion-related creativity styles. Cohen's d index was used to estimate the effect size referred to the difference between both mean scores. Finally, the scores obtained in EDICOS by students belonging to the four academic domains (Education Sciences, Health Sciences, Technical Sciences, and Business/Sociocultural Services) were compared using the one-way analysis of variance (ANOVA). Then, Tukey test was used for post hoc comparisons and Hedges' g coefficient was calculated to estimate the effect sizes referred to the differences between mean scores of the academic domains.

3. Results

3.1. Dimensionality

As we have described in the data analysis section, an exploratory factor analysis was conducted on the exploratory subsample ($N = 389$). First, the sample bias of the 30 items was analyzed via diagonal analysis of the correlation matrix. The Kaiser–Meyer–Olkin index ($KMO = 0.77$) and the Bartlett's sphericity test ($\chi^2_{435, N=389} = 3288.14, p < .001$) indicated the data matrix's suitability in regards to the factorial analysis requirements. Then, the Parallel Analysis procedure recommended extracting four factors that explained 42.55% of the total variance. The first factor grouped eight items assessing the tendency to feel unpleasant moods while thinking in a convergent way (convergent–unpleasant style), accounting for 13.63% of the variance. The second factor, that included eight items, was labeled convergent–preventive style and measured the tendency to prevent failure while thinking in a convergent way. This dimension explained 12.79% of the total variance. The third factor was referred to as divergent–pleasant style and evaluated the tendency to feel pleasant moods while thinking in a divergent way. The nine items included in this dimension accounted for 9.15% of the variance. The last dimension consisted of five items that evaluated the tendency to act proactively while thinking in a divergent way (divergent–proactive style) and explained 6.96% of the variance. Using .32 as the cut-off point for the factor loadings (Tabachnick & Fidell, 2001) the 30 items were placed in their corresponding factors (see Appendix 2). The correlations between the dimensions of EDICOS are presented in Table 1.

To check the fit of the four-factor model found in the exploratory subsample, a confirmatory factor analysis was conducted in the validation subsample ($N = 498$). Most of the indices calculated revealed an acceptable fit for the orthogonal four-factor model: The quotient of chi-square over degrees of freedom was 2.23 ($\chi^2_{394, N=498} = 880.394, p < .001$); CFI was .98; TLI was .95; RMSEA was .05; and SRMR was .06. All of these statistics indicated an adequate fit.

3.2. Reliability

The Cronbach's alpha coefficients for the total sample were: Convergent–unpleasant: $\alpha = .84$; convergent–preventive: $\alpha = .86$; divergent–pleasant: $\alpha = .82$; divergent–proactive: $\alpha = .84$. Correlation indices for the dimensions between the test and the retest were adequate: .70 (convergent–unpleasant), .68 (convergent–preventive), .69 (divergent–pleasant), .65 (divergent–proactive).

3.3. Association of EDICOS dimensions with creative-thinking styles, affective styles, and personality

As it can be seen in Table 2, the convergent–unpleasant style correlated positively with the tendency to feel negative affects (PANAS) ($r = .32; p < .01$) and with neuroticism (NEO–FFI) ($r = .42; p < .05$).

The convergent–preventive style correlated positively with preference for cognition (NC) ($r = .47; p < .01$) and with the consciousness personality dimension (NEO–FFI) ($r = .38; p < .01$). This style correlated negatively with avoidance of cognition (NC) ($r = -.38; p < .01$). To a lesser extent, it was also correlated with creative effort (QREATEGIAS) ($r = .33; p < .01$) and with openness (NEO–FFI) ($r = .30; p < .01$).

The divergent–pleasant style correlated positively with creative effort (QREATEGIAS) ($r = .38; p < .01$) and with the tendency to feel positive affects (PANAS) ($r = .30; p < .01$). The two personality factors most closely related to this style were extraversion and openness (NEO–FFI), both at $r = .32; p < .01$. On the other hand, the divergent–pleasant style correlated

Table 2

Correlations between the dimensions of EDICOS and the dimensions of NC, QREATEGIAS, PANAS, and NEO–FFI.

	Creative-thinking styles			Affective styles (PANAS)		Personality (NEO–FFI)			
	Need for cognition (NC)		Creative effort (QREATEGIAS)	PA	NA	NE	E	O	C
	PC	AC							
Convergent–unpleasant	-.13**	.13**	-.05	-.16**	.32**	.42*	-.10**	-.02	-.07*
Convergent–preventive	.47**	-.38**	.33**	.21**	.01	-.08*	-.01	.30**	.38**
Divergent–pleasant	.25**	-.35**	.38**	.30**	-.13**	-.23**	.32**	.32**	.10**
Divergent–proactive	.37**	-.28**	.56**	.30**	-.05	-.14*	.37**	.36**	.12**

Note: PC – Preference for cognition; AC – Avoidance of cognition; CE – Creative effort; PA – Positive affect; NA – Negative affect; NE – Neuroticism; E – Extraversion; O – Openness; C – Consciousness.

* $p < .05$.** $p < .01$.**Table 3**

Mean differences between women and men in the four dimensions of EDICOS.

	Women (N = 523)		Men (N = 364)		t (df)	p	Effect size d
	M	SD	M	SD			
Convergent–unpleasant	31.88	6.53	27.87	6.72	8.88 (766.69)	.001	0.60
Convergent–preventive	33.12	6.32	33.02	6.65	-.18 (885)	.851	0.01
Divergent–pleasant	42.07	7.33	42.51	7.23	-.88 (885)	.375	-0.06
Divergent–proactive	21.95	4.53	22.30	4.50	-1.15 (885)	.251	-0.07

negatively with the tendency to avoid and reject situations requiring sustained mental effort (avoidance of cognition) ($r = -.35$; $p < .01$).

The divergent–proactive style showed a substantial correlation with creative effort ($r = .56$; $p < .01$). This style correlated positively with the personality dimensions named extraversion and openness (NEO–FFI), at $r = .37$ and $.36$, respectively ($p < .01$). It also correlated with the tendency to make mental effort (NC, preference for cognition) ($r = .37$; $p < .01$).

3.4. Association of the EDICOS dimensions with gender

The results presented in Table 3 indicate that women's score ($M = 31.88$; $SD = 6.53$) was higher than that of men ($M = 27.87$; $SD = 6.72$) only in the convergent–unpleasant dimension ($t_{766.69} = 8.88$; $p < .001$). This difference had a medium effect size (Cohen's $d = 0.60$). No significant differences were found for the other dimensions.

3.5. Association of the EDICOS dimensions with academic domain

The results presented in Table 4 indicate that the mean differences between academic domains were statistically significant for the first three dimensions of EDICOS: Convergent–unpleasant ($F = 14.79$; $p < .001$); convergent–preventive ($F = 3.45$; $p = .016$); and divergent–pleasant ($F = 3.38$; $p = .018$). No significant differences between academic domains were found for the divergent–proactive dimension.

Overall, the multiple comparisons analysis conducted by Tukey post hoc test showed that Business and Sociocultural Services students obtained higher scores than Technical Sciences students in the convergent–unpleasant dimension, having found a moderate effect size for this difference (Hedges' $g_{d-b} = 0.64$). In a lesser extent, students of both Education and Health Sciences also scored higher than technical domains students in the mentioned dimension, being the effect size values of these differences between low and moderate (Hedges' $g_{a-b} = 0.37$; Hedges' $g_{c-b} = 0.37$). Keeping on with the same dimension, students of Business and Sociocultural Services obtained higher scores than Health Sciences students. However, the value of the effect size for this difference was low (Hedges' $g_{d-c} = 0.27$).

Meanwhile, in the convergent–preventive dimension, Health Sciences students scored higher than the Education Sciences students, but the value of the effect size corresponding to the mentioned difference was low (Hedges' $g_{c-a} = 0.28$).

4. Discussion and conclusions

The objective of this study was to construct a questionnaire to assess individual differences in creative-thinking (divergent and convergent), affective (pleasant and unpleasant), and motivational (proactive and preventive) styles by providing different sources of validity evidence and by testing its reliability in a large sample of higher education students ($N = 887$). In order to obtain content validity for EDICOS, a rigorous two-phase process was followed in which a large and representative battery of items for each dimension was used, a 40-item version was constructed based on consultations of an expert group and a

Table 4
Mean differences between academic domains in the four dimensions of EDICOS.

	(a) Education sciences (N=271)		(b) Technical sciences (N=225)		(c) Health sciences (N=202)		(d) Business and Sociocultural services (N=188)		ANOVA (inter-groups)		Post-hoc (Tukey)	
	M	SD	M	SD	M	SD	M	SD	F (df)	p	Multiple comparisons	Hedges'g
Convergent–unpleasant	30.47	6.67	27.95	7.24	30.50	6.73	32.32	6.23	14.79 (3)	.001	d > b ⁺ a > b ⁺ c > b ⁺ d > c ⁺	0.640.370.370.27
Convergent–preventive	32.58	6.22	32.82	6.58	34.39	6.38	33	6.56	3.45 (3)	.016	c > a ⁺	0.28
Divergent–pleasant	41.63	7.27	41.52	7.43	43.38	6.80	42.78	7.52	3.38 (3)	.018	–	–
Divergent–proactive	30.11	5.67	29.37	5.94	30.70	5.89	30.68	5.17	2.76 (3)	.051	–	–

⁺ $p < .05$.

⁺⁺ $p < .001$.

focus group, and a 30-item version was eventually used for the empirical validation phase. Results obtained in the exploratory and confirmatory factor analyses suggest the existence of four factors: “Convergent–unpleasant”, “convergent–preventive”, “divergent–pleasant”, and “divergent–proactive” styles, which were found to be reliable and temporally stable.

In addition, external validation data based on relationships between the EDICOS dimensions and other variables, such as creative-thinking styles, affective styles, personality, gender, and academic domain were provided. The analyses largely corroborated previous results. The convergent–preventive and divergent–proactive dimensions correlated positively with preference for cognition (NC) and with creative effort (QREATEGIAS). In line with motivational and cognitive process theories, individuals inclined toward effortful cognitive activities (convergent-thinking tasks) perceive themselves as able to also perform divergent-thinking tasks (i.e., because it is considered easier to generate different original ideas than to find a correct solution; Carver & White, 1994; Martinsen & Kaufmann, 1999; Steele-Johnson, Beauregard, Hoover, & Schmidt, 2000). The latter reflect the extent to which individuals are inclined to participate in cognitive activities closely related to fluency, flexibility and originality (dimensions of divergent-thinking tasks). Moreover, people with convergent–preventive and divergent–proactive styles could also consider a certain level of perseverance and concentration to be necessary, being both elements of the preference for cognition dimension (Alfonso, 2000).

As for the relationship between the emotional dimensions of EDICOS (divergent–pleasant and convergent–unpleasant) and the affective dimensions of PANAS (positive and negative affects), the results are in line with those that have found an association between positive emotions and divergent-thinking (included in the divergent–pleasant style) and between negative emotions and convergent-thinking (included in the convergent–unpleasant style) (Akbari Chermahini & Hommel, 2012b; De Dreu et al., 2008). The tendency to feel positively and to be in a positive mood might reflect the optimal mood state for divergent-thinking (i.e., tasks requiring flexibility and intuition) but not for convergent-thinking (i.e., tasks requiring strong top-down constraints and considerable cognitive effort). In contrast, the activated negative mood might be suitable for convergent-thinking tasks that require the individual to pay attention to errors, to reason critically and to find the best (and not just any) solution.

In regards to personality, results obtained in this study are partially in line with those found in the mood–creativity literature (e.g. Baas, De Dreu, & Nijstad, 2008; McCrae & Costa, 2004). The moderate association between both motivational styles of EDICOS (convergent–preventive and divergent–proactive) and openness to experience might reflect the constant desire for knowledge shared by all dimensions. Specifically, the need for convergent thinking is closely related to openness to learning, cultural topics and typical intellectual engagement; while need for divergent thinking is related to openness to new ideas, epistemic curiosity and search for new experiences. Regarding neuroticism, results from this study revealed that those who score high on neuroticism tend to feel moderate negative emotions during convergent-thinking processes, since the relationship between this personality characteristic is coherent with the convergent–unpleasant style. These associations are consistent with those reported by McCrae & Costa (2004). In addition, individuals with high scores in extraversion and openness tend to feel positive emotions during divergent-thinking processes (divergent–pleasant) and to be proactive to perform tasks requiring originality and flexibility (divergent–proactive). This result is coherent with those found by Martinsen and Kaufmann (1999) where individuals with the “explorer” cognitive style tend to prefer exercises that require stimulating cognitive processes and finding different experiences and results. People who score high in conscientiousness also obtained high results in the convergent–preventive style, as both need some self-discipline, deliberation, order, achievement striving, dutifulness, and competence in tasks requiring cognitive effort.

With respect to gender, our results are partially in line with earlier observations (Del Castillo Aparicio et al., 2009; Dhillon et al., 2000). Women have a greater tendency than men to feel unpleasant moods, such as a certain level of anxiety or tension while conducting tasks that require convergent thinking (convergent–unpleasant). However, no gender differences were found for the remaining dimensions. Similar results were reported by Baer and Kaufman (2008). Looking for gender differences in the interactions among cognitive aptitudes, motivations, affective styles, and opportunities would be one interesting area to investigate.

Regarding the relationships between creativity and academic domains, our results are partially in line with those studies that have considered three traditional domains as Technical Sciences, Social Sciences, and Arts (Carson, Peterson, & Higgins, 2005; Feist, 1998; Sánchez-Ruiz et al., 2011). Students of Business and Sociocultural Services scored higher than Technical Sciences students in the convergent–unpleasant dimension. In a lesser extent, those who were studying both Education Sciences and Health Sciences also obtained higher scores than Technical Sciences students in the same dimension. In line with Petocz and Reid (2001) students of technical domains show limited levels of emotional processing, which may hinder them to work on exercises requiring convergent thinking processes. Furthermore, the results observed by Zhang (2004) indicated that the students of Social Sciences and Humanities used the convergent thinking style more than those of Natural and Technical Sciences.

We acknowledge a number of limitations of our study. First, the sample consisted of higher education students of the Basque Country, which raises the question whether the results may generalize to adolescents and older adult populations, and to other countries and cultures. Further research is needed to ascertain whether the present findings can be generalized. Second, the findings regarding external validity are limited by the correlational nature of the study design which does not allow interpreting linkages between the various styles and preferences in causal ways. Thus, more research (experimental design or longitudinal data collection) is needed to disentangle the causal relationships of Emotion/motivation-related Divergent/Convergent thinking styles with their antecedents and outcomes. Third, in order to prevent the mono-method bias caused by the use of self-report instruments in this study and with the aim of providing more evidence of concurrent

validity, it may be useful to compare the data obtained in EDICOS with the data obtained in two creative performance tests: (1) The Torrance Test of Creative Thinking (TTCT-Figural Form B; Torrance, 1974; Spanish adaptation of scoring criteria by Ferrando, Ferrándiz, Bermejo, Sánchez, Parra, & Prieto, 2007), that examines fluency (number of meaningful responses given), flexibility (number of changes of response category), originality (number of statistically infrequent responses), and elaboration (number of items to embellish the ideas); (2) The Emotional Consequences Test (ECT; Averill & Thomas-Knowles, 1991), that examines the fluency, flexibility and originality of responses given in emotional situations, and the emotions (pleasant or unpleasant) felt in each situation.

Based on the sources of validity evidence provided and the reliability results found in this study, EDICOS is considered a useful measurement for both educational practice and research. Specifically, EDICOS can be used by practitioners and researchers for measuring individuals' disposition and preference to divergent and convergent thinking. Moreover, educators may find useful the data derived from EDICOS which could be employed to design training materials and intervention programs in the educational context to improve creativity skills. Finally, the results obtained by EDICOS may help to advance our understanding of the dynamic interplay of cognitive, emotional, and motivational factors in preventing, developing, and improving human creativity.

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Appendix 1.

Specifications for the formulation of the initial items of EDICOS.

Dimensions	Convergent–unpleasant style (COU) Convergent–preventive style (COPRE) Divergent–pleasant style (DIP) Divergent–proactive style (DIPRO)
Type of questionnaire	Self-perception
Target population	Students from higher education
Age	Between 18 and 32 years
Language	Spanish
Level of comprehension	Adapted to the understanding level of students with different training and cultural levels
Direction of items	Positive direction
Time for the evaluation	15–25 min
Type of application	Individual and collective
Number of departure items	40
Number of final items	30
Number of response options	Six response options: 1 = Strongly disagree 2 = Disagree 3 = Slightly disagree 4 = Slightly agree 5 = Agree 6 = Strongly agree
Example items	Item 8 (COU): ' <i>Cuando tengo que pensar mucho suelo sentirme algo tenso/a</i> ' ('When I have to think a lot I feel some tension') Item 15 (COPRE): ' <i>Considero interesante reflexionar sobre los problemas</i> ' ('I consider interesting to reflect on problems') Item 30 (DIP): ' <i>Cuando tengo que proponer ideas originales suelo sentirme alegre</i> ' ('When I have to propose original ideas I tend to feel cheerful') Item 22 (DIPRO): ' <i>Me interesa participar en retos originales</i> ' ('I am interested in participating in original challenges')

Appendix 2.

Items, factors, and factor loadings for the exploratory factor analysis (N = 389).

Items	F1	F2	F3	F4
1 Cuando le doy vueltas a un problema suelo sentirme algo tenso/a (<i>When thinking about a problem I often feel some tension</i>)	.66			
2 Mientras hago tareas complicadas suelo mantenerme en tensión (<i>While doing complex activities I tend to maintain tense</i>)	.64			
3 Mientras repaso un examen con detalle suelo sentir cierta ansiedad (<i>While reviewing an exam thoroughly I tend to feel some tension</i>)	.61			
4 Cuando hago una tarea intelectual suelo ponerme serio/a (<i>When making an intellectual task I often feel get serious</i>)	.63			
5 Cuando tengo que concentrarme en un ejercicio suelo sentir cierta tensión (<i>When I need to concentrate in an exercise I often feel some tension</i>)	.64			
6 Mientras abordo un problema complejo siento cierto nivel de ansiedad (<i>While working on a complex problem I feel a certain level of anxiety</i>)	.67			
7 Cuando tengo que decidir algo importante siento que me pongo serio/a (<i>When I must take an important decision I get serious</i>)	.66			
8 Cuando tengo que pensar mucho suelo sentirme algo tenso/a (<i>When I have to think a lot I feel some tension</i>)	.5			
9 Me gusta examinar los pros y los contras de cada opción antes de tomar una decisión (<i>I like examining the pros and cons of each option before I make a decision</i>)		.61		
10 Me motiva realizar ejercicios que requieren de esfuerzo mental (<i>I am motivated to perform exercises that require mental effort</i>)		.55		
11 Me gusta anticipar las consecuencias que tendrán mis decisiones (<i>I like to anticipate the consequences that my decisions will have</i>)		.52		
12 Me gusta reflexionar sobre una decisión difícil (<i>I like to think about a difficult decision</i>)		.61		
13 Me motiva realizar actividades que requieren de mucha concentración (<i>I am motivated in doing activities that require a lot of concentration</i>)		.68		
14 Me parece importante examinar los detalles de un problema complejo (<i>I consider important to examine the details of a complex problem</i>)		.7		
15 Considero interesante reflexionar sobre los problemas (<i>I consider interesting to reflect on problems</i>)		.64		
16 Me parece importante revisar un trabajo exhaustivamente (<i>I consider important to review a work thoroughly</i>)		.55		
17 Me motiva cambiar de idea hasta encontrar la que considero más innovadora (<i>I am motivated in changing ideas until finding the most innovative one</i>)				.36
18 Me ilusiona plantear nuevas soluciones a un problema (<i>I look forward to thinking up new solutions to a problem</i>)				.6
19 Me gusta pensar de forma más flexible de lo habitual (<i>I like to think more flexibly than usual</i>)				.68
20 Me motiva pensar en nuevas formas de alcanzar una meta (<i>I am motivated to thinking in new ways to achieve a goal</i>)				.66
21 Me gusta asociar ideas que aparentemente no están asociadas (<i>I like to associate ideas that are apparently not associated</i>)				.62
22 Me interesa participar en retos originales (<i>I am interested in participating in original challenges</i>)				.45
23 Me gusta romper con mis modos habituales de pensar (<i>I like to break with my standard ways of thinking</i>)				.42
24 Me agrada cambiar de idea hasta encontrar una más innovadora (<i>I like to change ideas to find a more innovative one</i>)				.48
25 Me motiva plantear nuevas soluciones a un problema ya existente (<i>I am motivated to suggest new solutions for an existing problem</i>)				.61
26 Planteando soluciones innovadoras a un problema suelo sentirme alegre (<i>While suggesting innovative solutions for a problem I tend to feel joy</i>)			.59	
27 Cuando pienso en nuevas ideas para lograr un reto siento emociones positivas (<i>When I think of new ways to achieve a goal I feel positive emotions</i>)			.42	
28 Cuando me implico en proyectos que requieren de creatividad, siento alegría (<i>When I get involved in projects that require creativity I feel joy</i>)			.76	
29 Cuando participo en un nuevo desafío predominan mis emociones positivas (<i>When participating in an new challenge my positive emotions predominate</i>)			.78	
30 Cuando tengo que proponer ideas originales suelo sentirme alegre (<i>When I have to propose original ideas, I tend to feel cheerful</i>)			.77	

Note: The items in parenthesis have been translated into English from the original version of EDICOS. This table only includes the factor loadings higher than .32. F1 = convergent–unpleasant style; F2 = convergent–preventive style; F3 = divergent–pleasant style; F4 = divergent–proactive style.

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