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How does creative giftedness differ from academic giftedness? A multidimensional conception☆

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A B S T R A C T

Giftedness is a multifaceted concept that involves a wide range of inputs and outputs. Hence, there are many theories suggesting a multidimensionality of giftedness. The aim of the present paper is (a) to position giftedness in terms of the processes involved and (b) to propose a multidimensional conception in order to differentiate creative and academic giftedness. Creative giftedness is represented by a high ability to produce ideas that are original and valuable in a specific domain or in several domains of work. There are many arguments that set creative giftedness apart from other types of giftedness. First, some empirical and theoretical data suggest that creativity is a specific characteristic that is independent from intelligence. Moreover, high levels of creativity are explained by specific processes that are not involved in high academic achievement. Finally, some researchers have observed cognitive styles and personality traits that may explain the distinction between high academic performance and highly creative performance.

Is there a single kind or are there multiple kinds of giftedness? This question has been debated for much of the last century related to issues concerning the unicity versus the multiplicity of intelligence(s) and the mind modularity (Fodor, 1985). The question of different kinds of intelligence has in part emerged with Thorndike's (1920) assumptions about social intelligence. It could be considered that these distinct intelligences are explained in terms of differences in the domain of investment (Gardner, 1993) or in the processes (or thinking) involved in treating information (Sternberg, 1996). Sternberg proposed in his theory a distinction between academic, practical and creative intelligence. Based on this last perspective, it could be interesting to identify to which degree creative giftedness can be distinguished from academic giftedness with both indicating a high level of excellence. Do they refer to distinct psychological processes? Do they depend on specific cognitive, conative and affective dispositions? The goal of this paper is to propose answers to these questions that describe why academic and creative giftedness are simultaneously dependent (i.e. creativity depends in part on intelligence) and independent from one another.

1. The notion of different kinds of giftedness: Creative versus academic giftedness?

1.1. Theoretical perspectives

Sternberg (2000) proposed a typology of giftedness that contrasts different kinds of giftedness including academic and creative giftedness. He proposes seven types of gifted individuals: The analyst, the creator, the practitioner, the analytic creator, the analytic practitioner, the creative practitioner, and the consummate balancer. This typology not only has the advantage of emphasizing the distinction between academic and creative giftedness, it considers also a potential association between high levels of academic and creative performance. Thus, even if Sternberg posits the existence of academically and creatively gifted persons, he proposes also that some gifted people like the analytic creator, exhibit high levels of performance in both the academic and the creative domains.

Milgram (1989) has also proposed a model of giftedness, which clearly distinguishes academic abilities from creative ones, and which has two dimensions: The first dimension, which defines the type of ability, includes two academic types and two creative types. The second dimension defines the level of ability. As in Sternberg's model (Sternberg, 2000), the first dimension allows us to construct a typology of giftedness which includes: Persons gifted with general intelligence; persons

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gifted with general original or creative thinking (the ability to generate a large number of ideas in problem-solving tasks); persons gifted with a domain specific academic ability; and finally persons gifted with domain-specific creative ability. It should be underlined that Milgram's model is not just composed of a cognitive component; it conceives giftedness as the result of a complex interaction of cognitive, socio-personal, and socio-cultural influences.

In the domain of mathematics, Sriraman (2005) examined the possibility of distinguishing creatively gifted mathematicians from academically gifted mathematicians. He based his analysis on Usiskin (2000) classification of mathematicians which describes mathematicians using seven levels. Level 1 refers to the basic cultural usage of numbers. Level 7 refers to the highest level of mathematicians who are the prizewinners in the field. The interesting point about this scale is the qualitative gap, which was suggested by Usiskin himself: Level 5 refers to the professional mathematicians whereas the two last levels refer to what he called creative mathematicians. Based on this continuum and as indicated by Sriraman, creativity involves giftedness but giftedness does not necessarily imply creativity. This distinction between levels 6 and 7 emphasizes the ambiguous question of the quantitative or qualitative differences between academic and creative performance. At this point, we could ask if there is any quantitative and/or qualitative distinction between creative or academic giftedness. From this perspective Sriraman proposed a definition of mathematical giftedness (academic giftedness in math) and mathematical creativity (creative giftedness in math). Academic mathematical giftedness is defined as a set of specific abilities including the ability to reason in abstract terms, to generalize and to discern mathematical structures; the ability to manage data; the ability to master mathematical principles; the ability to think analogically and heuristically; the reversibility of mathematical operations; the intuitive awareness of mathematical proof; the independent discovery of mathematical principles; the ability to make decisions; the ability to visualize problems; the ability to infer behaviors; the ability to distinguish empirical from theoretical principles; the ability to think recursively and the ability to learn at a faster pace.

Although creative giftedness in mathematics seems to involve these abilities, it also involves creation-specific abilities: "*The ability to produce original work that significantly extends the body of knowledge and/or the ability to open avenues of new questions for other mathematicians*" (Liljedahl & Sriraman, 2006, p 23). Thus, in this perspective there are both quantitative and qualitative distinctions between academic and creative giftedness: creativity involves academic abilities but also requires specific abilities and processes.

This definition is in line with Kuhn's perspective (Kuhn, 1976) which posits that creativity in science is supposed to be an action which occurs, when all regular ways of thinking about science (ordinary science) reach their limits and cannot help find solutions anymore. According to this perspective, creativity in science is a step that comes after all of the regular steps taken to solve preliminary, ambiguous scientific paradigms and Kuhn focuses on "scientific revolutions" or paradigm shifts. Eysenck (1995) suggests also that creativity helps scientists find new styles needed to solve problems and "restore interest" (p. 160). For Eysenck, intelligence is related to speed in the formation of associations needed to solve a problem and creativity is related to the breadth of associations generated by individuals.

Gardner and Sternberg (1994) and Kaufmann (2004) make the distinction between these two concepts based on the idea of novelty and necessity; creativity is viewed as a step to go beyond classic solutions like classical problem solving, as suggested by Kuhn (1976) and Eysenck (1995) for science. Gardner and Sternberg (1994) characterize intelligence and academic abilities as being useful for situations related to standard levels of novelty: these situations involve a more or less clever application of previous knowledge. As for Kuhn, creativity occurs when intelligence alone is not applicable because of the high level of novelty required for which previous knowledge and ideas are inadequate. As noted by Kaufmann (2004), this point of view is close to those of Raaheim and Brun (1985), and Gardner and Sternberg (1994), who suggest that intelligence refers to the transformation of partly unfamiliar situations into familiar situations whereas creativity refers to situations where there is total task novelty and where familiar patterns are no longer recognizable. Raaheim (1991) proposes an "upper threshold" of novelty beyond which intelligence and past knowledge have a non-significant impact. Kaufmann (2004) expands this distinction between intelligence and creativity by proposing two kinds of novelty: novelty of the stimulus and novelty of the response. Crossing these two types, he then proposes 4 conditions which imply the use of academic intelligence or the use of a process that is better suited to the novelty demand: Creativity. A familiar task with a familiar solution (routine problem solving) and a novel task with a familiar solution are related to intelligence because of the use of previous experiences and/or knowledge. This kind of task involves the use of standard operating procedures like induction/deduction and reasoning processes. Creative situations imply familiar tasks requiring novel solutions and novel tasks requiring new solutions where individuals have to go beyond reason, using imagination and specific creative processes.

In this view, as anticipated by Eysenck (1995) and Usiskin (2000), high creativity occurs only in the condition of high intelligence, not because they are correlated, but because creativity substitutes or compensates for it. However, most of the research performed in this area is in line with the initial threshold hypothesis of Guilford (1967) and Torrance (1974), which suggests the existence of a positive correlation between low creativity and low intelligence scores – a correlation that cannot be seen with higher scores. This was recently extended with new empirical evidences, showing that if intelligence and creativity are in part correlated (see Silvia, 2015), intelligence could be only described as a necessary-but-not-sufficient condition of creativity (Karwowski et al., 2016).

1.2. Empirical contributions: How much and when academic and creative performances are they independent?

The previous theories promote the ideas that both intelligence and creativity are relatively independent, in the process or in the function. Beyond these theories, empirical systematic data show also that academic and creative performances are independent. If this independence may appear relative, depending for example on the nature of the criteria and the type of task we use to evaluate creativity (Nusbaum & Silvia, 2011), numerous studies show that they are consistent.

For example, Milgram's previously introduced bi-dimensional model – including the distinction between creative and intellectual giftedness– was tested in the domains of both literature and mathematics. Hong and Milgram (1996) tested this model in the domain of literature using Confirmatory Factor Analysis (CFA), 773 students from the 7th to the 12th grade were recruited and completed two subtests of general intellectual ability, three tests of specific intellectual ability, two subtests of general creative thinking ability and a specific test of creative talent related to the domain of literacy. CFA supported the four-factor model proposed by Milgram and confirmed the distinction between academic and creative performance (correlations ranged from 0.04 to 0.37) for the four levels of performance (non-gifted, mildly gifted, moderately gifted and highly gifted students). Livne and Milgram (2006) empirically tested Milgram's model of giftedness in the domain of mathematics. Based on Milgram's model, they also remembered that great mathematicians such as Hadamard (1945) noted that inventions and accomplishments in mathematics have required creative talent rather than traditional academic ability. From this perspective they propose that the academic ability in mathematics is a computational ability whereas creative ability is related to original thinking about mathematical symbols, which allows gaining access to several solutions. To compare these two kinds of giftedness, they recruited 1090 students in 10th- to 11th-grades (Mean age = 16.50, $SD = 0.59$). Six measures were administered to assess domain-specific academic and creative abilities in mathematics. Using Structural Equation Modeling analyses, they showed strong evidence of discriminant validity of both domain-specific academic and creative abilities in mathematics for each of the four hierarchical levels assumed. They confirmed that creative thinking predicts creative, but not academic ability in mathematics, whereas intelligence predicts academic, but not creative ability in mathematics with regard to the level of performance of students (from non-gifted to highly gifted students).

More generally, research exploring the relationship between intelligence and creativity and their independence has been a long-standing enterprise. In this perspective, Kim (2005) conducted a meta-analysis with a set of 21 studies to identify how much creative and intellectual performances are related or independent. Her observed a mean creativity-intelligence relation ($r = 0.17$). Kim tested also the threshold hypothesis indicating that a positive relationships exist between intelligence and creativity for IQ inferior to 120. He rejected the threshold theory, judging that the mean correlations below and above an IQ of 120 were not statistically different ($r = 0.20$ and $r = 0.23$, respectively). This suggest a consistent weak relationship between creativity and intelligence even if it is related in part to a) the nature of the tests used to measure IQ and creativity, b) the domains in which creativity is measured (e.g., verbal vs. non-verbal), c) the dimensions of creativity being tested (e.g., fluency, flexibility, originality, and elaboration); and d) the age of the sample.

In fact, the relationship between creativity and intelligence has usually been described as a J or pear form in the scatter plots, showing that this relationship is not linear across all the levels of the IQ. This suggests that, the people with a high IQ do not necessarily show high performance on creativity, suggesting the independence of these constructs at some levels of performance. If we consider that the relationship between creativity and intelligence is not linear, and the strength of the relationship changes depending on the level of IQ, then it is important to explore at what level of IQ the relationship changes. The level in which the relationship between creativity and IQ change is called the “threshold”. Guilford and Christensen (1973) proposed a threshold at IQ equal to 120, suggesting that high performance on creativity requires high or at least above-average intelligence; above this threshold, creativity is no longer limited by intelligence (Jauk, Benedek, Dunst, & Neubauer, 2013). Many other studies have been conducted to explore the existence of the “threshold”, and these studies typically found threshold values between 100 and 130 IQ scores (Cho, Nijenhuis, Vianen, Kim, & Lee, 2010), or didn't find a threshold (Child & Croucher, 1977).

One of the methods commonly used to test the threshold is to group the sample across several levels of IQ and compute the correlations between IQ and creativity both above and below a specific IQ score. Karwowski and Gralewski (2013) proposed three criteria to assess when correlation above and below these thresholds reveal a difference in the pattern of association. First, when a sample is stratified by IQ, the IQ-creativity correlation should be statistically significant below, but not above the IQ threshold. Second, the correlations above and below the threshold should differ statistically significantly from each other. Third, the correlation below the threshold should be positive and higher than the correlation above the threshold. Using this criteria Gralewski, Weremczuk, and Karwowski (2012) found that the correlation below the threshold was significant, but not above the threshold. However, no differences were found between the strength of correlation above and below the threshold, rejecting the threshold theory.

More recently, other statistical methods have been used to explore the IQ-Creativity association. Karwowski and Gralewski (2013) used three different strategies to analyze the data in the work of: the scores obtained with Standard Progressive Matrices (SPM) and the Test for Creative Thinking–Drawing Production (TCT-DP) were analyzed as raw test scores, as Item Response Theory factor scores, and as Confirmatory Factor Analysis factor scores. Three thresholds were examined (+0.50 IQ SD, +1 IQ SD, +1.33 IQ SD) and the result showed that the confirmation or rejection of the threshold depends strongly on both the analytical strategy and theoretical decisions required for acceptance/rejection of the thresholds. Jauk et al. (2013) examined the relationship between creativity and intelligence using the piecewise regression technique: This is a technique that allows the detection of abrupt changes in the slope of the regression, which are called breakpoints. In the framework of the threshold hypothesis, the breakpoints are located at points where the relationship between creativity and intelligence changes. The authors, in line with Kim's work (Kim, 2005), found different thresholds depending on how creativity was measured. For example, with a liberal criterion of ideational originality (i.e., two original ideas), a threshold was detected at around 100 IQ points. But when more demanding criteria were used (i.e., many original ideas) the threshold was 120 IQ points, and for creative potential (i.e., ideational fluency) the breakpoint was approximately 85 IQ points. In other research using the same technique but with other measures for creativity and intelligence in Saudi students, Mourgues et al. (2015) found different thresholds depending of the participant's age and the aspect of creativity that was measured. Thus, the threshold were found between 87.3 and 108.8 IQ scores, however for the three criteria proposed by Karwowski and Gralewski (2013), the threshold was found only for 6th–8th graders at a level of analytical skills of 108.8, and at 108.4 for 9th–11th graders. The studies reported above have been explored the relation been explored in which point creativity and intelligence appear as different skills. A different perspective was proposed by Karwowski et al. (2016) to explore this relationship. Through 8 studies that involved 12,225 participants explored to what extent intelligence is a necessary but not sufficient condition for creative achievement. Using the Necessary Condition Analysis was found that different aspects and facets of creativity are relate to intelligence differently. They found that the effect size for fluency scores were stronger than those observed for originality, but in both cases intelligence was necessary but not sufficient condition of creativity, they observed that very few participants who had high creative activity or achievement, and low intelligence. Therefore, they concluded that intelligence constitutes a necessary but not sufficient condition for creative behaviors and accomplishments.

In any case, these empirical studies tend to show that the relationship between creativity and intelligence does not exist at every level of intelligence. In this perspective, they allow us to anticipate that academic abilities are at least partly independent from creativity and allow distinguishing creative giftedness from academic giftedness.

However, these data are not sufficient to demonstrate how, as in Kuhn's (1976) and Eysenck's (1995) perspectives, creativity is a step that allows going beyond intelligence and academic skills. This is why it appears relevant to describe the factors that explain the differentiation between academic and creative giftedness.

2. The determinants of a multi-perspective view of giftedness

Regarding academic and creative giftedness, we have identified some processes and/or motivations in which they are involved and which allow us to talk about two kinds of giftedness in any performance domain (e.g. social, mathematical, and musical). For example, when considering the social domain, some authors defined social intelligence as the ability to understand and assist other people and to be engaged in social interaction (Thorndike, 1920) or as a set of knowledge related to the social world (Cantor & Kihlstrom, 1987). The concept of “social creativity” has been suggested to characterize creative engagement in social domains. Mouchiroud and Bernoussi (2008) define this as a set of abilities that allows solving social problems with new, creative strategies. Similarly, there are definitions of emotional intelligence (Salovey & Mayer, 1989) and emotional creativity (Averill, 1999).

Considering the inquiries of the differential processes involved in academic and creative giftedness as the main focus of the present paper, three distinctive kinds of factors are postulated to explain the distinction between these processes in individuals. The first type of factor refers to abilities per se, which let us search for the answer to the question of whether or not there are cognitive factors to explain the distinction between academic and creative giftedness. In the search for these abilities, we aimed to refer to the neuropsychological functioning underlying cognitive performance. In this perspective we the specific use of both hemispheres of brain is emphasized.

Beyond this neurocognitive component, conative and affective components are determinants that distinguish academic giftedness from creative giftedness. These factors refer mainly to stable behaviors, motivations and cognitive styles, but also refer to emotions. Sriraman's model (Sriraman, 2005) stresses the importance of these factors. Thus, to boost "access" to creative giftedness, he suggests that teachers should help pupils from the K-12 level to harmonize creativity by encouraging them to tolerate ambiguity, to take risks, to appreciate the aesthetics of unusual solutions, and to give time to the incubation stage involved in the creative process.

2.1. A differential neuropsychological functioning?

Since the research conducted by Benbow (1988), giftedness has been related to particular neuropsychological functioning. These works suggests an absence of the classic asymmetry hemispheric functional areas, contrary to the observations in general population.

Research on the cerebral imagery by O′Boyle and colleagues (O'Boyle & Singh, 2004; O'Boyle et al., 2005) showed that in problem-solving tasks, people who were "gifted" in math do not have the hemispherical asymmetry that one would classically expect. During problem-solving, both hemispheres of these children's brains were activated whereas the general population of children showed an asymmetry which is classically observed in favor of the left hemisphere. In 2005, O′Boyle and colleagues examined also brain functioning of people gifted in mathematics using a mental rotation task. They observed greater activation of the left hemisphere in a process that essentially requires the activity of the right hemisphere. They conclude that these children show a more generalized cortical activation compare to typical children regardless of the type of the cognitive activity examined. They observed a better inter-hemispheric communication, and thus a more integrated brain function. This activation suggests the possibility for gifted children to access and use different types of information at the same time. In turn, this facilitates, cognitive flexibility allowing the child to have access to different types of concepts at the same time and thus to be able to combine them in order to create new solutions.

This specific neuropsychological functioning varies between the intellectual or creative nature of performance. Thus Jausovec (1997, 2000) showed that even if highly intelligent gifted and highly creative gifted both exhibit more cooperation between brain hemispheres and less mental activity compared to average intelligent and creative individuals, they differ in the neurological activity displayed. When the solving of an ill-defined problem, which is operationalized creativity in terms of a divergent thinking task, participants displayed more alpha power (i.e. less mental activity) than during the solving of a well-defined problem, which is operationalized as intellectual academic ability tasks (Jausovec, 1997). These results are in line with other works showing that the higher the level of arousal of individuals, the lower their creativity (Filipowicz, 2006; Zenasni & Lubart, 2002; Zenasni & Lubart, 2009). Martindale (1999) explains these results in terms of remote association activities. A high level of arousal allows individuals to focus on a limited number of semantic domains because it sustains the focus of attention: the higher the level of arousal, the higher the attention, the lower the ability to make connections between information coming from distinct semantic domains. High arousal strengthens the tendency to give dominant and stereotypical answers (Martindale & Greenough, 1973). Moreover, Jausovec (2000), conducting two experimental studies with EEG evaluation during intellectual and creative complex tasks showed that EEG patterns related to intelligence are "not so numerous and more clear-cut than those related to creativity" (p. 234). Jausovec suggests that creative individuals demonstrate more cooperation between different hemispheres compared to academically gifted individuals who may show more specialized brain activities.

Since this early work, there has been increased research on the neural substrate of creativity in non-gifted individuals (Cassotti, Agogué, Camarda, Houdé, & Borst, 2016; Dietrich & Kanso, 2010). This research suggests that creative thinking does not depend on any specific mental process or brain region. Takeuchi et al. (2011) have shown, using FMRi (functional magnetic resonance imaging) that creativity evaluated by divergent thinking is related to diffuse attention. This was already suggested by Whitfield-Gabrieli and colleagues, (Whitfield-Gabrieli et al., 2009), who found an association between creativity, schizotypy and diffuse attention, which was confirmed in more recent studies (Beaty et al., 2014; Takeuchi et al., 2012). Jauk, Benedek, and Neubauer (2012), examining EEG alpha activity related to convergent and divergent thinking observed that highly creative individuals displayed more variability in frontal areas. This effect appeared to be more marked in the right hemisphere. This suggests that highly creative individuals are possibly better at switching between different modes of cognitive processing and accordingly show increased frontal flexibility. Beaty et al. (2014) extended these results, showing that different neural networks interact during the process of idea generation particularly with an increased functional connectivity between seed regions in the inferior prefrontal cortex and the default neural network, suggesting that creative thinking includes both controlled and spontaneous cognitive processes.

As instructive as the recent neuroscientific studies are, they are still not informative enough to demonstrate how exactly creative thinking differs from non-creative thinking (Abraham, 2013, 2014). However, it seems important to distinguish creative cognition from a normative cognition (Abraham, 2014) especially for gifted individuals.

2.2. A cognitive distinction between academic and creative giftedness

A cognitive concept that may distinguish academic from creative giftedness is the mode of thinking used to solve problems or "think about the world". Early work on intelligence and imagination suggested already such a distinction between creative abilities and academic, normative intellectual abilities. Thus, Binet, interested in both imagination (Binet, 1896) and the metrics of intelligence (Binet & Simon, 1905) developed an assessment which involved divergent thinking tasks: Individuals have to generate as many solutions as possible to specific stimuli such as an ink blot. However, these tasks, which were developed to measure imagination, were finally not retained by Binet and Simon as a subtest of the metric scale of intelligence. Ribot (1906) developed also theories and measurements opposing a reproductive imagination to a "creative" one. To him, reproductive imagination is very close to the concept of memory, whereas creative imagination is a specific skill that supposes associations, combinations in order to generate new productions or solutions. Vygotski (1930), in line with Ribot's view, proposed a vision of human activity that summarizes this very well: he distinguished between (a) reproductive activity, which is "very closely linked to memory" and "consists of a person reproducing or repeating previously developed and mastered behavioral patterns"; and (b) creative activity, also termed imagination, which involves "the creation of new images or actions" (page 7). Hence, the originality of Vygotsky's framework is that it does not contrast reproduction/representation and imagination, but implies that they are constantly interconnected.

Since Guilford (1950), divergent thinking is defined as the ability to generate several solutions to solve a problem or considering possible constraints whereas convergent thinking usually refers to analytical and logical thinking supposing a logical validity of the generated solutions (Cropley, 2006). Divergent thinking is usually considered as an important characteristic of creative giftedness (Runco, 1986), whereas convergent thinking may mostly contribute to high academic performance. Thus in the first case, creative giftedness could be considered as involving individuals who will spontaneously base their reflection on associative thinking allowing them to combine ideas and then to formulate new and original solutions. This tendency is related to specific cognitive traits, which motivate creative people to adopt this mode of thinking. This difference was emphasized in the sixties where researchers such as Torrance (1962), Wallach and Kogan (1965), and Mednick (1962) theoretically and empirically supported the stochastic independence between creative and intellectual cognition as we already mentioned in the previous part of this paper. In this continuity Kim (2005) showed through in his meta-analysis that divergent thinking contribute more to creative achievement than IQ (respectively $r = 0.216$ and $r = 0.167$).

Beyond this distinction between divergent and convergent thinking, we may consider a more critical cognitive way to generate solutions or new ideas: Creative gifted people have a high level of associative processes whereas academically gifted people demonstrate a high level in hypothetico-deductive abilities favoring divergent or convergent thinking, respectively. Wundt (1896) distinguished associanistic from intellectual thought.

It is possible to consider that divergent thinking results from associative thinking; a divergent production of solutions is facilitated when association phenomena generate new ideas. Wallach and Kogan (1965) and Wallach (1970), developed the notion of associative flow of ideas previously proposed by Mednick (1962). In their 1965 study on the distinction between intelligence and creativity, Wallach and Kogan analyzed the productions of artists and scientists in order to elaborate the tasks of divergent thinking and work on their application. Given these analyses, they claimed the existence of "*free and original associative thought*" in the act of creation (1965, p.49). They reported that the creators emphasize especially the act of creating an associative content, which is characterized by both its productivity and strong originality. Here, there are two components of divergent thinking – one quantitative, and one qualitative – related to the concept of association through which the creator generates many different and original ideas. This associative process itself may be the consequence of a mechanism of attention deployment: creative individuals can focus their attention on different aspects of a single stimulus and consequently, they can generate significantly more associations than other individuals (Wallach, 1970).

According to Eysenck (1995) a creative genius is an expert in making associations because the creative person presents (a) a large pool of information to generate associations from, (b) a high speed in the production of associations and (c) a "well-functioning comparator" that is needed to filter false associations. In line with this proposition some authors have suggested that the associative processes underlying creativity are related to unfocused attention (Eysenck, 1995; Martindale, 1981, 1999; Schmajuk, Bates, & Aziz, 2009): creative individuals are those who are able to unfocus their attention and consequently to have more original solutions/ideas. This attention may depend on cognitive (latent inhibition) emotional (such as positive or negative affect) and/or neurophysiological (such as the release of dopamine) variables (Ashby, Isen, & Turken, 1999; Zenasni & Lubart, 2009, 2011). Martindale showed that higher creativity may be related to a lower level of arousal. Eysenck (1995) suggested that latent inhibition (LI) and impairments seem to cause to a cognitive (dys)function involving high creativity because of the high rate of associations it can favor. Carson, Peterson, and Higgins (2003) showed that high lifetime creative achievers had significantly lower LI scores than low creative achievers. However, they suggested also that a high IQ is necessary to "limit" the failure of latent inhibition and help individuals to be creative and not be (overly) impaired by intrusive thoughts or associations.

Another cognitive model related to this process, called the attentional-associative model and developed by Schmajuk et al. (2009), illustrates some potential mechanisms underlying combinations and associations of ideas on creativity. This model assumes an interaction between attention to stimuli and the regrouping of these stimuli during the memory storage and retrieval process (Laurrari & Schmajuk, 2008).

2.3. A conative distinction

Following the multivariate approach to creativity, the distinction between academic and creative giftedness is also expected on conative grounds. Conative variables refer both to personality traits and to stable motivation or achievements.

Personality traits like stable motivation and perfectionism are among the traits that are highly developed in gifted people. As a matter of fact, giftedness is related to a high need for precision which can be projected in many type of behaviors such as meticulousness of the thought, the need of logical explanations, or the need to be the most excellent in a class (Kline & Meckstroth, 1985). Supporting these assumptions, some researchers showed a high prevalence of perfectionism in gifted children (Schuler, 1999; Parker & Adkins, 1995).

Due to the multidimensionality of perfectionism (Chan, 2010), the types of perfectionism observed in gifted children may help interpret the distinction between academically and creatively gifted individuals. First, an opposition between healthy and an unhealthy perfectionism in gifted children can be considered. Chan (2010) and Hamachek (1978) distinguish normal perfectionism, which can be observed as efforts to achieve excellence, from pathological perfectionism, which can be observed as avoidance attitude to get a solution because of very high standards. This distinction is important because it suggests that gifted unhealthy perfectionists may have the tendency to always look for the best solution and may favor divergent thinking and thus creativity, whereas normal perfectionists may focus on a limited number of satisfying solutions which they will detail as far as they can according to their standards.

Findings from Parker and Stumpf (1995) support this hypothesis; in their study, in which they evaluated type of perfectionism in gifted adolescents using a self-report scale they observed that 38% of adolescents were non-perfectionists, 42% were healthy-perfectionists and 20% were unhealthy perfectionists. Moreover, by evaluating personality traits of these gifted children with the Big Five inventory, they found that healthy perfectionism of these gifted children was associated with higher levels of extraversion, agreeability and conscientiousness, whereas unhealthy perfectionism is associated with higher neuroticism, higher openness to new experiences and lower consciousness. These characteristics of gifted unhealthy perfectionists may appear as significant resources of creativity: Openness to new experiences leads to creativity (Feist, 1998; McCrae, 1987) and low levels of consciousness lead individuals to generate and check alternative solutions instead of focusing and developing one optimal solution. In this perspective a high level of giftedness associated with a high level of perfectionism may lead to creative giftedness or academic giftedness depending on the type of perfectionism developed.

Another perspective about perfectionism and the type of giftedness is related to the orientation of the perfectionism under scrutiny. Hewitt and Flett (1991) defined self-oriented and socially-prescribed perfectionism: self-oriented perfectionism implies having high expectations or standards for oneself whereas socially prescribed perfectionism is defined as perceiving others as having high expectations for one's performance. Speirs Neumeister (2004) clearly demonstrated that these two kinds of perfectionism may be related to the educational style of parents. This conception of perfectionism with two modalities is very close to the conception of the bidimensional view of motivation which distinguishes between extrinsic and intrinsic motivation. Extrinsic motivation is defined as the tendency of individuals to act for an external reward that is outside of the task itself whereas intrinsic motivation refers to "*any motivation that arises from the individual's positive reaction to qualities of the task itself*" (Amabile, 1996, p.115). A large body of research shows the positive impact of intrinsic motivation on creativity (Amabile, 1985; Amabile, 1996; Runco, 2005).

2.4. Two distinct emotional structures?

Emotion and affect are obviously important aspects of human life and are integrated in the description of personality (Hilgard, 1980; Mayer, 2003). Gifted children and adolescents seem to have specific emotional characteristics. As mentioned earlier, perfectionism has some associations with affect due to the anxiety that it may create. But affective intensity/sensitivity appears as a relevant emotion-related personality trait for describing gifted people (Gere, Capps, Mitchell, & Grubbs, 2009; Piechowski, 1999; Piirto, Montgomery, & May, 2008; Tavani, Zenasni, & Fradin, 2009). Affective intensity may be defined as the tendency to live or feel different emotional experiences in an intense way (Larsen & Diener, 1987).

The concept of affective intensity is related to the hypotheses about overexcitability developed by Dabrowski (1972) via his theory of positive disintegration. He gives a prominent role in affective intensity with which an individual will live his/her experiences and Dabrowski underlines the importance of the emotional components in the developmental process. Dabrowski identifies five domains of overexcitability referring to the extreme reactions and constants as a response to internal and external stimuli. One of the four forms of hyperstimulability is purely emotional by nature. Thus, positive or negative emotions of gifted children are felt and expressed more intensely than in children of average intelligence. But what distinguishes creatively gifted people from academically gifted people in terms of affect intensity?

One interesting point is that affective intensity of gifted children may be expressed in several different ways depending on the degree of their inhibition or channeling of high-intensity emotional reactions (Gere et al., 2009; Piechowski, 1999). Sword (2001) suggests that affective intensity may also be accompanied by symptoms such as somatization, high emotional memory, high anxiety or high attachment to others. Following this perspective we may wonder to which degree creative giftedness is not a specific mode of regulation of emotional overexcitability and affective intensity. Furnham, Batey, Anand, and Manfield (2008) found positive relationships between hypomania (defined by DSM-IV as an elevation of mood identified by the usual criteria for mania like irritability, racing thoughts, distractibility, but with a lesser intensity and duration) and self-evaluated creative behavior. Albert (1991) and Runco (1998) assume that tension favors creativity with its motivator and problem identifier effect. For Adaman and Blaney (1996), investment in creativity is a way to reduce high levels of affect intensity, which are not comfortable for the subject especially if they tend to recur.

Academic and creative giftedness may also depend on the level of arousal, a principal component of emotional experience, and the use of unconscious thought which are usually associated with lower level of arousal. Martindale (1981, 1999), supposes that creativity depends on remote associations and levels of consciousness. These elements are not directly associated but indirectly connected. For example artists are able to make remote connections particularly if they are in a low level of arousal allowing them to connect to the ideas associated with the primary process of thinking (Botella, Zenasni, & Lubart, 2011; Botella, Zenasni, & Lubart, 2015). Primary process of thinking refers to unconscious thinking based on symbols and metaphor, and focused on immediate gratification of instinctual demands and drives. This perspective is in line with Suler (1980) who proposed that gifted artists use unconscious affects and fantasies when producing a creative work in case of low levels of arousal. Zhong, Dijksterhuis, and Galinsky (2008) using experimental studies, showed that compared with a conscious contemplation or mere distraction, unconscious thought may favor the creativity of participants or in other terms it could be said that creativity could be enhanced if people "use" more often their "unconscious thought". In this perspective, one suggestion is that creative giftedness is associated with more particular arousal regulation mechanisms compared to academic giftedness.

3. A final review: Academic or creative giftedness?

By considering personality and motivational constructs, many factors that may explain the differences between academic and creative giftedness can be taken into account. However, we may add a metacognitive perspective embodying all these elements.

One possible synthesis to compare academic with creative giftedness is the following (see Table 1 for synthesis). First, it appears that both academic and creative giftedness refer to a high level of potential and/or achievement. Some theories (Guilford, 1967; Sternberg & Lubart, 1995) and empirical studies (Barron & Harrington, 1981) show that academic intelligence and creativity may be related partially through a *g* factor. However, from a certain level of intelligence, a higher level of independence between these two intellectual modes of operation appears, sustaining an idea of specificity between academic and creative giftedness. This is in line with the IQ = 120 cut-off point (Barron, 1963; Jauk et al., 2013): Starting from this IQ level, the independence between creative and intellectual performances becomes larger. This is also in line with Milgram and colleagues' (Milgram, 1989; Hong & Milgram, 1996) model, which suggests a relative independence between academic intelligence and creativity, in relation with the level of giftedness. This evolution of dependency/specificity according to the degree of giftedness does not mean total differentiation between the two concepts, because creativity is always partly based on academic intelligence and cognitive abilities going with it (e.g. verbal and fluid abilities). Creative giftedness without high intelligence could be detrimental or impossible: Relevant creativity requires intelligence in order to be applicable to the environment (Otherwise, without intelligence, creativity might put us in troubling situations as indicated by Carson et al., 2003). In any case, this underlines the idea that for both academic and creative thinking there must be a *g* factor, which can be considered as the representation of the level of general investment of the intellect.

Second, purely academic and creative thinking in giftedness may refer to two different forms of investment and/or of the use of intellect: One favoring convergent and logical, hypothetico-deductive thinking and the other favoring divergent and associative thinking (Gardner & Sternberg, 1994). From this perspective, each function will be associated with specific neuropsychological process, and specific conative and socio-emotional factors. Considering creative giftedness, two kinds of creative processes should be enhanced in line with the theory of Kaufmann (2004). The first is proactive creativity which refers to a situation where an individual tries to find a new solution in a familiar situation that is not presented as a problem to solve. There is a "free" perspective for the individual to engage in creative thinking and innovation. Alternatively, reactive creativity refers to the need to find new solutions to solve a problematic situation. This is typical of problem

Table 1
Main theoretical differences and similarities between creative and academic giftedness.

Creative giftedness	Academic giftedness
• Creativity in science occurs in an upper phase.	• Creativity in science occurs in a regular phase.
• Generates fast and original solutions	• Generates fast solutions
• High level of novelty	• Standard level of novelty
• Implies academic giftedness	• A required component of creativity
• Stimulated by ill-defined problems	• Stimulated by well-defined problems
• Inversely proportional with the level of arousal	• Directly proportional with the level of arousal
• Presents a high level of associative processes	• Presents a high level of hypothetico-deductive abilities
• High level of perfectionism	• High level of perfectionism
• High level of potential of achievement	• High level of potential of achievement
• The independence becomes larger from a certain level of intelligence.	• The independence becomes larger from a certain level of intelligence.
• Favors divergent and associative thinking	• Favors convergent and logical hypothetic-deductive thinking

solving task. Zenasni and Lubart (2008) observe in part this kind of distinction, examining the impact of emotions on creative performance, except that the nature of the problem – if it exists – concerns the affective mood of the creators and not the nature of the creative task per se. According to specific variables (nature and intensity of the emotion, level of arousal) creativity may appear as a proactive or a reactive action. They propose that creativity may refer to (a) regulation/adaptation processes and (b) self-actualization processes: For regulation/adaptation processes, creativity corresponds to a tendency to suppress a tension or an emotional problem; in the case of self-actualization processes, creativity corresponds to the expression of well-being.

4. Conclusion

We put forward the hypothesis that academic and creative giftedness can be considered as two different phenomena. In this line, we first review specific theoretical and empirical contributions that indicate that intelligence and creativity can be considered as different, in spite of the observed correlations between the two constructs. More precisely, we highlighted the idea that creativity refers to a specific process that allows going beyond intelligence and academic skills. Indeed, it appears that intelligence constitutes a necessary but not sufficient condition for creative behaviors and accomplishments. Considering this distinction between creativity and intelligence, both in their mechanisms and their function, we suggest that academic and creative giftedness are not based on the same components. Using a multidimensional approach, we propose that specific cognitive, conative and/or emotional dimensions may help to further identify differences and similarities between creative and academic giftedness (see Table 1).

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