

Creativity in Children with Attention Déficit Hyperactivity Disorder (ADHD)

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Abstract

Research about creativity in ADHD children is very limited and has shown discordant results. Some features of cognitive functioning in ADHD, such as scattered attention, difficulty suppressing brain activity of the default neural network, inefficiency to inhibit irrelevant stimuli that access consciousness, or common markers-based genetics, are at the base of the connection between ADHD and creativity. The aim of this study is to explore whether the ADHD children are more creative and obtain better results in the divergent tasks traditionally considered as measures of creativity regarding children control. **Method:** The sample comprised 68 children, aged 8 to 13 years. A group of 34 children diagnosed with ADHD (M age 10.5, SD = 1.6) was compared to a control group of 34 without ADHD (M age = 10.8, SD = 1.7). None were under pharmacological treatment. The children were assessed using the Torrance Tests of Creative Thinking Figurative (TTCT). **Results:** ADHD children showed better results in some areas of creativity, showing higher scores in Fluency, with a greater number of responses, Originality, with a greater number of unusual or unconventional responses, together with higher scores in Creative strengths, which include measures for movement or action, emotional expressiveness, story-telling articulateness, unusual visualization, humor or fantasy. Partial η^2 effect sizes ranged from 0.19 to 0.34. As a consequence of those partial superior resultados, the ADHD children show a higher global creativity index than the control group. **Conclusions:** Our results suggest that children diagnosed with ADHD are more creative, than typically developing children, not in all evaluated areas but in some of them. This finding could provide guidance for the use of more effective assessments and interventions to promote this positive quality in children with ADHD.

Keywords

ADHD, Children, Creativity, Torrance Tests of Creative Thinking

1. Introduction

Whether there is a greater disposition for creativity in children with attention deficit hyperactivity disorder (ADHD) than in typically developing children remains inconclusive (Paek, Abudulla, & Cramond, 2016). Yet, the hypothesis is attractive insofar as it could highlight positive characteristics of children with ADHD. According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) from the American Psychiatric Association (2013), ADHD is characterized by the appearance of three core symptoms: inattention, hyperactivity and impulsiveness. It is described as a persistent pattern of personal functioning that prevents typical normalized development or daily activities and negatively interferes with school activities. ADHD is one of the most frequently diagnosed disorders in the child population. A meta-analysis conducted by Polanczyk, Lima, Horta, Biederman, & Rohde (2007) initially estimated a prevalence of 5.3% among individuals under the age of 18. Drawing on a review of 175 studies on ADHD prevalence, a work by Thomas, Sanders, Doust, Beller, & Glasziou (2015) estimated an overall pooled estimate of 7.2% in the whole child population.

The most direct consequence of this disorder is the impact on different aspects of personal and social relationships (Barkley et al., 2002). Broadly speaking, in comparison with typically developing children, ADHD children are more likely to drop out of the educational system, less likely to complete a university degree, more likely to work in lower class employment, more likely to be involved in antisocial activities and high-risk situations, and frequently present difficulties and conflicts, in relationships with peers and families. In a longitudinal study (Holbrook et al., 2014), over a 6-year period, children ADHD were aged from 5 to 13 years. They found that inattention symptoms were maintained until adolescence, and the symptoms of hyperactivity impulsivity decreased with age. According to Biederman, Petty, Clarke, Lomedico, & Faraone (2011), in their 11 years of follow-up of children with ADHD, these difficulties tend to appear in early childhood and persist into adulthood. Their study shows that once diagnosed, in different degrees and in different areas, the disorder continues to affect 78% of subjects with ADHD in adulthood, with variations according to clinical or subclinical symptoms.

Creativity is regarded as an individual's ability to generate new ideas and potentially useful solutions in different situations (Sternberg & Lubart, 1996). Despite multiple theories of creativity (Runco, 2014; Sternberg, Kaufman, & Pretz, 2002), a consensus appears to exist that novelty and utility are two key factors in the creative process (Plucker, Beggheto, & Dow, 2004; Runco, 2007; Sternberg & Lubart, 1999). The novelty or originality of a response is defined in statistical terms by its rarity or singularity; utility refers to the capacity to achieve an objective in a certain context. For Simonton (2004), the concept of creativity requires

the willingness to think outside the usual norms, to find novelty and the unconventional along with the ability to be open to experience. It is for this reason that the creative people have as characteristics such as unfocused attention, divergent thought, and behaviors oriented to the independence and nonconformity. This form of functioning, can also be presented in ADHD people. [Cramond \(1994a\)](#) warned about possible overlapping functional traits of creative children and ADHD children. [Sternberg & Kaufman \(2010\)](#) warned about the risk of not identifying creative people hidden by their ADHD. The relationship between ADHD and creativity is based on possible overlapping forms of functioning, similar cognitive or neurological characteristics.

It should also be considered that intellectual ability is one of the factors that may be affecting creativity, according to [\(Jauk, Benedek, & Neubauer, 2014\)](#) depends on the intelligence the conversion of skills or knowledge gained in remarkable creative achievements.

In the case of children, there is an added difficulty in evaluating creativity, the tests measure their creative potential, since recognized creative products may need time, experience and a level of knowledge not reached in childhood making it necessary to evaluate their potential creativity [\(Beghetto & Kaufman, 2007\)](#). Consistent with this consensus on the nature of creativity, one of the most representative and widely used divergent thinking tests to measure creative potential is the Torrance Tests of Creative Thinking (TTCT, [Torrance, 1974; 2008](#)). It measures different creativity dimensions that are defined in [Table 1](#).

Table 1. TTCT figurative Torrance subtests.

Dimension Creativity	Definition	Score range Min.-max
Fluency	The number of drawings completed.	40 - 153
Originality	The statistical infrequency and unusualness of the response.	40 - 154
Elaboration	The individual's ability to develop, extend and elaborate upon ideas: the number of additional details used in developing the response beyond what would be strictly necessary for the basic response.	40 - 160
Abstractness Titles	The ability to produce good titles using synthesizing and organizing processes. The ability to capture the essence. Such a title enables the viewer to see the picture more deeply and richly.	40 - 160
Resistance Premature Closure	A creative person's ability to stay open and tolerate ambiguity long enough to generate novel ideas and perform the mental leap that makes possible original ideas.	40 - 160
13 Creative Strengths	Emotional expressiveness, storytelling articulateness (context, environment), movement or action, expressiveness of titles, synthesis of incomplete figures, synthesis of line or circles, unusual visualization, internal visualization, extending boundaries, humor, richness of imagery, colorfulness of imagery, fantasy.	1 - 26

1.1. Neurological Hypothesis

The common nexus between ADHD and creativity is based on forms of cognitive functioning, such as a delay in cortical maturation affecting two aspects, the maturation process trajectory and final cortical thickness reached. In children with ADHD this process can be delayed by two or more years, compared to the typical development expected for children without ADHD, as documented by authors (El-Sayed, Larsson, Persson, Santosh, & Rydelius, 2003; Shaw et al., 2007). This delay, from the point of view of Thompson-Schill, Ramscar & Chryssikou (2009), would offer an evolutionary advantage since this immaturity in the prefrontal control, where the executive functions are located, regulates the thought and the behavior and favors a flexible way of thinking that is not conditioned by expectations or beliefs. Uncontrolled cognition allows us to approach new solutions or creative ideas without limitations.

Regarding the way to confront the creative task, there are similarities of functioning between ADHD and creative, both groups show difficulties for the deactivation of the default neural network (DNN) to tasks that require more mental effort, which leads to the maintenance of a dispersed, unfocused mental state (Mattfeld et al., 2014, Sonuga-Barke & Castellanos, 2007, Uddin et al., 2008).

At the genetic level the common nexus between the creative and the ADHD group is based on that they can share some genetic markers, all of them related to dopaminergic neurotransmission. One of the most supportive hypotheses is the presence of the DRD4-7R gene (Auerbach, Benjamin, Faroy, Geller, & Ebs-tein, 2001, Dietrich & Kanso, 2010, Munafò, Yalcin, Willis-Owen, & Flint, 2008), known as the search for novelty gene and at the same time associated with a greater dispersion and attentional amplitude, present in ADHD, make essential traits for divergent thinking emerge, (Auerbach et al., 2001). This behavior can already be identified in very young children, around one year of age, when they perform tasks of structured play and tasks of information processing that require a certain degree of attention, this form of carrying operation with more dispersed attention and preference for novelty was observed with greater intensity in children DRD4-7R gene compared to children without the 7R allele (Auerbach et al., 2001).

1.2. Experimental Studies with ADHD Children

Other authors have found evidence for widened attentional focus which would enhance creative processes in ADHD children. Shaw & Brown (1990, 1991) demonstrated that ADHD children used more diverse nonverbal information and were able to focus attention on different stimuli in their immediate environment, resulting in higher figural creativity. Other authors suggest the inability of ADHD children to screen out irrelevant stimuli when performing a task (latent inhibition) results in the availability of more stimuli for use in creative processes (Carson, Peterson, & Higgins 2003; Pritchard, Healey, & Neumann, 2006).

A number of studies have addressed the relationship between ADHD and creativity, with a variety of designs and findings. Healey & Rucklidge (2006)

found that 40% of creative children showed elevated levels of ADHD symptomatology, although none met the clinical diagnostic criteria for ADHD. Using Torrance's Figurative TTCT, Cramond (1994b) compared a group of children with ADHD and a group of creative children, finding that 26% of creative children had ADHD trends measured on the SNAP-IV scale (Swanson, 2003) and that 36% of children with ADHD scored high on creativity.

In the study conducted by Abraham, Windmann, Siefen, Daum, & Güntürkün (2006) on creative cognition in ADHD, adolescents ADHD outperformed healthy and matched control participants in the task of giving new uses to a toy. Their poor inhibitory control or being easily distractible make them better able to override the restrictive influence imposed by relevant or relevant knowledge when it comes to being creative. And they can expand conceptual structures to include unusual or new associations. Taylor (2006) found that children with ADHD had high levels of fluidity and flexibility, understanding that the latter was the ability to generate varied ideas. According to White & Shah (2006), young adults with ADHD were more likely to find creative solutions than those who did not, showing a preference for generating ideas. However, they did not perform better than the control group when "correct" responses were required (White & Shah, 2011). In contrast to the above, other authors (Healey & Rucklidge, 2005; Sang, Yu, Zhang, & Yu, 2002) did not find that children with ADHD were more creative than those who did not.

One of the potential methodological problems in comparing the different studies is the lack of control of the medication status of research participants, since pharmacological treatment can improve attention deficit symptoms (Pliszka, 2007; Swanson, Cantwell, Lerner, McBurnett, & Hanna, 1991) but can also decrease curiosity, exploratory effort and cognitive flexibility (Hansen & Hansen, 2006). High doses can produce excessive focusing and clinical symptoms of perseveration (Tannock & Schachar, 1992), findings suggest that methylphenidate (MPH) may reduce cognitive flexibility temporarily in some ADHD children, and as recently demonstrated, can decrease fluency, originality and number of creative strengths and the overall index of creativity, measured by the TTCT-Figurative (González-Carpio & Serrano, 2016). Other authors have found no relationship between medication and excessive focusing and widened attentional focus (Douglas, Barr, Desilets, & Sherman, 1995; Funk, Chessare, Weaver, & Exley, 1993).

Limited research with children with ADHD shows that there is a controversy surrounding the greater or lesser degree of creativity in people with ADHD, especially in the child population, the aim of this study was to analyze the possible differences in creativity in a group of ADHD children compared to a control group, none of whom were under pharmacological treatment. Our hypothesis was that children with ADHD would perform better on creativity than the controls.

Creativity was operationalized using the Torrance Tests of Creative Thinking Figurative (Torrance, 1998, 2008) scored for each of the five dimensions of crea-

tivity (Fluency, Originality, Elaboration, Abstractness of Titles and Resistance to Closure), the sum of Creative Strengths, which measure characteristics of creative personality, and the Creativity Index, which combines the five dimensions and the creative strengths score.

2. Methods

2.1. Participants

2.1.1. Participants with ADHD

A total of 34 children with ADHD participated in the study, all outpatients recruited from the Child and Youth Mental Health Unit (SMIJ) at the Virgen de la Salud Hospital, Toledo (Spain). The diagnosis was given by experienced clinical psychologists, following the DSM-5 criteria. The assessment used a children's mental health interview with parents and children covering all developmental aspects, symptoms over the last six months and current symptoms, and information obtained from teachers at the children's schools. Teachers completed the SNAP-IV scales (Swanson, 2003). Children with an ADHD diagnosis were included if within the age range 8 to 13 years and willing to take part in the study.

All ADHD children taking stimulant medication, or any other type of medication, at the time of the study or during the previous year, were excluded, as were those presenting associated disorders, anxiety disorders, mood state disorders, and child or adolescent onset antisocial behavior and autism spectrum disorders. We also excluded children with low intellectual capacity, neurological disorders, or uncorrected visual or hearing problems. Out of 34 children belonging to the ADHD group 16 were ADHD with no other diagnoses added and the remaining 18 were ADHD with one or more associated disorders, including: four cases of oppositional defiant disorder; (F91.8), two cases of enuresis, in the younger age group (F98.1), 12 had reading-writing disorders, (F81.0) along with learning difficulties, (F81) and because of these difficulties, seven had also repeating a school year.

2.1.2. Participants without ADHD

A total of 34 children in a similar age range of 8 to 13 years were selected for the control group. All the participants were below the threshold for ADHD diagnosis, confirmed by experienced clinical psychologists. Clinical interviews were conducted with children and parents and information was collected from teachers by use of the SANP-IV scales. The children's mental health history was also consulted. The control group was recruited from patients attending the SMIJ for various reasons, specifically.

The difficulties of this group of children who attended the consultation were: six children had unspecified learning disorders (F81.9), six children had repeated courses due to poor school performance, (Z55.3), a child had somnambulism, (F51.3), 10 children with problems related to family breakup by separation, (Z63.5), five children with problems related to adjustment to vital transitions, (Z60.0), two cases of bullying, (Z55.4), a child with problems related to inade-

quate social skills, (Z73.4) and three cases without pathology. We established two groups matched by age, gender and place of origin. Selection was conducted simultaneously with the ADHD group. The same exclusion criteria were used as for the ADHD participants. **Table 1** shows the characteristics of the ADHD and control group.

2.2. Procedure

Participants were recruited from children referred to the Child *and* Youth Mental Health Unit (USMI) by the pediatric neurology service, the pediatrician or the family physician at the local health centers. For your evaluation, either for suspected ADHD or other problems. Subsequently, the SNAP-IV scales performed by the teacher were analyzed and punctuated, and the clinical diagnostic interview was carried out to complete the history of children's mental health.

Once the information was verified from the three points of view the school, family and clinical diagnosis was established by clinical psychologists. After the evaluation, children and families were voluntarily invited to participate in the study, following the inclusion criteria/Exclusion mentioned above. Once consent was given, the K-BIT test battery was administered to measure intellectual ability and in a subsequent session the TTCT-Figurative creativity test was administered. The tests were performed by a single investigator, previously trained to administer and record the test, which facilitated consistent data collection. Each session lasted between 60 and 90 minutes, depending on the willingness of each child to collaborate. The TTCT-figurative was administered in a relaxed manner appropriately. The children were asked to draw pictures, following the instructions in the test manual. All procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national) and with the Declaration of Helsinki of 1975, revised in 2000 (Manzini, 2000).

2.3. Measures

ADHD symptom rating scale. The SNAP-IV Rating Scale Revised IV-R (Swanson, 2003) is a scale with nine Likert-type items (range 0 - 3) for the attention subscale and nine items for the hyperactivity-impulsivity subscale. The scale is completed by teachers, who rate the presence of the symptoms. Scores represent the average rating per item on each subscale and the total scale. Percentile 95 is used as the cut-off point for normality. Cut-off points for the teacher rating: 1) For attention deficit: 2.56, 2) For hyperactivity/impulsivity: 1.78, and 3) 2.00 for attention deficit and hyperactivity/impulsivity.

Intellectual functions. The Kaufman Brief Intelligence Test (K-BIT) (Cordero & Calonge, 2000) is a general intelligence measure consisting of two subtests: vocabulary (expressive vocabulary and definitions) and matrices. The scores obtained have a mean of 100 and a standard deviation of 15, for both the vocabulary and matrices subtests and the compound intelligence quotient.

Measure of creativity. Torrance Tests of Creative Thinking-Figurative (TTCT),

parallel forms A and B (Torrance, 2008), translated into Spanish, consist of three subtests or games: 1) constructing a drawing, 2) completing a drawing, and 3) making different drawing using two parallel lines. Five dimensions comprising creativity are evaluated. **Table 1** defines the five subscales or dimensions of creativity and the thirteen creative strengths. A total Creativity Index is derived from the five dimensions and the Creative strengths. The battery enables conversion of test scores to percentiles with a mean of 100 and standard deviation of 20. Torrance (1998) reported reliability ranging from 0.89 to 0.94, and Torrance (1990) reported that reliability was over 0.90. According to the study by Kim, Cramond, & Bandalos (2004), the alpha coefficient for consistency was 0.79.

2.4. Data Analysis

Scores were distributed normally to groups, as assessed by the Shapiro-Wilk normality ($p > 0.05$). There was homogeneity of variances, as assessed by Levene's test of homogeneity of variance ($p > 0.05$). Box plots revealed an atypical value but this was not omitted from the study as it did not affect the results. One-factor ANOVAs were conducted to compare ADHD and control group scores on each dimension of creativity and the total score. Effect sizes were calculated for all the comparisons of means, following Cohen (1988), using eta partial squared ($\eta^2 p$) to more accurately determine the magnitude of the difference (Castro & Martini, 2014). An alpha of 0.05 was set for the statistical analysis. SPSS version 20.0 was used for data analysis.

No significant differences were found between the ADHD children and controls for age, gender or general intellectual capacity. As expected, the children without ADHD obtained significantly lower scores and did not meet the cut-off points on the SNAP-IV questionnaire to assess ADHD symptoms.

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Regarding the ADHD group, no significant differences were found between the two subtypes predominantly inattention or hyperactivity-impulsivity, regarding scores on the SNAP-IV scale, according $t(33) -1.372$, $p = 0.179$ $d = 0.23$. So, they have not been able to differentiate specific subtypes, being grouped for subsequent analysis. The control group, also not found significant differences $t(33) -1.630$, $p = 0.113$, $d = 0.28$.

A one-factor ANOVA was conducted to determine whether there were differences between the children with ADHD and the controls for the levels of fluency, originality, elaboration, abstractness of titles, resistance to premature closure, creative strengths and the overall creativity index. Analysis of each variable showed significant differences for fluency, originality, creative strengths and the overall creativity index with a large effect size. No significant differences were found between the children with ADHD and the controls for elaboration, abstractness of titles or resistance to premature change (**Table 2**), with effect size.

responses implying unusual visualization of perspective, representing internal content or visualization from unexpected angles, as well as figures, objects or nature in movement. This is in line with the findings of other studies such as that by [Sahib \(2012\)](#), in a group of 40 ADHD children of 5 and 6 primary grades evaluated by TTCT figurative, compared to the control group, in which ADHD group exhibited more movement responses and a greater number of imaginative stories than controls, although both groups provided the same number of fantasy responses.

In our study, no significant differences were found between ADHD children and controls for the other dimensions of Elaboration, Abstractness of titles and Resistance to premature closure.

So, in the overall Creativity Index that combines the scores of the five subtests and is a global assessment of creative potential, the children with ADHD scored significantly higher than control children.

In the present study, 21% of children with ADHD scored at or above 70% for the overall creativity index, according to the age-adjusted scale for a general population. This percentage suggests that there are more highly creative children in the ADHD group than in a general population. The percentage of highly creative children in the ADHD group in the present study was not as high as that obtained by [Fugate, Zentall, & Gentry \(2013\)](#), who, using the TTCT-figurative, found that 41% of their ADHD group scored O above the 90th percentile in the overall creativity index. In their ADHD group, however, 53% reached or over the 70th percentile in intellectual ability, which may have been a determining factor in the results ([Shaw & Brown, 1990, 1991](#)). With a sample of 34 children with ADHD, [Cramond \(1994b\)](#) found that 50% scored above the 70th percentile in TCTT-Figurative, thus exhibiting high intellectual and creative abilities.

Although there is no total agreement on the threshold hypothesis, it establishes outside IQ range 80 - 120 intellectual capacity becomes independent of creativity. The relationship between creativity and intellectual ability suggests the need for further research into this relationship, including other factors such as motivation or personality factors.

In conclusion, our results show that children with ADHD aged 8 to 13 exhibited greater general and specific creative potential in certain areas (fluency, originality and creative strengths) but presented no differences from controls in other areas (elaboration, abstractness of titles and resistance to premature change). It would be of great interest to know if this creative potential is converted into creative achievements in the future.

3.1. Implications

The correct identification of ADHD children to their full potential would favor their integration and adaptation to the school system and if the existence of greater creative ability in ADHD children was revealed as a trend, it could help in identifying positive aspects of these ADHD children. This would make it possible to improve the traditional evaluation systems that usually only focus on

the deficits presented.

This would allow us to have a more complete view of these children and potentially, this could contribute to better designs of treatments that enhance their creativity, even though ADHD does not possess this characteristic uniformly and above the rest of the population. First, at the educational level, intervention plans can be designed to improve their already traditional academic performance deficiency. But they also improve the vision that parents and partners have of these children usually impaired by behavior problems.

Secondly, the diagnosis would also be improved, since as [Cramond \(1994a\)](#) points out. The consequences of not identifying creative children due to their altered and unconventional behavior may affect their use in all areas. But creativity can also be hidden in ADHD, due to only considering the negative part of the disorder, so a misdiagnosis and the use of a pharmacological treatment must be performed from both perceptive.

The potentialities of this study about children with ADHD were carried out in a trend to develop an innovative intervention.

Based on this assumption the line of research of the present work has sought to provide a further advance in the knowledge of the functioning of a group of ADHD children, for future designs of effective treatments and educational interventions. If, as we have seen, creativity in some areas offers some advantage for ADHD, it could be evaluated and used as compensatory features of its habitual difficulties.

3.2. Limitations and Future Research

The size of the sample may make it difficult to obtain significant results, but it has been compensated by obtaining a size effect of the differences obtained from moderate to large, which has allowed us to generalize results. The sample size may also affect the originality subtest, as its score is based on the number of unusual responses according to the TTCT manual guidelines, some authors found that originality may be different for each specific culture. Should be considered for research in large populations, allowing the establishment of scales adapted to the study population. In this study, we have focused on creativity limited to assessing the creative potential that is expected to be most associated with creativity in children who have not yet had the opportunity to be evaluated from possible future achievements. The psychometric evaluation of creativity has been based on the divergent thinking tests ([Runco & Acar, 2012](#)), but the multifaceted nature of creativity makes it necessary in future research to measure from different perspectives, where self-report measures, information collected from parents/teachers and real achievements can be included.

[Simonton \(2014\)](#) showed that creativity and psychopathology could share common traits. Moreover, at the extreme of greater psychopathology this relationship disappears ([Abraham, 2015](#)). Severe mental health disorders were refused in this study to avoid influencing outcomes. Although in future research the relationship between mental health pathologies clinical and subclinical, in

children and creativity may have implications for explaining creativity.

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