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# Attention and Impulsivity in Children with High Intellectual Ability and Children with ADHD

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# Abstract

**Introduction.** Certain behaviors associated with high intellectual ability, such as inattention and early response, are often confused with attention deficit and hyperactivity disorder (ADHD), making correct diagnosis more difficult. The objective of the present study was to analyze the performance of students with high intellectual ability and students with ADHD in sustained attention and impulsivity.

**Method.** Participants included a total of 25 children with high intellectual ability and mean age of 6.15 years, and 25 children with ADHD and mean age of 6.96 years. *Conner's Continuous Performance Test II for Windows* (CPT II) was administered to all participants. An ex post facto methodology was followed. The results were analyzed statistically, using SPSS, through a *t* test for independent samples.

**Results.** Significant differences were found in Omissions, Hit Reaction Time, Reaction Time Standard Error and Hit Reaction Time at Change of Inter-Stimulus Interval.

**Discussion and conclusions.** (1) Children with high intellectual ability have significantly better consistency in response speed, better consistency in reaction times at different inter-stimulus intervals, and make greater errors of commission compared to students with ADHD. (2) Children with high intellectual ability perform significantly faster when answering correctly during the test. Performance tests such as the CPT-II for the measurement of attention and impulsivity represent an alternative assessment, with differential diagnosis between these populations. This process must be carried out by qualified personnel who have experience with both populations.

**Key words:** inattention, impulsivity, high abilities, ADHD.

# Resumen

**Introducción.** Comportamientos asociados a la alta capacidad intelectual, como la inatención y respuesta anticipada amenudo se confunden con el trastorno por déficit de atención e hiperactividad (TDAH) y dificultan su identificación. El objetivo del presente trabajo fue analizar el desempeño de los alumnos con alta capacidad intelectual y alumnos con TDAH en la atención sostenida y la impulsividad.

**Método.** Participaron un total de 25 niños con alta capacidad intelectual, edad promedio 6.15 años y 25 niños con TDAH, edad promedio de 6.96 años, evaluados mediante el *Conner's Continuous Performance Test II for Windows* (CPT II). Se ha seguido una metodología ex post facto. Los resultados se analizaron estadísticamente, utilizando el programa SPSS, mediante una prueba t para muestras independientes.

**Resultados.** Se encontraron diferencias significativas en Omisiones, Tiempo de Reacción, Error del Tiempo de Reacción y Tiempo de Reacción a Estímulo al Cambio de Intervalo Entre Estímulo.

**Discusión y conclusion.** (1) Los niños con alta capacidad intelectual poseen significativamente una mejor consistencia en la velocidad de respuesta, mejor consistencia en los tiempos de reacción en los distintos intervalos inter-estímulo y cometen mayores errores de comisión en comparación con los alumnos con TDAH. (2) Los niños con alta capacidad intelectual ejecutan significativamente más rápido al responder correctamente durante la prueba. Las pruebas de rendimiento como el CPT-II para la medición de la atención y la impulsividad representan una alternativa de evaluación, de diagnóstico diferencial entre estas poblaciones; este proceso debe ser realizado por personal calificado y con experiencia con ambas poblaciones. Este proceso debe ser realizado por personal calificado y con experiencia con ambas poblaciones.

**Palabras Clave:** inatención, impulsividad, altas capacidades, TDAH.

## Introduction

While high intellectual ability and attention deficit with hyperactivity disorder (ADHD) are not mutually exclusive diagnoses--they may coexist in some cases--it is true that teachers and other education professionals are often observed to have difficulty distinguishing between children with ADHD, and children with high intellectual ability (Orendorff, 2009). There are behaviors associated with high intellectual ability, such as lack of attention (in activities that bore them or do not interest them) and answering ahead of time (because they know the answer), that can also be characteristic behaviors of ADHD (Webb & Latimer, 1993; Hernández & Borges 2005, Valadez, 2012).

Webb and Latimer (1993) noted that children with high intellectual ability were often misdiagnosed because they showed certain behaviors like restlessness, inattention, impulsivity, daydreaming, etc., for which they received a wrong diagnosis of Attention Deficit with Hyperactivity Disorder (ADHD). Elsewhere, both Hernández and Borges (2005) and Antshel (2008) refer to the inattention that can happen when students with high intellectual ability are not being challenged and they find themselves in a boring educational environment, with repetitive, meaningless tasks. Most of the time these children waste up to 50% or more of their time waiting for the other classmates to understand the tasks, and this may lead them to call for attention, to display disruptive behaviors in the classroom, to refuse to do the work or to not write down the homework assignments (Sanz, 2017). It is therefore not surprising that many characteristics of students with high intellectual ability are confused with ADHD symptoms (Mullet & Rinn, 2015).

According to the DSM V (American Psychiatric Association, 2013), ADHD is a neuro-developmental disorder characterized by a persistent pattern of inattention and/or hyperactivity/impulsivity that interferes with a child's functioning or development. Examples of possible behaviors are that the child often does not pay enough attention to details, does not keep his/her attention on task, seems not to be listening when spoken to, does not follow instructions or finish tasks, moves around and talks too much, or jumps ahead to give answers before the end of the question, and so on.

By contrast, children with high intellectual ability may present behaviors such as: poor attention, especially in activities that they have quickly mastered; boredom and daydreaming in specific situations; high imaginative excitability; low tolerance for sticking with tasks that

seem irrelevant to them; resistance to practicing skills they have not yet mastered; a lag in their development of judgement, compared to their development of general intelligence; possible power conflicts with authority; high levels of activity, even to the point of needing less sleep; questioning rules, customs and traditions (Neihart & Betts, 2010).

Many ADHD diagnoses are made based on behavior-related criteria. The problem with this form of diagnosis is that it only takes into account the child's observable behaviors, not the causes of these behaviors in each individual (Orendorff, 2009). The situation and the origin of the behavior must be analyzed for each child, in order to determine when a child has ADHD or high ability, since the origins of these conditions differ considerably. Regarding ADHD, the etiology may be a cognitive deficiency, while in the case of children with high intellectual ability, their behaviors may be due to a lack of motivation, boredom and over-excitability (Hartnett, Nelson, & Rinn, 2003; Benito, 2001).

According to Benito (2001), the intense, curious behavior of children with high abilities, exacerbated by boredom in class, shows similarities to the behavior of children with ADHD; both teachers and the children's parents are affected by this confusion. Maureen (2003) considers that it is difficult to distinguish between true attention deficits and the typical behaviors and temperaments of children with high intellectual ability; mental health professionals are therefore greatly concerned about possible diagnosis errors that pathologize the normal behavior of persons with high ability. In both populations we find interest in specific topics, difficulty following classes and their content, as well as a deficit in relating to peers of the same age (Benito, 2001).

There are few empirical studies that offer specific data or an accurate estimation of how often children or adults with high intellectual ability are misdiagnosed with other mental disorders, including ADHD. Most researchers specializing in the topic concur that misdiagnosis is a phenomenon that occurs and has high likelihood of occurring, especially in relation to Attention Deficit/Hyperactivity Disorder, due to the similarity of its symptomology (Lovecky, 2014; Rinn & Reynolds, 2012; Webb, Goerss, Amend, Webb, Beljan & Olenchak, 2006).

In their clinical practice, the authors recount how parents have brought children to them for a second or third opinion; from clinical experience they estimate that typical behaviors of gifted children are being misinterpreted as behavior disorders in over 25% of the cases. Some of the disorders that most frequently appear as wrong diagnoses in gifted

children are: ADHD, Asperger Disorder, Obsessive-Compulsive Disorder, Oppositional Defiant Disorder and Bipolar Disorder. For these reasons, an appropriate diagnosis ought to come from a team of expert professionals in the topic (Webb, Goerss, Amend, Webb, Beljan & Olenchak, 2006).

A misdiagnosis of a child with high ability or with ADHD may come about due to similarities between populations, to the peculiarities of each individual, or to the numerous difficulties in the identification process, including unfamiliarity with either or both conditions in education professionals and staff who perform the diagnoses, not to mention a possibly inappropriate learning environment (Edwards, 2009). This is particularly important due to the negative impact on the individual from receiving a wrong diagnosis, making it highly unlikely that his or her needs are being properly met (Fisher, 2013).

One widely used instrument for diagnosing ADHD is the CPT II (Conners & MHS, 2013), which has been used both for the diagnosis of children with ADHD and in comparative studies between children with and without ADHD. In the same way, it has been used in a population with and without high ability, as in the study by Shi et al (2013), where they conclude that the former show higher performance than their peers with average intelligence; specifically, they show more ability to concentrate, better containment of impulses in daily tasks, better precaution and action in undertaking these tasks, as well as greater sensitivity to test stimuli. However, a large part of the sample of students with high ability had already had three years or more of enrichment; this may constitute a variable that had influence on the results. In the same way, Benito and Guerra (2014) compared CPT II test results of children with high intellectual ability with and without ADHD, and of children with ADHD with and without high ability. This study constituted an approach to both populations; however, we note that the age range of the study population was very large (ages 4 to 20, such that there were developmental spikes in certain executive functions like attention) and we note that the results do not include a comparison between students with high intellectual ability and students with ADHD.

*Objectives and hypotheses*

The objective of the present study was to analyze performance variation between children with high intellectual ability and children with ADHD in sustained attention and impulsivity as assessed through the CPT II test.

## Method

### *Participants*

There were fifty participating children who came for assessment at the Laboratory of Psychology and Special Education, in the Applied Psychology Department, Health Sciences School, University of Guadalajara (Mexico). Based on their diagnoses, they were distributed into two groups: (1) 25 children who had high intellectual ability (Intelligence Quotient over 125, obtained on the Wechsler Intelligence scales), mean age of 6.15 years and standard deviation of 1.15 years, of whom 17 were boys; (2) children diagnosed with ADHD under the DSM-V criteria, including one girl and 24 boys, mean age of 6.96 years and standard deviation of 0.97 years.

### *Instruments*

*Conner's Continuous Performance Test II for Windows (CPT II)* (Conners & MHS, 2013). Test application requires that the program be installed on a computer that uses Windows operating system. The person being assessed is asked to press the space bar on the computer keyboard, or click the left mouse button, every time a letter appears on the screen, except when the letter "X" appears. The stimuli are organized into six blocks and these in turn into three sub-blocks of 20 stimuli each. The lapses between stimuli can be 1, 2 or 4 seconds, with a display time of 250 milliseconds. Total application time is 14 minutes.

Following application, results are generated automatically, as a group of tables with raw data and their statistical analyses. The program captures response times, measuring speed and consistency. Responses with reaction time under 100ms are considered perseverations, since it is virtually impossible to react so quickly. The variables of analysis are grouped into two blocks: inattention and impulsivity. Table 1 presents the different variables analyzed and which block they correspond to.

Table 1. *CPT variables analyzed*

| Scale | Inattention | Impulsivity | Errors |
|---|---|---|---|
| Omissions | X | | X |
| Commissions | X | X | X |
| Hit reaction time | X | X | |
| HRT Standard error | X | X | |
| Variability | X | X | |
| Detectability | X | X | |
| Response Style | | | |
| Perseverations | | X | |
| HRTBC | | | |
| HRTBC Standard error | | | |
| HRTISI | | X | |
| HRTISI Standard error | | X | |

*Note:* HRT: Hit reaction time; HRTBC: Hit reaction time block change; HRTISI: Inter-stimulus interval.

### *Procedure*

The *Continuous Performance Test II* (CPT II) V.5 for Windows was applied to children diagnosed with ADHD or identified as having high intellectual ability, in the Laboratory of Psychology and Special Education (LAPSYSE) of the Health Sciences School, University of Guadalajara. All applications were carried out on the same computer, and all test administrators were specially trained for this task.

### *Data analyses*

In order to verify whether there were differences in scores obtained by the high abilities group compared to the ADHD group, Student's *t* test for independent samples was carried

out, using SPSS (version 21 for Windows), being calculated in order to determine the Hedges *g* effect size.

## Results

Means and standard deviations were obtained for all CPT II variables for each of the groups. Results are presented in Table 2.

Table 2. *Means and Deviation of the scores obtained by each group on each of the CPT II variables*

| Population | High Abilities | ADHD | t(48) | *P* < | g |
|---|---|---|---|---|---|
| Omissions | 55.75 (12.16) | 73.79 (20.73) | -3.75 | 0.001 | -1.04 |
| Commissions | 50.63 (8.84) | 52.10 (5.72) | -0.71 | 0.438 | -0.19 |
| HRT | 52.63 (9.14) | 67.60 (12.74) | -4.77 | 0.001 | -1.33 |
| HRT Error | 53.27 (7.83) | 65.86 (11.07) | -4.74 | <0.001 | -1.29 |
| Variability | 53.02 (9.33) | 58.19 (14.21) | -1.52 | 0.135 | -0.66 |
| Detectability | 52.24 (7.88) | 60.22 (25.00) | -1.52 | 0.135 | -0.50 |
| Response Style | 54.68 (21.34) | 62.16 (19.13) | -1.31 | 0.198 | -0.36 |
| Perseverations | 50.42 (12.89) | 53.46 (26.04) | -0.52 | 0.604 | -0.15 |
| HRTBC | 50.13 (10.59) | 55.54 (11.30) | -1.74 | 0.087 | -0.49 |
| HRTBC Standard error | 50.72 (9.12) | 51.15 (8.91) | -0.167 | 0.868 | -0.05 |
| HRTISI | 55.84 (8.98) | 62.42 (14.75) | -1.96 | 0.063 | -0.53 |
| HRTISI Standard error | 51.58 (8.43) | 57.35 (8.32) | -2.44 | 0.019 | -0.68 |

*Note*: mean (standard deviation); HRT: Hit reaction time; HRTBC: Hit Reaction Time Block Change; HRTISI: Hit Reaction Time by Inter-Stimulus Interval (Hit RE ISI Change)

As seen in Table 2, Student's *t* indicated statistically significant differences in the variables of Omissions, Hit Reaction Time, Hit Reaction Time Error and Hit Reaction Time by Inter-Stimulus Interval. Children with high intellectual ability committed fewer omissions, presented significantly better consistency in response speed, better consistency in reaction times at different inter-stimulus intervals, and committed greater errors of commission compared to students with ADHD.

## Discussion and Conclusions

The objective of the present study was to analyze the performance of children with high intellectual ability in comparison to children with ADHD, and to find the similarities and differences between the two populations. The results of the present study indicate that there are significant differences between children with ADHD and children with high intellectual ability in attention performance and impulsive behavior, where children with high intellectual ability show better attentional indicators (response time and omissions) and less impulsivity.

Children with ADHD were found to make more omissions, their scores being significantly higher when compared to the children with high intellectual ability. A similar finding is seen in other studies that included subjects of different ages, where the subjects with ADHD committed more omissions and commisions, but there were few significant differences in other CPT measures ( Epstein, Conners, Sitarenios, & Erhardt, 1998).

In the same way, this finding concurs with results from the study by Benito and Guerra (2014), where they compared test performance of gifted children with and without ADHD, and of children with ADHD with and without intellectual giftedness, and likewise found that the children with ADHD with and without intellectual giftedness committed more omission errors than the other populations. The authors also concluded that children with ADHD without intellectual giftedness obtained higher scores than the gifted children with ADHD on this measure. Results obtained here concur with those of Rosengren (2004), who compared CPT performance of gifted children and children with normal intelligence and found that the gifted children presented better test performance, as expressed in faster response time, less variabil-

ity in response throughout the test, and better attention to the stimuli, than did children with normal intelligence.

In addition, Shi et al. (2012) discussed in their comparative study how their sample of children with high intellectual ability committed significantly fewer omission errors, fewer errors of commission, and they had less skill in distinguishing between objective stimuli and non-objective stimuli (*Detectability* variable d'), in comparison to children with normal intelligence. In our study, we only partially support the results presented by Shi et al. (2012); we concur in that the children with high intellectual ability committed significantly fewer omission errors, but we do not find significant differences in commission errors, quite the contrary, results from the *commissions* variable were very similar in our samples. Moreover, we do not find differences between populations regarding their skill in distinguishing between objective and non-objective stimuli through *Detectability* measure d'. Notwithstanding, the present study did find that reaction times differed significantly between groups, in contrast to the study by Shi et al. (2012), probably because their comparative group was made up of children with normal intelligence with no associated psychiatric disorder, where the present study sample comprises children diagnosed with ADHD.

We must point out that, while there were significant between-population differences in certain measures, in both inattention and impulsivity, most of the measures assessed with the CPT II did not result in significant comparative differences. It is also important to note that from a qualitative analysis, the commissions measure, belonging to both inattention and impulsivity, showed very similar results in both populations, indicating that the children in our sample with high intellectual ability and the children with ADHD make a similar amount of commission errors.

Misdiagnosis between children with ADHD and with high intellectual ability is a phenomenon that affects proper detection and intervention in children (Webb, Goerss, Amend, Webb, Beljan & Olenchak, 2006). Performance tests like the CPT II for measuring attention and impulsivity are presented as an assessment alternative that may help contribute to better differential diagnosis between these populations (Moreno García, Delgado Pardo, Aires González, & Meneres Sancho, 2013).

Finally, the results obtained here suggest that the assessment and diagnostic process of children with attention deficit with hyperactivity disorder, as well as the process of identifying children with high intellectual ability, must be carried out by qualified personnel with

experience in both populations, in order to avoid confusion that may lead to a misdiagnosis. Similarly, interpretation and use of the CPT II during the differential diagnosis process should be carried out with caution and only by expert professionals. In addition, based on this study, we recommend incorporating the assessment of executive functions in the diagnostic battery.

One of the *limitations* of the present study was the sample size, which disallows generalization of results; nonetheless, useful information has been contributed towards understanding how the two variables function in these two populations.

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