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Numerical and Calculation Abilities in Children with ADHD

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The aim of this study was to investigate the specific numerical and calculation abilities of 28 children with ADHD without comorbid mathematical learning disabilities (LD), ranging from the 1st to the 5th grade of primary school, and to examine the stability or the development of the arithmetic profile. Our results showed that a high percentage of children with ADHD have severe difficulties on numerical and calculation tasks, particularly with counting and arithmetical facts, and these percentages increase with age. Whereas younger children show more problems with lexical processes, for older children, mental calculation and counting processes are particularly difficult. The older students had a statistically worse performance than the younger students on the two measures of time (i.e., mental calculation time and counting time), indicating automatization deficits. This study underlines the importance for teachers to taking the individual arithmetic profiles of children with ADHD into account and of identifying the processes which should be enhanced through education and teaching interventions.

Keywords: Numerical and calculation abilities, ADHD, primary school, and automatization deficits.

Introduction

Attention deficit hyperactivity disorder (ADHD) is a developmental condition characterized by the presence of severe and pervasive symptoms of inattention, hyperactivity and impulsivity. Furthermore, individuals with this disorder are at a high risk for developing a wide range of impairments affecting multiple domains of life, such as interpersonal, school, and family functioning (Harpin, 2005).

The main theoretical explanation for the ADHD symptomatology is related to executive function (EF) deficits, with important weaknesses found in planning, working memory, response inhibition and vigilance (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005). Along with EF deficits, individuals with ADHD have difficulties in many general cognitive abilities, such as memory, visuo-motor competencies, behavioral control, and social skills (Crawford, Kaplan, & Dewey, 2006; Seidman, Biederman, Monuteaux, Doyle, & Faraone, 2001).

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One area of impairment that is especially important in childhood is academic performance. The literature shows that school-aged children with ADHD experience numerous academic and educational problems (Daley & Birchwood, 2010). Loe and Feldman (2007) reviewed the literature on the academic and educational outcomes of children with ADHD, concluding that it is associated with poor grades and poor reading, as well as poor math standardized test scores. The meta-analysis carried out by Frazier, Youngstrom, Glutting, and Watkins (2007) indicated a moderate to large discrepancy in academic achievement between individuals with ADHD and their typically achieving peers, thus substantiating the significant impact of ADHD symptoms on academic performance.

The low performance of children with ADHD could be due to the high comorbidity that this disorder presents with learning disabilities (LD), ranging from 25 to 65% (Mayes, Calhoun, & Crowell, 2000; Mayes & Calhoun, 2006). In a recent publication by DuPaul, Gormley, and Laracy (2013), a total of 17 studies (2001-2011) that examined ADHD-LD comorbidity were reviewed, revealing a mean comorbidity rate of 45.1%. However, even when children with ADHD do not present comorbid LD, it has been demonstrated that they present a significantly lower development as compared to their peers on academic performance. Barry, Lyman, and Klinger (2002) found that children with ADHD (with average intellectual abilities) obtained significantly lower scores in reading, writing, and mathematics skills. In addition, they demonstrated a greater discrepancy between actual and predicted achievement than a group of children without ADHD. Moreover, ADHD behaviors predicted academic underachievement, even when the participants with comorbid ADHD and LD were excluded. The authors conclude that the greater the severity of the behavioral symptomatology in children with ADHD, the greater the negative impact on their school performance.

Most of the research on academic performance and ADHD has focused on reading disorders in children with ADHD, rather than difficulties in mathematics (Capano, Minden, Chen, Schachar, & Ickowicz, 2008); in fact, research on the calculation skills of children with ADHD is limited (see Lucangeli & Cabrele, 2006). Studies on ADHD and mathematical achievement have basically used global measures of arithmetic that confirm a general poor performance (Barry et al., 2002; Biederman et al., 2004). However, very few studies have attempted to investigate the specific numerical and calculation deficits associated with ADHD (Kauffman & Nuerk, 2008).

Numerical and calculation abilities comprise different subcomponents that are relatively independent. The basic mechanisms of numerical ability are lexical, semantic, and syntactic processes (Lucangeli, Tressoldi, & Fiore, 1998). Semantic processes involve the ability to understand the meaning of the number, and they are related to operations of quantity discrimination and number ordering with Arabic numbers. Syntactic processes involve the spatial relationships between the digits of the number, they require knowing the number's value based on its position, and they are the "grammar" of the number. Finally, lexical processes refer to the ability to name the numbers, and they are related to telling the sequence of numbers or knowing how to read and write them. These numerical knowledge processes are basic to learning other complex mechanisms like calculation (Lucangeli, Iannitti, & Vettore, 2007).

Zentall and colleagues have studied the specific relationship between ADHD and mathematics. Zentall, Smith, Lee, and Wieczorek (1994) compared 121 boys with typical development and 107 boys with ADHD, aged 7.4 to 14.5 years, on timed arithmetic word problem-solving and mental calculation tasks. They found that the boys with ADHD demonstrated not only significantly lower problem-solving ability and conceptual understanding, but they were also significantly slower on computation. However, one of the conclusions of Zentall's group research is that, by the middle school years, accuracy is no longer a sensitive measure of ADHD, and only fluency continues to differentiate students with ADHD from comparison participants (Zentall, 2007).

In a more recent article, Zentall, Tom-Wright, and Lee (2012) conducted a comprehensive examination of the literature on the academic deficits in mathematics and reading of children with ADHD -with and without co-occurring LD- and the effects of psychostimulant and sensory stimulation. In this review, Zentall and her collaborators summarized the deficits observed in math calculations of children with ADHD without LD. Findings showed less mature math procedures involving finger counting (Rubinsten, Bedard, & Tannock, 2008); slower retrieval speed and greater variability across grade levels (Dykman & Ackerman, 1991; Zentall & Smith, 1993); reduced accuracy of calculations up to middle school, especially regarding time on task and on multiplication facts and addition and subtraction facts with negative numbers and borrowing (Bennett, Zentall, French, & Giorgetti-Borucki, 2006; Zentall & Smith, 1993).

Kaufmann and Nuerk (2008) studied the specific mathematical processes where children with ADHD fail. These authors compared 16 children with ADHD-combined type (ADHD-C) and 16 children without ADHD, from 9 to 12 years old, on a wide range of number processing and calculation tasks. Their aim was to investigate which specific components of these skills might be impaired in children with ADHD without concomitant dyscalculia and/or dyslexia. The tasks used by Kaufmann and Nuerk were simple and complex mental calculations, written calculations, and core numerical processing tasks: two involving non-verbal magnitude representations (i.e., thermometer task and number comparison) and three involving verbal representations (i.e., counting sequences –forward and backward-, transcoding -dictation-, and dots enumeration). They found that children with ADHD-C did not perform worse than children without ADHD on simple and complex calculation tasks and on most of the number processing tasks, except for those related to non-verbal number magnitude representation.

Specifically, children with ADHD made more errors on the number comparison task for all distances, and they showed a typical numerical distance effect; that is, the greater likelihood of errors interacted with number magnitude, causing them to make more errors, particularly in adjacent number pairs. Although the authors did not find significant group differences on calculation tasks or reaction time, children with ADHD tended to be slower and more variable, and they performed quantitatively lower on all the calculation tasks, so that in some cases null group differences might be moderated by power or ceiling effects. Moreover, both groups displayed comparable scores on executive functioning and working memory tasks, so that the observed group differences were not due to differences in more general neuropsychological functioning. These authors interpret their results in terms of a semantic verbal processing deficit in children with ADHD.

These results could be linked to those found in a recent study on estimation calculation (Sella, Re, Lucangeli, Cornoldi, & Lemaire, 2012). In this study, the authors found that children with ADHD and controls were able to correctly execute a selected strategy on more than 97% of the problems; however, children with ADHD selected the best strategy for each problem less often than the children in the control condition, and they took more time to estimate sums of two-digit addition problems, especially with adjacent number pairs.

Miranda, Melia, and Marco (2009) set out to investigate the deficits of children with ADHD and mathematical LD compared to children with ADHD, children with mathematical LD, and children in the control condition on cognitive and metacognitive calculation abilities, as well as on EF. They used a computerized test to evaluate mathematical cognitive processes in 86 six- to eleven-year-old children. The test consisted of eight tasks grouped in three factorial scales: numerical knowledge (reading units and tens, operation symbol comprehension, and numerical production and comprehension), calculation procedures (arithmetical procedures and mental calculation), and arithmetic problem solving. The ADHD and mathematical LD group performed significantly worse than all the other groups and was associated with more severe EF impairments. Specifically, children with ADHD and mathematical LD performed worse than the control group on almost all of the numerical knowledge tasks (operation symbol comprehension, numerical production and comprehension) and on the calculation procedure tasks. In contrast, children with ADHD without mathematical LD did not differ from the control group on any of the numerical knowledge and calculation procedure tasks. However, except for one task (reading units and tens), the mean scores of the children with ADHD were consistently lower than the control group's scores, and this was particularly noticeable in mental calculation.

In summary, the results from the review of the existing literature on specific mathematics problems in children with ADHD are contradictory. Some studies found that children with ADHD without comorbid mathematical LD presented accuracy and speed calculation problems, specifically on arithmetic facts, whereas other studies did not find a worse performance on calculation or number processing tasks. One possible explanation for these differences would be that problems in mathematical abilities may be different depending on the age of the children; that is, there could be a change or development in the mathematical abilities of children with ADHD over time.

Moreover, a recent meta-analysis about the effectiveness of drug treatments in improving the academic achievement of children with ADHD in the classroom concluded that, although drug treatment benefited children in the amount of school work they completed, it less consistently improved children's accuracy on specific assignments such as arithmetic (Prasad et al., 2013). These results, together with the essential role of mathematics in daily life, justify studying specific mathematical deficits in children with ADHD in order to design effective interventions.

Addressing these issues, the present study proposed to investigate the numerical and calculation abilities of children with ADHD without comorbid mathematical LD in order to detect their specific difficulties. The second objective of this study was to examine the stability or development of this profile during school age. The strengths of the present research are that we had a specific individual profile of the mathematical abilities of children with ADHD, and we could individualize the strengths and weaknesses of the children with ADHD in the field of calculation. Moreover, we collected data from the first to the fifth grade of primary school, which will allow us to determine the stability of any difficulties found over time.

Method

Participants

Twenty-eight primary school children with ADHD, assessed at the Center for Education and Learning Difficulties (Padova, Italy), participated in this study. Primary school in Italy lasts five years and is divided into two cycles: the first cycle (first and second grades) and the second cycle (third, fourth, and fifth grades). We categorized the children in two groups according to the cycle they were attending.

For all students involved in this investigation, we received appropriate approval from parents and the school. All the students were Caucasian, had no physical, sensory, or neurological impairments, and spoke Italian as their first language. According to their teachers, each of the participants had grown up in an adequate socio-cultural environment. Demographic information about the age, gender, and ADHD subtype is summarized in Table 1.

In order to identify ADHD-specific underlying numerical and calculation deficits, children with comorbid dyscalculia were excluded from the study. According to the Italian official guidelines (AID-AIRIPA, 2012), the diagnostic criteria for dyscalculia are the following:

1. According to standardized calculation tasks, children must have a performance below the 5th percentile (or -2 SD) on almost 50% of the tasks on a specific battery for the assessment of calculation (e.g. for Italy, AC-MT, Cornoldi et al., 2002);
2. Persistence of problems during the child's academic history;
3. Resistance to treatment: children with dyscalculia do not improve significantly after a period of specific treatment on calculation;
4. The disorder must have important consequences in the child's daily school life;
5. General criteria for LD have to be respected.

Each child's mathematical learning was assessed in a quiet room by a psychologist specialized in LD.

Table 1. ***Demographic characteristics of the subjects***

	ADHD (Total) $N = 28$	ADHD (Cycle 1) $N = 9$	ADHD (Cycle 2) $N = 19$
Age in months (*SD*)	101.04 (14.48)	82.89 (4.56)	109.63 (7.91)
Male (%)	60.7	66.7	57.9
ADHD subtype			
Inattentive (%)	60.7	66.7	57.9
Combined (%)	39.3	33.3	42.1

Measures

The most widely-used Italian test battery, the AC-MT (Cornoldi, Lucangeli, & Bellina, 2002), was used to assess the students' mathematical skills. The AC-MT is a standardized battery for assessing calculation ability; it is a paper and pencil tool used for screening in schools and clinical settings. Test-retest reliability of the AC-MT is r =.65 (mean for all subtests). The calculation assessment measures taken into account were:

Mental calculation: Children are asked to compute some calculations in their heads (6 operations, 3 additions and 3 subtractions). For each operation, the time is measured from the moment the operator finishes saying the numbers in the operation aloud, to the moment when the child answers. The time limit for each calculation is 30 seconds. The operator asks the children what strategies they used and records their responses. Two parameters are considered for this task, i.e. number of errors and time (total time for correct and incorrect responses).

Written calculation: This task aims to examine the child's application of the procedures needed to complete written computational operations and the automatism involved. Children in the first and second grades are asked to solve four operations (additions and subtractions), while children in the third, fourth, and fifth grades are asked to solve eight operations (additions, subtractions, multiplications, and divisions). The parameter considered is the number of correct responses.

Counting: Children are asked to count aloud as quickly as possible. This task changes for different grades: first-grade children have to count forward from 1 to 20; second-grade children have to count forwards from 1 to 50; and for the other grades, children are asked to count backward from 100 to 50. This task is used to investigate whether children have learned the sequence of numbers as a memorized sequence, and if they have understood the role of each number in the counting. The parameter considered is the number of errors (number of times the solution of continuity is interrupted).

Number dictation: Children are asked to write down some numbers in a verbal dictation (numbers range from one to six digits depending on the children's age). This test provides information about syntactic and lexical mechanisms of number production. The parameter considered is the number of errors.

Arithmetical facts: This task is used to investigate how children have stored some combinations of numbers, and whether they are able to access them without having to perform controlled calculation procedures. The operations include additions, subtractions, and multiplications, presented verbally and with 5 seconds allowed to answer each operation (there are 12 operations). Examples of arithmetic facts are simple operations such as multiplication tables, or 8 + 2 or 10 - 5. Here again, the number of errors is considered.

Numerical knowledge is a multiple task including the following subtasks (and the parameter considered is the sum of correct answers on all the subtasks).

Number comparison: Six pairs of numbers are presented, and children are asked to circle the largest number in each pair; e.g. 856 versus 428, "Which number is larger?" This task requires an understanding of the semantics of numbers and the ability to read numbers (lexical level).

Transcoding in digits: This task assesses the children's ability to elaborate the syntactic structure of numbers that governs the relationship between the digits the numbers contain. Children are shown six series of verbally-described numbers, and they have to transform them into a final number; e.g; "we have 3 tens, 8 units and 2 hundreds," and the child has to transform them into the number 238.

Number ordering (from the greatest to the least, and vice versa): This task is used to assess the semantic representation of numbers by means of quantity comparisons. To answer correctly, the child must be able to recognize single quantities, compare them, and place them in the right order. Five series of 4 numbers were presented; e.g. 36, 15, 576, 154, and the child had to arrange them in the right order.

Data Analysis

To facilitate comparisons between the different age groups, *z-scores* for all the individual measures were calculated using normative data. Then, children were categorized in three groups according to their level of proficiency on each of the subtests: "without difficulties" (children who were above - 1 SD), "moderate difficulties" (children between - 1 and - 2 SD) and "severe difficulties" (children who were lower than - 2 SD). The percentages of the 28 children placed in each of these groups were calculated.

Next, the sample was divided according to the primary school cycle, and the percentages were recalculated. Then, the *z-scores* for the cycle 1 and cycle 2 groups were compared on each subtest, using *t-tests* for independent samples, in order to test the development of the ADHD arithmetic profile during their primary school years.

Results

General Arithmetic Profile of Children with ADHD

Table 2 shows the percentage of children with ADHD who present moderate or severe difficulties on each subtest of the AC-MT. The most impaired measures were mental calculation times and the two counting measures (errors and time), where more than 25% of children fall into the "severe difficulties" category. There were high percentages of children in the "moderate difficulties group" on written calculation and arithmetic facts, while numerical knowledge, number dictation and mental calculation errors seem to have the highest percentages of children with good performance, up to 75%.

Table 2. ***Percentages (%) of children with ADHD distributed according to their performance on the AC-MT subtest***

AC-MT subscales	**No difficulties (z > - 1 SD)**	**Moderate difficulties (-1 < z < -2 SD)**	**Severe difficulties (z < - 2SD)**
Mental calculation (errors)	75	7.1	17.9
Mental calculation (time)	71.4	3.6	25
Written calculation	68	20	12
Counting (errors)	57.1	7.2	35.7
Counting (time)	64.3	7.1	28.6
Number dictation	82.1	-	17.9
Arithmetic facts	57.7	30.8	11.5
Numerical knowledge	92.6	3.7	3.7

Developmental Arithmetic Profile of Children with ADHD

In order to see whether the arithmetic profile is stable over time or changes with age, we divided the sample according to the primary school cycle. Table 3 shows the percentages of children categorized by their performance on the AC-MT subtests according to the cycle they were attending.

When children were divided into the two groups by age, the difficulties showed different patterns. Children with ADHD who attend first and second grades have more difficulties with counting (errors) and number dictation, where more than 30% fall into the "severe difficulties" category. The other two subtests on which an important percentage of children score in the "moderate difficulties" category are written calculation and arithmetical facts. However, all or almost all of the children were within the parameters of normal performance on mental calculation (errors and time), counting (time) and numerical knowledge.

Children who attend third, fourth, and fifth grades generally showed more difficulties on the AC-MT subtests. Specifically, more than 20% of these children presented "severe difficulties" with mental calculation (both errors and time) and counting (both errors and time). A high percentage of children showed "moderate difficulties" on arithmetic facts, and most of the children seemed to fall inside the normal parameters only on number dictation and numerical knowledge.

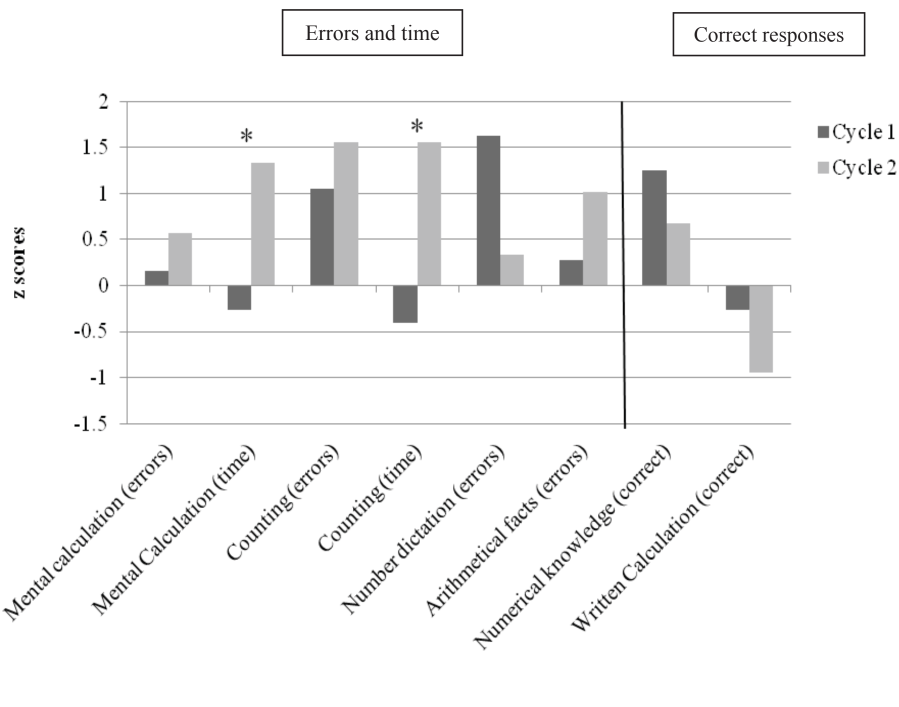
Table 3. *Percentages (%) of children with ADHD categorized by cycle and distributed according to their performance on the AC-MT subtest*

	First cycle (1^{st}, 2^{nd})			Second cycle (3^{rd}, 4^{th}, 5^{th})		
AC-MT subscales	**No difficulties (z > - 1SD)**	**Moderate difficulties (-1 < z < -2 SD)**	**No difficulties (z > - 1SD)**	**Severe difficulties (z <- 2SD)**	**Moderate difficulties (-1 < z < -2 SD)**	**Severe difficulties (z <- 2SD)**
Mental calculation (errors)	88.9	-	68.4	11.1	10.5	21.1
Mental calculation (time)	100	-	57.9	-	5.3	36.8
Written calculation	75	25	64.6	-	17.7	17.7
Counting (errors)	66.7	-	52.6	33.3	10.5	36.9
Counting (time)	100	-	47.4	-	10.5	42.1
Number dictation	66.7	-	89.5	33.3	-	10.5
Arithmetic facts	71.4	28.6	52.6	-	31.6	15.8
Numerical knowledge	88.9	-	94.4	11.1	5.6	-

Differences in Numerical and Calculation Abilities Between Cycle 1 and Cycle 2 of Children with ADHD

The *z-scores* of the cycle 1 and cycle 2 groups, calculated from normative data, were compared on each subtest using *t-tests* for independent samples. Results of independent-sample *t-tests* showed statistically significant differences between the *z-scores* of the first and second cycle groups on mental calculation time ($t(26) = -3.39$, $p = .002$) and counting time ($t(26) = -3.97$, $p = .001$). Specifically, the second cycle group was significantly slower on the mental calculation task (cycle 1: $M = -0.26$, $SD = 0.61$ vs. cycle 2: $M = 1.33$, $SD = 1.84$) and on the counting tasks (cycle 1: $M = -0.41$, $SD = 0.77$ vs. cycle 2: $M = 1.55$, $SD = 1.85$). Arithmetic facts and written calculation were near significance ($p < .10$), with the oldest group showing worse performance. The only subtests on where cycle 1 performed worse than cycle 2 were number dictation and numerical knowledge (see Figure 1).

***Figure 1.* Comparison between Cycle 1 and Cycle 2 students on ACMT performance**



Discussion

This study aimed to better understand the mathematical abilities of children with ADHD by examining their performance on different numerical and calculation tasks.

First, our results showed that a high percentage of children with ADHD reported severe difficulties on numerical and calculation abilities, greater than what would be expected in the general population, even when these children with ADHD did not have a diagnosis of dyscalculia. Specifically, counting and arithmetic facts were the most affected processes in the school-age children with ADHD in our sample, probably because these processes require a certain degree of automaticity. However, this profile seems to change with age, at least within the primary school population. In general, the percentages of children presenting severe and moderate difficulties increase with age. In the first cycle, there was a high percentage of children without difficulties, even reaching 100% on some of the measures (mental calculation time and counting time). The main difficulties in these children were found on counting errors and number dictation, classified as lexical processes involving the ability to name numbers. In contrast, a high percentage of children in the second cycle encountered difficulties on almost all the measures of numerical and calculation abilities. Specifically, these children had greater problems with mental calculation and counting, considering both errors and time. This result indicates that the errors are not due to impulsivity, or responding quickly, a characteristic that sometimes characterizes children with ADHD; despite being slower and needing more time, they continue to commit errors. These data seem to show that both mental calculation and counting processes are particularly difficult for children with ADHD in the second cycle of primary school.

It is worth noticing that in both cycles numerical knowledge appears to be intact, as none of the children reported problems in this task. Thus, they do not show difficulties with basic calculation processes, such as lexical or syntactical ones processes, but they do have problems in learning procedural knowledge. The difficulty does not lie in the conceptual knowledge of the number, but rather in its application to automated tasks. Another aspect that can explain these results is the educational style of the teachers. For example, a recent study (Re, Pedron, Tressoldi, & Lucangeli, in press) found that after specific training in calculation abilities, children with difficulties in these areas showed very meaningful improvements, even reaching normality in some cases. This data supports the idea that specific teaching that takes the specific learning profiles of the children into account can produce good results and avoid learning problems.

One limitation of the present study is the small sample size, which could affect the generalization of the findings and the power of the statistical analysis. Nevertheless, in spite of the small number of participants, we found significant differences in some variables between children attending cycles 1 and 2. When the two cycles were compared, statistically significant differences emerged in times to perform mental calculation and counting; moreover, differences in arithmetic facts were very close to significance. These three tests are related to automatization deficits, and on all three tests, children in the second cycle had greater problems than children in the first cycle. These results support those found by Zentall's group, namely, that by the middle school years, fluency is the process that differentiates students with ADHD from comparison participants (Zentall, 2007). Due to automatization deficits, these children may encounter major problems on other tasks that require the use of calculation, such as solving arithmetic problems.

However, we must take into account that the counting task was different for the two cycles. While children attending first and second grades had to count forward from 1 to 20 and from 1 to 50, respectively, in the other grades children were asked to count backward from 100 to 50. This latter task also involves working memory. Therefore, these specific results on counting might be due to deficits in working memory, a cognitive ability that has been shown to be deficient in children with ADHD (Martinussen & Tannock, 2006). This explanation is supported by several research outcomes that have studied the relationship between mathematical LD and EF in children with ADHD, finding a relationship with working memory (Biederman et al., 2004). In fact, some researchers attribute the significant mathematical delays in children with ADHD to attentional, working memory and EF impairments, and these skills are necessary for calculations.

In summary, even if absence of a comorbidity with dyscalculia, children with ADHD show difficulties with some aspects of calculation. It appears that children with ADHD have difficulties in learning mathematics, and these difficulties vary with age. In the first years of primary school, the more severe difficulties were observed in the lexical processes, while in older children, the deficits were concentrated in the automatization and procedural processes. These findings seem to indicate that difficulties in some aspects of the calculation of children with ADHD (without mathematical LD) do not appear from the first years of life, but instead are acquired over time, as, at least in primary school, the older children have more severe problems. Some persistent errors in counting were found; however, the changes observed from the first and the second cycle of primary school may be attributable to instruction. In fact, several explanations could be found for these difficulties. On the one hand, the impairments may be directly related to ADHD symptoms and deficits in executive functioning that characterize children with ADHD, as some authors have shown. For example, a review by Daley and Birchwood (2010) suggests that deficits in executive functioning could be at the heart of ADHD-related academic underperformance, and that there is a possible inattention-EF impairment pathway to academic problems in individuals with ADHD. Thus, a plausible explanation is that the objectives of the mathematics curriculum progressively make more EF demands on working memory, planning or monitoring. Therefore, future studies should explore the role of EF in the specific mathematical difficulties of children with ADHD.

Another possible explanation could be the deficiencies of the school system itself, especially in adapting the teaching-learning process to the peculiarities of students with ADHD. In the population of children in general, the development of mathematical skills at school starts late, teachers do not know how to enhance these skills very well, and teaching methodologies are often dysfunctional (Re et al., in press). These factors could affect children with ADHD more severely, especially when school tasks increase in difficulty, and more mental resources are needed to cope with them.

Mathematical abilities are important not only for academic success but also for their impact on daily life. Our results show that calculation and numerical abilities are impaired in children with ADHD, even if they do not present mathematical LD. For this reason, the present study has important practical implications. First, it demonstrates the need for a comprehensive evaluation of specific mathematical aspects, even though the children do not present mathematical LD, paying particular attention to number sequencing and arithmetical facts. Secondly, the specific assessments should be continued throughout the academic years, since the areas where we will have to intervene will be different depending on the age. When children are younger, the planning of programs with specific contents should focus especially on lexical aspects, while in older children greater attention should be paid to the learning of procedural knowledge and the application of automated tasks.

Because these difficulties increase with age, it is also important to consider the role of motivation. Specifically in the case of mathematics, motivation has been found to have a role in predicting mathematical performance in children with ADHD that could be even greater than the role played by the executive functions. Therefore, the teacher must not only attend to transmitting contents, but he or she must also foster motivation toward learning (Miranda, Colomer, Fernandez, & Presentancion, 2012). Finally, our data underline the importance for educators/teachers of taking individual calculation profiles into account. Individual profiles identify which processes should be enhanced through education in order to ensure the development of all the components of an individual's pattern.

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