

ADHD and Writing Learning Disabilities: Overlapping Disorders and Educational Implications

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In this review, we discuss the historic evolution of ADHD research up until the present, and explain the actual theoretical models of writing in relation to ADHD and attention. Given the characterization of writing as a recursive process, and in order to show its relationship with attention disorders, examples of applicable writing models are also described. These models contribute to a far better understanding of the findings from empirical studies. Additionally, a review of the empirical research on ADHD and writing conducted in the last decades is presented. The conclusions obtained from this analytical review suggest a lack of empirical studies concerning writing and ADHD. Specifically, this shortfall is even more obvious in those studies that have focused on the relationship among written composition, processes followed by ADHD students during tasks, and the written products they construct. Only a few studies have been carried out in this context, however, they have approached the combined problem in a superficial way without examining it in detail. A review and analysis of the association between ADHD and writing learning difficulties is the most novel and fundamental element with respect to the theoretical contribution we herein present.

Keywords: ADHD, writing, Learning disabilities, research, models

INTRODUCTION

Given the frequent connection between attention disorders, particularly attention deficit hyperactivity disorder (ADHD) and writing difficulties, and the implications that this association may have on learning and academic performance in children and adolescents, an extensive review of previous literature on this topic appears warranted. Thus, the primary purpose of this review is to comprehensively examine the peer-reviewed studies on this topic that have been

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conducted on the basis of Haye's (1980, 1996) and Kellogg's (1996) *classical models of writing*. These models were integral in the laying of key foundations for later empirical studies of writing, as they emphasized the role of the subject, and the influence of the task and/or the environment on writing composition processes. As a direct result of such models, a novel perspective of the connection between attention and writing difficulties has also evolved.

In order to provide a thorough analysis of this topic, the present review is organized into three distinct sections: First, a general characterization of attention disorders and writing difficulties is provided; second, the aforementioned models of Hayes and Kellogg are described; third, the relationship between attention disorders and writing difficulties is addressed, with a particular focus upon those empirical, experimental and theoretical studies conducted from the viewpoint of the organization skills required for the writing process and intervention outcomes in this area.

Characterization of ADHD and Writing Difficulties

According to the *Diagnostic and Statistical Manual of Mental Disorders-5* (American Psychiatric Association, 2013), Attention Deficit with Hyperactivity Disorder (ADHD) affects about 5% of students. Prevalence tends to decrease with age, and there is some evidence of national variation (Faraone, Sergeant, Gillberg, & Biederman 2003). Epidemiological studies have indicated that between 3% and 10% of all school-age children and youth suffer from this challenging disorder (e.g., Frazier Youngstrom, Glutting, & Watkins, 2007; Jakobson & Kikas 2007). Children and adolescents with ADHD are known to have difficulties with academic achievement across domains including reading, math, and writing (Barkley, 2006). In fact, youth with ADHD have been shown to be underachievers on measures of written expression (Barry, Lyman, & Klinger, 2002; Mayes & Calhoun, 2007). Furthermore, learning disabilities in written expression have been reported to be twice as common in children and adolescents with ADHD in comparison to learning disabilities in other academic domains (Mayes & Calhoun, 2006).

One major reason that a close link between serious problems in writing composition and any one of the different subtypes of ADHD might well be assumed is the role that working memory plays in the processes required to produce a coherent text (Hayes & Flower, 1980). This task imposes a high work load on the attention system and the working memory alike. Because writing composition is generally more complex than reading and/or calculating, and because it also entails a higher cognitive load on the working memory of a person, children with ADHD are more prone to fail in a writing task than a reading or mathematics task (Mayes & Calhoun, 2007).

On the other hand, the relationship between working memory and writing processes is a relatively recent area of research (Butterfield, Hacker, &

Albertson, 1996; Hayes, 1996). Major fundamental studies have contributed to understanding the role of working memory in writing, and have collectively described the cognitive processes used by writers (McCutchen, 1996). In general, the diverse models of writing (Hayes & Flower 1980; Kellogg 1996) and other studies concur in the fact that writing is a cognitive task that requires the coordinated deployment of a relevant set of cognitive abilities that are used during the process of writing, one of which is working memory (WM) (Berninger, 2011). Kellogg's model (1996) proposes that all three components of the Baddeley (1986) 'multi-component working memory model' (central executive, visuo-spatial and phonological loop) are used to varying extents during the different processes of writing. This suggests that the process of *monitoring*, also referred to as the *review process* by Hayes (1996), imposes strict cognitive requirements upon the central executive - phonological loop. In an attempt to explain the relationship between the activity of working memory and textual production, Vanderberg & Swanson (2007) studied the different processes involved in written composition, and found that the central executive component of working memory significantly predicted *threads planning, editing and revision*, as well as most microstructure measures of writing. In this context, Swanson and Berninger (1996) believe that individual differences in writing ability in young children are related to individual differences in WM capacity; this influence being more predictive of text elaboration (high-level processing) than of transcription (low-level processing). Other studies have shown that high WM capacity writers employ a different strategy to explore the visual source; making longer writing pauses, correcting misspellings more efficiently, and demonstrating more detailed procedures. Thus, such individuals are capable of achieving their communicative goals far more efficiently, partly by producing compositions that are more coherent (and thus unproblematic) for the reader (Alamargot & Chanquoy, 2001; Piolat, Roussey, Olive & Amada (2004).

Thus, it is not surprising that Re, Pedron and Cornoldi (2007) found lower scores for adequacy, structure, grammar and vocabulary in texts produced by children with ADHD, in comparison to age-matched peers without analogous symptoms. Additional studies have revealed that boys and girls with ADHD commit a relatively high number of syntactic and coherence errors. They use a simple structure and a very basic vocabulary (García, Rodríguez, Pacheco, & Diez, 2009). The short time devoted by students with ADHD to planning and supervising their work (using processes of writing that are very fixed and basic) has a negative impact on the final result, and can lead to the production of short stories in which some of the most fundamental components are omitted. Furthermore, Re et al. (2007) suggest that children with ADHD usually experience difficulty producing a text because they struggle to integrate ideas at the planning stage. In addition, they experience problems in spelling,

because they attempt to simultaneously reflect on their spelling and consider their ideas. This, in turn, can often overstress their attention systems as well as their working memory capacities.

While there is a degree of evidence of a comprehensible link between ADHD and writing difficulties, some researchers have argued that the findings are not entirely conclusive, and that the relationship between ADHD and writing difficulties is overestimated (De La Paz, 2001; Mayers & Calhoun 2006; Re et al., 2007). Re and Cornoldi (2010) hold the view that the comorbidity between ADHD and problems in expressive writing is not as close as some authors might assume. According to Lange et al. (2007), the partially inconsistent outcomes and the different interpretations of available findings are associated with a number of shortcomings that some of the previous studies exhibit (e.g., lack of a sophisticated analysis of comprehensive writing-productivity, structure, coherence, and quality). For instance, in some papers, text composition is measured by analyzing only the production of single words and single sentences. Mayes, Calhoun and Lane (2005) argue that such an approach is certainly not sufficient if one intends to gain an accurate assessment of a student's writing skills.

In summary, it can be stated that much more research is needed in order to frame sound and evidence-based statements about the connection between ADHD and problems in expressive writing. In this regard, quite recent research has shown that attention variables and higher-order literacy factors were predictive of both composition quality and fluency in first-grade students (Kent, Wanzek, Petscher, Al Otaiba, & Ki, 2014). Future research should be directed towards investigating the writing process in inattentive and hyperactive children (Re & Cornoldi, 2010). We need to know far more about the peculiarities of boys and girls with ADHD in situations where they attempt to produce a written text, and this can only be achieved by taking all of the relevant facets of the writing process into account.

Classical Theoretical Models of Writing in Relation to ADHD

Within this context, as well as from a theoretical perspective, we aimed to approach this dilemma from two different angles: on the one side, writing disability traits; and from the other side, ADHD characteristics. Specifically, we focused on Hayes' Model, which is remarkable given its evolution, and is one of the most widely used and applicable models available. We also focused upon Kellogg's *Model*, which highlights various components related to deficits in ADHD and, as expected, the aforementioned problem of comorbidity.

Hayes' model. Based on the pioneering model of Hayes and Flower (1980), many advances were made in the field of psychology probing the process of writing, both in relation to the overall architecture of the models of writing, and in relation to the organization and functioning of the writing process (Alamargot & Chanquoy, 2001). This evolution identified various limitations

in the previous theoretical model of Hayes and Flower (1980), one of which, the failure to consider the role of working memory as an important aspect, is even more relevant in the context of learning difficulties in writing and ADHD.

At the same time, limitations regarding the increasing importance of emotional, motivational, and metacognitive aspects were also highlighted, together with the impossibility of experimentally verifying the theoretical models (Hartley, 1991; Kintsch, 1987; Kemper, 1987; Kellogg, 1993; 1994). This led Hayes (1996) to propose a revision of the theoretical model developed in the 1980s.

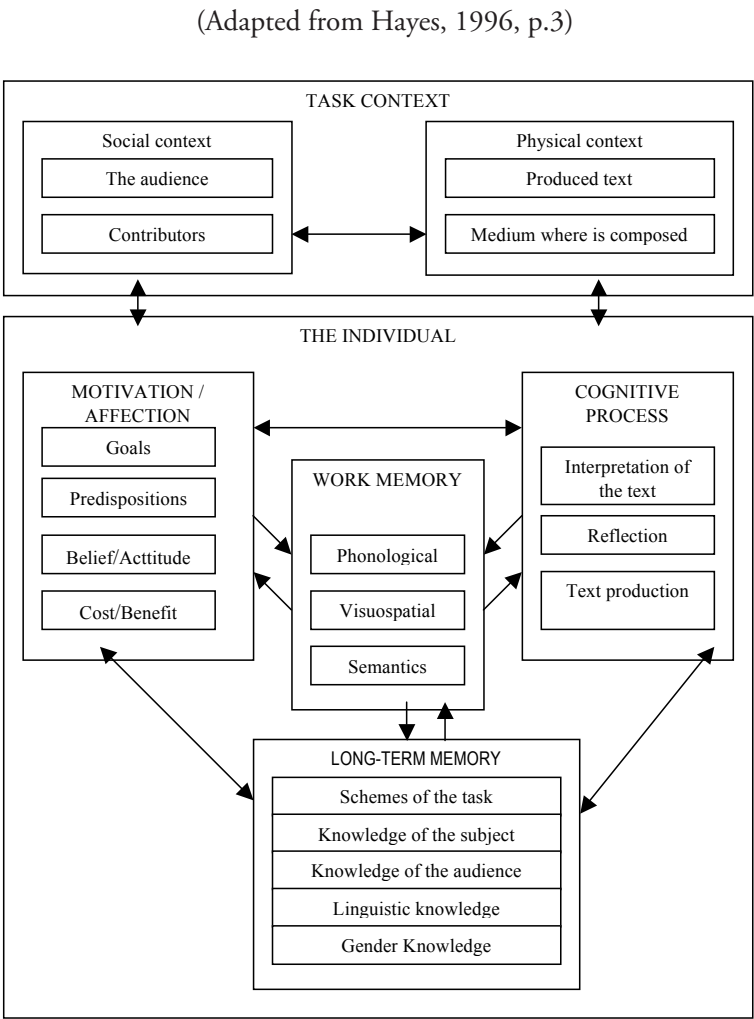
The revised model developed by Hayes in 1996 conceptualizes writing in terms of two main components: the *task* and the *subject* (see Figure 1). It is noteworthy that in this model some similarities with aspects of ADHD can be found, as the etiological basis of the disorder relates an external environmental component to its development, thus suggesting the possibility of a deeply-rooted biological basis.

The *task-related component* includes all the external factors that may influence the writer. These factors are grouped into two blocks in relation to the social and physical component surrounding the writer. Within the social component, references to the audience of the text -and to other writers in the case of collaborative writing are included. Similarly, the physical component of the model comprises the text that is being developed, as well as the characteristics of the writing environment itself, which has also been previously studied in children with ADHD (Imhof, 2004).

Moreover, in the second dimension proposed in the model, the element of *the individuality of the person*, Hayes includes four aspects related to the writer: cognitive and affective aspects, as well as working memory, and long-term components. Hayes gives greater weight to these components within the model, according to the current conception of learning difficulties.

The first component relates to *emotional and motivational aspects* of the person. This component includes aspects concerning the writer's beliefs and attitudes, predisposition to the task, estimations of the cost and benefit derived from the task, goal setting, etc. The second component concerns the *cognitive processes* of written composition, and includes three types of processes: reflection, interpretation and text production. The *reflection* process refers to a set of mental activities that allow us to transform the known information into additional knowledge. These processes play an important role in the elaboration of the textual content. The process of textual *interpretation* includes reading and understanding the text that is being composed, in order to continue writing in a manner that is consistent with what has been already written, or to proceed to a conceptual or linguistic revision of the text.

Figure 1. Hayes’ model (1996)



The third component concerns precisely that upon which associative bridges between learning difficulties in writing and ADHD can be built, as it relates to *working memory* (which had not been included in the initial model put forward in 1980). This component includes issues related to visuospatial, phonological, and semantic processing, putting stress on the operation of the Central Executive System. This makes it possible to propose that both problems have a common underlying basis that is very likely of a neurological nature.

With respect to the fourth component, it is related to *long-term memory*. This includes a set of different types of knowledge that are responsible for various functions within the writing process. Five types of knowledge concerning the formatting of a text are listed: knowledge of the textual genre, audience awareness, linguistic knowledge, knowledge of the subject, and the underlying schemes of the task.

Regarding the presence of metacognitive component in this model, Hayes highlights the *schemes of the task* as the procedures involved in performance guidance and control for the effective realization of the textual production. In this sense, these *schemes* are assumed to represent the functions performed by the monitoring processes in the above theoretical model (Hayes & Flower, 1980). Thus, in this new theoretical approach, the nature of control and monitoring processes change. Having evolved from being described as part of the general process of writing itself (Hayes & Flower, 1980) to becoming viewed as procedural knowledge stored in the writer's long-term memory, the process is now referred to as *schemes of the task* (Alamargot & Chanquoy, 2001).

However, despite this difference in conceptualization, both formulations - monitoring processes (Hayes & Flower, 1980), and schemes of the task (Hayes, 1996) - share the role of regulating and monitoring progressions in the process of writing. In addition, both conceptualizations reveal an important deficit associated with ADHD (i.e. the impairments in behavior self-regulation), an aspect highlighted in the theoretical model of Barkley (2006). These self-regulating processes make it possible to modify the writing activity when necessary by replacing one process for another as needed, which is the basis of step by step reviewing in the writing process (Alamargot & Chanquoy, 2001). This idea is now being taken into consideration in intervention studies in the fields of writing disabilities and ADHD, whether they are being addressed separately or together (Reid & Lieneman, 2006).

At the same time, regarding the bilateral nature of ADHD and writing deficits, this model also pays attention to the personal components of motivation and emotion. Following the cyclical model of self-regulation proposed by Zimmerman (2002, 2008), this aspect also relates to the self-regulation processes of the individual.

Kellogg's model. Whether or not the relationship between ADHD and writing is highlighted by the aforementioned model, the complementary model proposed by Kellogg clearly adds to the evidence of this association. The most outstanding contribution of this theoretical model is that its design integrates information processing systems with the process of expressive writing (Alamargot & Chanquoy, 2001). This is represented in the model as the component of *working memory* in much the same way as it had been developed by Baddeley (1986).

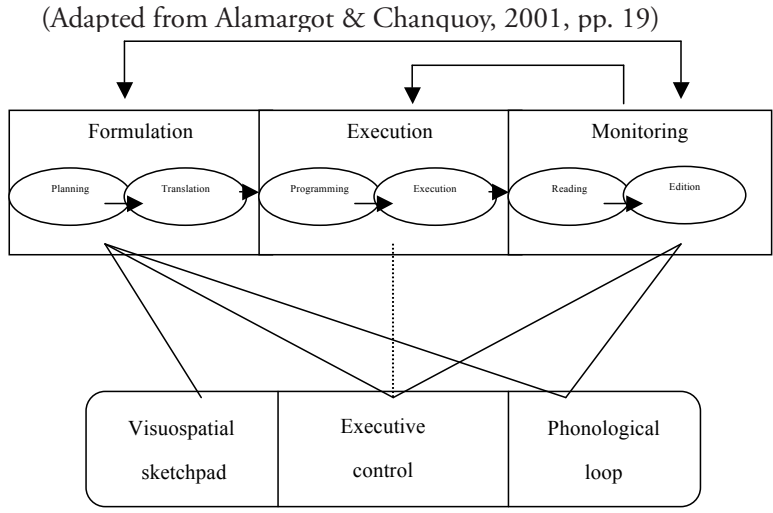
Poor working memory is nowadays a recognized impairment, and is also an important concept in the context of ADHD. In this model, working memory is an essential factor in understanding the activity of writing. The architecture of working memory is comprised of a *processing executive control* component, and two independent components: the *visuospatial agenda* and the *phonological loop* (Figure 2). The latter two components are responsible for the visual and auditory maintenance of the representations (Baddeley, 1986).

Moreover, in regard to interactions within the processing system, this model describes the architecture of the writing process; in which three basic components are included: formulation, implementation and monitoring.

The component of *formulation* includes two processes, *planning* and *translation*. The process of *planning* refers to goal setting, information searching according to the posed goals, and the organization of the information that is retrieved. The Central Executive becomes important during these processes, in which children with ADHD have two clear problems –planning and organization. Subsequently, the process of *translation* allows the transformation of these ideas into linguistic structures.

The component of *execution* involves *programming* (or motor elaboration of the translation results), and its *execution* (or graphic performance). This component is well-known and extensively studied, as is the role of graphomotor skills in children with ADHD, particularly in relation to their impairments in fine motor skills while writing (Lange et al., 2007).

Figure 2. Kellogg's Model (1996)



Finally, the *monitoring* component entails two processes. The first, *text reading*, involves re-reading and verifying the sense of what one has written during and/or after the elaboration of the text. The second process is *editing*, which involves detecting and diagnosing problems during the writing process, in order to later compose a new version of a given statement once the problems have been solved.

Kellogg's model there is also a *monitoring* process. This process is part of the overall process of writing, controlling and regulating the sequence of the writing process (Alamargot & Chanquoy, 2001). However, although its name, location and purpose are the same, its functioning is completely different. Specifically, in Kellogg's Model the term *monitoring* more closely resembles the concept of *revision* proposed by Hayes and Flower (1980), which thus introduces a certain degree of confusion as to the nature of the term. Nonetheless, this process controls the activation of the writing processes that are needed to continue composing the text, or to modify what has been already written (Alamargot & Chanquoy, 2001).

In this same context, the reference to the metacognitive dimension of *regulation* is also present in the component of the working memory of the *processing executive control*. This leads to two possible analyses of the self-regulatory process in written composition, which is particularly interesting in relation to interventions intended for children with self-regulation problems, as clearly happens to be the case in ADHD (Rodriguez et al., 2009).

Kellogg's theoretical model has one outstanding feature that makes it indispensable in order to gain an increased understanding of the writing process. Within the perspective of the relationship between ADHD and writing, this model is also much more comparable empirically (Levy & Ransdell, 2002).

A BRIEF OVERVIEW OF THE RELATIONSHIP BETWEEN ADHD AND WRITING DIFFICULTIES: MAIN FINDINGS FROM A REVIEW OF PREVIOUS RESEARCH

The literature on comorbidity between ADHD and Learning Disabilities (LD) has clearly focused on the areas of reading, orthography, mathematics, and other developmental disorders, and their associations with ADHD have been similarly addressed. With regard to LD in writing, however, this has not been the case. Difficulties in written composition are twice as common (65%) as LD in reading, mathematics and orthography individually (Mayes, Calhoun, & Crowell, 2000). Such figures suggest that learning and attention problems frequently interact or coexist, and that the severities of the difficulties are a continuum.

In order to establish the above possibilities, a theoretical review and detailed analysis of international studies on ADHD and LD in writing was carried out. The authors focused on the studies conducted within the last ten years,

whilst also taking into account those previous studies that (given their contribution to this area of research) are worth highlighting. In this sense, using the terms “attention”, “writing composition”, “intervention” and “process”, a total of 95 references were found on the Web of Sciences, covering the period from 1992 to 2015. Only those that actually met the objectives of the present review were considered for further discussion (a total of 19 studies that readers can refer to in Tables 1, 2 and 3). The criteria for inclusion were the following: a) the study had to suppose a contribution to the research topic, either because of the sample size, the scope of the results or the number of citations received; b) the components of attention or/and writing composition had to be present and clearly described; and c) the methodology used needed to be adequately clarified. The results from the present review indicated that, while this research topic has received some interest, certain limitations and gaps in previous studies suggest the need for further investigation in this area.

The studies that were examined are tabled and discussed in separate sub-sections of this review according to the category of study. Finally, a description of the most relevant studies (those most pertinent to the aims of this review) is also provided.

Experimental and Intervention Studies

The specific findings of our review of prior research in this area (such as which aspects of writing in ADHD were most scrutinized) are listed below in Table 1. Gaps in the research that need to be filled in the future are also shown.

In the above set of studies, those of an experimental nature appear to share one common characteristic. Although they focus on examining writing in different samples with ADHD, all but two of these studies also included difficulties in mathematics and reading. Thus, it is interesting to note the contributions that the two studies dedicated solely to writing make, from the perspective of their specificity. The first study, conducted by Gregg et al. (2002), does not examine writing abilities from the broader perspective of *written composition*. It also does not analyze consistency, quality, organization or structure. In contrast, it focuses on specific aspects of *productivity*, such as the words used and the degree of elaboration in sentences. In spite of these shortcomings, its importance will be explained below. The second study (Imhof, 2004) exclusively addresses writing and ADHD, and also focuses on aspects of the context of the task, particularly the influence of the color of the paper upon writing. This makes the objectives of that study appear to be aimed in a divergent direction to those of other the empirical studies reported here. In summary, these studies do not focus entirely on writing and, when they do, they do not delve deeply into the higher-order aspects of written expression, instead devoting primary attention to peripheral or mechanical components of composition.

Table 1. Review of experimental and interventional studies on writing and ADHD in the last 10 years

<i>Citation</i>	<i>Intervention</i>	<i>Sample</i>		<i>Research Design</i>	<i>Findings</i>	<i>Limitations</i>
		<i>Number</i>	<i>Age</i>			
Gregg et al. (2002)	Types of words used, composition characteristics and levels	87 LD 50 ADHD 58 ADHD + LD 92 no LD	High-school education	Experimental	High correlations between production, quality, and vocabulary in the written compositions	Does not include errors and lacks an approximation to the instruction
Reid, & Lienemann, (2006)	Effectiveness of Self-Regulated Strategy Development (SRSD)	3 ADHD and LD in writing	9-10	Intervention	The SRSD strategy results were highly effective in the improvement of the narrative tasks	The sample was very limited
Mayes et al. (2000)	Intelligence and LD in writing, mathematics, reading, and attention	119 students	8-16	Experimental	Indicates LD and attentional problems to be a continuum, and usually coexist	There were very few evaluation instruments
Miranda, Soriano, & García, (2006)	Differences in reading comprehension and written compositions	30 ADHD 30 Control	7-12	Experimental	Deficits in reading comprehension and written composition reflect deficiencies in the executive processes	An absence of contributions at qualitative level

De la Paz, (2001)	Effects of a self-regulatory strategy (SRSD) on improving writing ability in children with special educational needs	3 LD and/or ADHD	13-14	Intervention	The SRSD strategy is potentially viable to improve writing ability of children with language difficulties and attention deficit	Only three participants had been diagnosed with special needs, and there was no control group
Shimabukuro et al. (1999)	Effects of a self-monitoring program on productivity and accuracy in homework involving reading, writing and mathematics	3 ADHD and LD	12-13	Intervention	The monitoring strategy increases the effectiveness and productivity of children with ADHD and LD in writing, maths and reading, but is more effective in math and reading	Small sample. No control group
Imhof, (2004)	Effects of color stimulation on the graphomotor skills of children with ADHD	66 ADHD	6-10	Experimental	The effects of paper stimulation produces positive effects on spelling, behavior, control and the quality of written compositions	Does not consider other forms of stimulation, and does not control for the different variables in the tasks
Kent et al. (2014)	Influence of kindergarten-component skills on writing outcomes	265 students	Kindergarten and first grade	Experimental	A model including attention was more appropriate. Attention and higher-order literacy factors were predictive of composition, quality and fluency	The sample for this study comes from a single school district. Only the teacher-ratings of attention/self-regulation were included in the study

Note: ADHD = Attentional Deficit Hyperactivity Disorder; LD = Learning Disabilities

Regarding the studies of an interventional type, they form an interesting group. The main observation in this sense is that only three studies dealing with ADHD and writing were found; two of them based on self-regulation, and the other on self-monitoring strategies. The latter study by Shimabukuro, Prater, Jenkins and Edelen-Smith (1999) does not specifically target writing, as it also addresses mathematics, reading and writing. However, its findings did indicate an increase in productivity and effectiveness in the three studied areas due to the intervention, albeit that this intervention seemed to be more effective in math and reading than in writing. The remaining two studies (De la Paz, 2001; Reid & Lienemann, 2006) present results solely concerning writing, which indicated positive effects in the two interventions based on self-regulation (SRSD) in children with ADHD and LD in writing. These results also showed the potential of SRSD intervention as a future basis upon which to build effective instructional strategies in this area, in line with the theoretical conclusions previously reported here. On the other hand, a negative aspect of this research is that all of the above studies have obvious limitations in terms of both sample size, and the absence of a control group.

Comparative Studies

The second category of research study reviewed comprised a sufficient number of investigations to be discussed as a single group. In addition, it is interesting to scrutinize the types of designs used. These comparative studies were the most abundant form of research in the area of ADHD and LD in writing found in the relevant literature. A summary of these studies is presented in Table 2.

This set of comparative studies has several specific characteristics. First of all, none of the studies analyzed the differences in writing between students with LD and a sample of students with a formal diagnosis of ADHD. Rather, they focus on those students that differ from a general sample, particularly those who meet the criteria for ADHD according to parents and teachers perceptions (i.e., diagnosis is based on the reports provided by external informants). Also, when various LD and/or dysgraphia are included, no control group is used to compare differences in writing and other aspects. Secondly, there is only one study that focuses on productivity and the quality of the written composition (Re et al., 2007), though there is an important tendency to study writing in relation to executive functions.

Table 2. Review of comparative studies on writing and ADHD in the last 10 years

Citation	Intervention	Sample		Research Design	Findings	Limitations
Mayes & Calhoun (2006)	Prevalence of LD in Developmental Disorders (DD)	949 DD	6-16	Comp.	The neurogenetic disorders are evaluated in the LD due to the high probability of appearance,	Lacks direct evaluation because only observational evaluation is used.
Tucha, (2004)	Effects of pharmacological treatment on the ability to write	48 ADHD	Children and adults	Comp.	The medication improves writing movements in children but not in adults	Small sample with different ages
Harder, (2007)	Relationship between executive functions and written composition in ADHD	31 ADHD 27Control	19-28	Comp.	Indicated a connection between executive functions and written expression in adult students	The sample is not very large and only adults participated
Adi-Iapha, et al. (2007)	Characterization of the difficulties in writing in children with ADHD	20 ADHD 20 ADHD + Dysgraphia	11-13	Comp.	The writing and spelling errors come from a non-linguistic deficit and the linguistic factors play a secondary role	Small sample and a short range of ages

Riccio et al. (2006)	Differences between subtypes of ADHD in executive function and the learning of mathematics, reading and writing	40	9-15	Comp.	Some domains of executive function interfere with school performance and skills. There were differences in cognitive function based on the opinion of the parents	Limitations related to the gender-ratio and sample size, in addition to the utilization of a limited context
Re et al. (2007)	Abilities in written expression; errors in the description of verbal stimulus or images in a narrative task	48 and 163 participants with ADHD (2 studies)	11-13	Comp.	The group with ADHD scored worse results in writing, which was associated with a large number of errors. These children wrote with notably lower quality and less productivity	No formal clinical diagnosis of participants
Barry et al. (2002)	Academic problems in children with ADHD, and their relationship to executive function impairments	33 ADHD 33Control	8-14	Comp.	The problematic of the behavior of children with ADHD interferes in their school performance. This could be due to interrupted Executive functioning affecting their performance in mathematics, reading and writing	The study does not consider the possible presence of LD in the students with ADHD, nor in the control group

Yoshimasu et al. (2011)	Determine the incidence of written-language disorder (WLD) among children with and without ADHD in a population-based birth cohort.	5718	>5 years	Comp.	For both genders, the cumulative incidence of WLD by 19 years of age was significantly higher for children with ADHD than for children without ADHD.	Is possible that some incidental cases of WLD and/or ADHD were not identified, as screening measures were not performed for every child
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Note: ADHD = Attentional Deficit Hyperactivity Disorder; LD = Learning Disabilities; Comp. = Comparative study.

In general, comparative studies on writing do not address the problem of comorbidity between ADHD and LD specifically, although they analyze groups of students who have both problems, and focus on the product and the process of writing. Additionally, there seems to be some difficulty in recruiting large samples with different typologies, with the exception of one study (Riccio, Homack, Jarratt, & Wolfe, 2006) which examined differences in writing by ADHD subtypes. Finally, it is important to note that several of the studies reviewed were published in the last few years, which may indicate a growing interest in understanding writing problems in ADHD from a comparative perspective.

On the whole, the comparative studies reviewed have certain limitations concerning the sort of sample used, and it seems to be difficult to access wide samples of children with ADHD. Moreover, the evaluations carried out are often too general, and neglect to include a specific assessment of writing. Rather, they carry out analyses that are based upon performance. It would thus seem necessary to address this generality with future studies that are focused on more specific aspects, such as the relationship between process and product in written composition. It is also essential to conduct studies with larger samples, taking into account the differences that may exist among ADHD subtypes, given that it is a very heterogeneous disorder (Harder, 2007).

Descriptive and Theoretical Review Studies

Finally, a summary of theoretical review and descriptive studies carried out recently is presented in Table 3. Although these studies are not numerous, they are interesting because they provide an insight into the current research on writing and ADHD. Only three studies were found that could be categorized within this group; however, each of them emphasizes a particular field of research.

These studies also discuss general features of writing, but they do not deeply examine more specific aspects, such as process and product. In this sense, it is especially necessary to note their limitations. For example, in the descriptive study by Bruce, Thernlund and Nettelbladt (2006), only questionnaires were used for the evaluation indicating that students with ADHD are more likely to have writing and reading difficulties.

With respect to the two review studies conducted, they highlight two completely different aspects. One review (Lange et al., 2007) focuses on writing mechanics and spelling, while also addressing writing in ADHD from a medical standpoint (as it relates these difficulties to remedial treatments and medication). Therefore, it is not a study that examines LD in writing, or one that makes a thorough review of how spelling affects the academic performance of children with ADHD. However, the study presents novel concepts on how to improve spelling in ADHD by training graphomotor skills. Such research is interesting and necessary, but it perhaps deviates from the objectives of the other empirical

studies. The second review (Reid, Trout, & Schwartz, 2005) fully approaches school instruction by analyzing the effects of self-regulatory interventions on learning and other aspects, including composition writing. It seems, therefore, that while it does not clearly focus on writing and ADHD, it does provide a background to designing and implementing promising interventions based on self-regulation for children with ADHD and LD in writing.

Reid et al. (2005) carried out a review on the usefulness of interventions based on self-regulation to improve basic academic skills, and found comprehensive interventions to be the most effective treatment. This is consistent with previous research on interventions in ADHD (Chu, 2003; Miranda, Jarque, & Tarraga, 2006). It is noteworthy that although 16 studies were reviewed, the total number of participants in these studies amounted to 51, indicating that the sample sizes in each of them were very small.

In the other study of this type, Lange et al. (2007) reviewed investigations aimed at improving graphomotor skills and calligraphy in students with ADHD. Their study does not examine the issues we posed at the outset of the present review, such as composition writing and other higher-order components. However, these authors found that pharmacological treatment alone does not improve graphomotor skills in ADHD.

Finally, in the third descriptive study, Bruce et al. (2006) explore learning problems in children with ADHD. They found an increased frequency of difficulties in writing and reading—mainly in reading comprehension. The most notable limitation of this study was the application of questionnaires as the sole measure of learning difficulties.

Having reviewed the research listed in the above three tables, four specific studies from within these groupings will now be discussed in greater depth. These studies are particularly relevant due to the applicability, the nature of their findings, and their empirical designs, to the overall objectives that stimulated the present review.

Table 3. Analysis of review and descriptive studies on writing and ADHD in the last 10 years

Citation	Intervention	Sample		Research Design	Findings	Limitations
		Number	Age			
Reid et al., (2005)	Self-regulatory interventions in ADHD	51 participants (16 studies)	7-15	Review	Self-regulatory treatments combined with a multimodal intervention offer better results	The types of studies reviewed (low sample numbers).
Lange et al. (2007)	Effects of training in grapho-motor skills in ADHD			Review	Pharmacological treatment is insufficient to improve writing and calligraphy in ADHD. Children with ADHD will improve more when multiple instructions to improve attention are applied.	The research analyzes several aspects of ADHD in only one study, thus its conclusions are vulnerable to errors.
Bruce et al. (2006)	Language and learning problems in children with ADHD	76 ADHD	11	Descriptive	Language problems, especially at the comprehension level, are common in ADHD, and their frequency in reading and writing are highlighted.	Only questionnaires were used

Note: ADHD = Attentional Deficit Hyperactivity Disorder.

One of the studies that should be highlighted was conducted by Miranda et al. (2006). A positive aspect of this study (published in Spanish) is the fact that it makes a comparison between levels of written composition and reading comprehension in a sample of 30 children (aged 7-12 years) who were clinically diagnosed with ADHD, and in an age-matched sample without ADHD. Students were evaluated by using four types of reading comprehension tasks (literal, inferential, order of a story, and retrieval), and a written composition tasks consisting of spontaneous writing about a tour. They measured performance-time, number of sentences, words per sentence, productivity and richness of vocabulary. The most notable results indicated the presence of greater problems in written composition -and especially productivity- than in reading comprehension, with no differences in literal or inferential comprehension tasks. These results suggested that there may be deficiencies in the executive processes in children with ADHD. However, one of the limitations of this study is that it does not differentiate between ADHD subtypes, and does not deal with specific aspects of writing, such as coherence, quality and the sorts of processes or strategies used.

In another study focusing on written composition (Gregg et al., 2002), comorbidity between ADHD and LD was also examined. A sample of 287 adolescent students took part in the study. Participants were divided into four groups: a control group ($n = 92$), a group with LD ($n = 87$), a group with ADHD ($n = 50$), and a fourth group with both conditions ADHD + LD ($n = 58$). The measures evaluated were: general ability, cognitive processing, oral language, performance and socio-emotional functioning. This study is distinguished from the other studies discussed in the present review because of its rigorous design and differentiation of the sample into four groups, as well as the factors it incorporated that were based on communicative writing. Moreover, the study's results indicated that there were significant differences among the groups. However, although this study analyzes errors and productivity through standardized measures, it does not address the quality or consistency, or the processes involved in the elaboration of an expository text. Thus, it differentiates some specific aspects of productivity, but fails to provide measures of structure, consistency, quality and, most especially, the orchestration of the cognitive processes involved in writing.

A further study, conducted in Italy by Re et al. (2007), analyzed differences in writing between a group of 24 children with ADHD – diagnosed according to teacher's reports- and 24 children without ADHD, with both groups drawn from the 6th or 7th grades. The design consisted of three different studies, which examined spelling, productivity and writing speed. The first study involved writing a verbal description; the second study, a description based on

visual stimuli; and the third study, a narrative text. The adequacy of writing, grammatical structure and the number of different words used were the key measures analyzed. The results showed that the ADHD group obtained lower scores on the parameters studied, making shorter texts and more mistakes, with no differences in the three proposed tasks. In this study, the limitations stem from how the ADHD cases were diagnosed, and the limited sample size. In addition, the study did not address the more complex aspects of writing, such as consistency and quality. While this study seems to somewhat rely upon estimations, it generally indicates the existence of writing difficulties in ADHD, particularly in written composition.

Finally, it also important to note the lack of research on interventions in ADHD and LD in writing. The study by Reid and Lienemann (2006), based on the SRSD strategy, is a particular exception. Similarly, with regard to epidemiological studies, the research conducted by Mayes et al. (2000) is also noteworthy. The latter researchers found that 70% of individuals in a sample of 119 children with ADHD (8-16 years) had at least one form of LD, and that difficulties in writing were more frequent than difficulties in reading or mathematics.

CONCLUSION

The main goal of the present authors was to conduct a review of the literature on ADHD and writing difficulties, paying special attention to the empirical studies that have been published in recent years. Upon completion of this review, it has been concluded that only few studies have been directly related to the specific issue underlying this review. Moreover, it seems that writing difficulties are prone to be addressed superficially, without studying the written product completely (i.e. productivity, structure, consistency, quality), and with even less attention paid to the key processes involved in writing (Rodríguez et al. 2011).

Moreover, regarding the samples with ADHD, an important limitation is the fact that it is frequent to find that diagnoses had been based upon external informants' reports –mainly teachers–, rather than relying on more objective measures, based on performance. In addition, sample size in most of the studies reviewed herein was also very small. In general, however, the analyzed studies agree on the presence of writing difficulties in children with ADHD, although some of them illustrate these difficulties in terms of general indicators instead of measures based on the text and the individual. Nonetheless, the present authors conclude that the findings from these studies, and their limitations, may well serve as the basis for future empirical research and thus lead the way to a progress in the study of this issue.

Furthermore, it is also important to consider the fact that ADHD is a heterogeneous developmental disorder, and relying solely upon a single clinical diagnosis may be insufficient in some cases. Thus it is necessary to obtain

a detailed description of any additional problems, such as comorbidities, intellectual ability and/or motivation, as well as to take into account various factors inherent to the use of different measurement strategies, such as social desirability in relation to questionnaires. By means of comprehensive analyses, researchers and professionals would gain more certainty about the basic characteristics of ADHD, and this would allow the elimination of the possible effects of different modulator variables when a detailed description and diagnosis of groups with ADHD needs to be made. However, ADHD research is complex in this regard, given the plurality of the problems associated with the disorder. Any attempt to cover the whole spectrum of associated disorders at this depth is almost unaffordable.

Implications for Practice

In view of the theoretical review carried out, and paying attention to the results from previous research on comorbidity, prevalence and intervention, it is concluded that intervention in ADHD -and of course in learning disabilities- is very much needed. However, this is even more important in the case of difficulties in written composition, as although both problems presently exist in our classrooms, competent writing has become a necessary skill in our society, a fundamental skill that seems to be often overlooked today (Gregg et al., 2002; Jakobson & Kikas, 2007).

It is also important to note that although the frequency of intervention studies in ADHD and written composition seems to be increasing, a qualitative improvement in this area is needed (e.g. by increasing sample sizes and/or including control groups). In addition, it is essential to promote generalization strategies that lead to the maintenance of intervention effects over time, and it seems that instructional programs based on self-regulation strategies may well produce satisfactory results in this context (Reid & Lienemann, 2006). Fortunately, it is also worth noting that some studies have indeed analyzed writing in depth, by including samples of students with LD and also by employing different measures of writing. These types of studies potentially serve as a precedent for future research on this issue.

Previous research has also highlighted the fact that the writing problems in children and youth with ADHD and/or Writing Learning Disabilities are both far-reaching and multi-faceted. This specific population would be likely to benefit from a step-by-step method of instruction to support their writing skills, however, this should be carried out in combination with enhanced procedural facilitations. At these early stages of development, both declarative knowledge (i.e. knowing what has to be done) and procedural expertise (i.e. being able to actually perform the task) have to be addressed, with special attention given to the latter aspect, as this is directly related to executive functioning difficulties that frequently characterize children with ADHD (Re & Cornoldi, 2010).

Limitations of the Study and Directions for Future Research

In the light of the theoretical review presented here, a number of limitations in previous research can be observed. One of the most important weaknesses in this sense is that although there have been several studies on the relationship between ADHD and writing disabilities conducted, with some utilizing substantial data-bases (Smith & Adams, 2006), very few of these studies were carried out with samples of children who had been appropriately diagnosed (i.e. their problems had not been comprehensively analyzed and subsequently described).

In addition, future research should focus on shedding further light on the writing processes of children and youth with attention and writing problems. Working memory plays a vital role in this context, as it assists one's endeavor to compose a coherent text. In the studies examined in the present review however, this aspect had not been addressed to its fullest extent. It is thus necessary to explore the peculiarities of the writing process in students with ADHD and WLD in far greater detail in order to design more effective intervention tools, or to improve existing interventions that are already well-established.

The scientific community involved in special education should certainly pay more attention to writing problems in childhood and adolescence, especially when ADHD is also present, because this population is at an extremely high risk of never learning how to compose a meaningful text unless efficient support is provided at an early stage (i.e. before the student completely loses self-motivation and interest in writing, and/or education in general). The gap between the high prevalence of difficulties in written composition and the extent to which this phenomenon has been investigated through empirical studies needs to be narrowed. In particular, we need a sound psycho-educational model that takes both ADHD and severe writing problems into account (Graham & Harris, 2005; Graham & Perin, 2007).

Finally, some limitations concerning the review presented here must be acknowledged. First of all, the number of studies described and discussed may appear to be somewhat limited, however, the current authors believe that the majority of studies that were relevant to (and representative of) the issue at hand were considered and scrutinized. Although it is possible that there may have been some gaps in the literature examined, in order to shed light on the full extent and significance of prior research in this complex area a systematic review would be necessary. In this context, the present study might well be seen as an appropriate starting point for future studies and more comprehensive analyses of previous research.

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