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AN ANALYSIS OF CURRENT THEORETICAL MODELS OF WRITING AND ITS RELATION TO ATTENTION-DEFICIT HYPERACTIVITY DISORDER (ADHD)

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Understanding writing as a recursive process, we set out to explore the theoretical bases of the principal models of writing, and also how these models are related to Attention-Deficit Hyperactivity Disorder (ADHD). Our aim is to identify a connection between writing and the difficulties found in ADHD, given the scarcity of literature on this topic. In turn, we attempt to establish a relationship between the theory of writing and current theoretical models of ADHD. Within these general writing models, and bearing in mind that text revision is one of the key cognitive processes in writing, we focus on two specific models referring to the revision process, with the aim of widening the theoretical perspective and providing a specific example to illustrate the difficulties of children with ADHD.

Key words: *ADHD, Writing, Models, Text revision.*

Entendiendo la escritura como un proceso recursivo, se presenta un estudio que pretende explorar, de forma general, los principales modelos de escritura. Intentando a su vez, explicitar elementos y conceptos relevantes de los mismos en relación con el Trastorno por Déficit de Atención e Hiperactividad (TDAH). Con ello, de una forma reflexiva se pretende realizar una primera conexión entre la escritura y los problemas del TDAH debido a la escasez de literatura al respecto. A su vez, se pretenden relacionar teóricamente, los aspectos destacados de estos modelos, con los modelos actuales y más usados del TDAH. Dentro de estos modelos generales de escritura, y teniendo en cuenta que la revisión textual es uno de los procesos cognitivos esenciales, se dedica mayor atención a dos modelos concretos de escritura referidos a este proceso, con el fin de ampliar la visión teórica, y ejemplificar las dificultades del niño con TDAH en un proceso concreto.

Palabras clave: *TDAH, Modelos, Escritura, Revisión textual.*

Attention-Deficit Hyperactivity Disorder (ADHD), which basically comprises the constructs of inattention, hyperactivity and impulsivity, has been redefined and re-conceptualized over the years since it was first identified (Barkley, 2001). This conceptual approach to ADHD is supported by current theoretical models (Barkley, 2007).

At the same time, research on written composition has made considerable progress in recent years, in an effort to understand the processes involved in it. In particular, theoretical models of writing have tried to explain writing from cognitive, communicational and social perspectives (Alamargot & Chanquoy, 2001; MacArthur, Graham, & Fitzgerald, 2006; Rijlaarsdam et al., 2008). All such models, despite their diversity, set out to explain the architecture of writing processes, their components and their organization as a recursive process, as well as identifying components that are modifiable according to the writer's motivation, attitudes, cognitive processes (working memory, knowledge stored in the long-term memory) or processes of metacognition (self-regulation and metacognitive knowledge). In general, the various models coincide on the fact that writing is a cognitive task that requires the coordinated deployment of a relevant set of mental processes, in a simultaneous and recursive manner. Such complexity demands the involvement of multiple cognitive resources, including the control of attention, self-regulation and working memory. In turn, it requires the use of specific writing skills, and strategies related to the deployment and organization of the cognitive processes involved in producing a written text and the respective cognitive demands.

At the present time, and given the development of research on cognitive processes in writing and their relations with attention and ADHD (García & Rodríguez,

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2007), it is important to be familiar with current theoretical models and their connections. The goal of the present study is to consider these two constructs (ADHD and writing) theoretically, and more specifically, to describe the theoretical models that explain them. Likewise, we shall attempt to make theoretical connections between these models and the knowledge provided by recent research on ADHD, concerning the relevant conceptualization and other aspects, such as diagnosis or intervention.

We shall look at the role of written composition in writing models as a recursive process that makes considerable cognitive demands on attention and working memory, also focusing on text revision processes, a source of particular difficulty for students with Learning Disabilities (LD) in writing, but also for those with ADHD.

THEORETICAL MODELS OF WRITTEN COMPOSITION AND ITS RELEVANCE IN ADHD

Research on writing and written composition has made considerable progress in recent years. This progress is reflected not only in methodological refinements, such as on-line measures of the processes involved in written composition, but also in advances related to the identification of the nature of such processes, or the way they develop.

Recent research has explored both the improvement of written composition through instruction and the development of theoretical models, all of which can be tested, such as that of Kellogg, by means of experimentation or even through comparative, clinical and instructional studies, recent examples of which would include Graham and Perin's (2007) meta-analysis on effective elements in the teaching of writing, McArthur, Graham and Fitzgerald's (2006) handbook on the psychology of writing, or the review by Rijlaarsdam et al. (2008) showing the three approaches employed in the development of knowledge on key elements in the improvement of writing.

In this section we briefly analyze theoretical models of writing with a view to considering possible connections between writing and ADHD. This connection is not proposed directly by the theoretical models, but given the types of components they include we can make some inferences that will help us to better understand the relationship of overlap or comorbidity between ADHD and learning disabilities in writing, for example.

The models we shall analyze are: the Hayes model, which is notable for having evolved since its inception and for being one of the most extensively used (at least according to reports) and most widely applicable – especially the most recent version from 1996, modified in 2006 (Hayes, 2006); and the Kellogg model, which highlights in several of its components the relationship between writing and deficiencies found in ADHD, reflecting the kinds of comorbidity problems that we set out to demonstrate in the present work (Troia, 2006). As regards specific models of text revision, we shall look at those of Scardamalia and Bereiter (1985) and Butterfield, Hacker and Albertson (1996), chosen above all for their application to intervention in the area of writing and the components they include, many of them relevant to ADHD.

Hayes' model

As an essential reference in any study on written composition we should highlight the model of Hayes and Flower (1980). This model represented a change of orientation in research perspectives on the writing process. Moreover, it largely laid the foundations for the theoretical models that followed it, and was constructed on the basis of writers' thinking out loud during the task of text composition. The principal contribution of the model was its emphasis on the interactive nature of the process, corroborating its recursive character and discarding its conceptualization as linear. Also of relevance were its contributions in relation to the sub-processes and operations present in writing processes.

From a structural point of view, Hayes included as basic components the *task environment* or *production context*, with all the aspects external to writers and that influence them, *long-term memory*, which includes three types of knowledge area, general topic of the text, the communicative act and linguistic knowledge associated with production of the text, and finally, the *general process of written composition*, made up of the three basic processes of *planning*, *translating* and *reviewing*, coordinated by a fourth control process, *monitoring*, whose purpose is to regulate the recursive sequence of written composition.

However, given the progress made in the field of the psychology of writing, and the limitations of the model, we shall concentrate on the 1996 model and the modified version published by its author in 2006. Among the limitations of the original model was the absence of the role of working memory, a construct of considerable

relevance in today's conceptualizations of written composition, as well as in those of both LD and ADHD (Vanderberg & Swanson, 2007). A further limitation was the failure to include emotional and motivational or metacognitive components. But the most important shortcoming of this pioneering model and of others from that period concerned their lack of experimental verification, an issue addressed by models such as that of Kellogg, which permits the generation of directly testable hypotheses (Kellogg, 1994).

Therefore, it makes sense here to consider briefly the most recent Hayes (1996) model and its latest modifications (Hayes, 2006). This model conceptualizes writing in terms of two principal dimensions, related to the task and to the individual (see Figure 1).

The dimension related to the *task* includes the different external factors that can influence the writer. These factors are grouped in two blocks, related to the writer's social and physical environments. The *social component* refers to the audience of the text, and in the case of collaborative writing, to the rest of the writers; the *physical component* includes the text being produced and the characteristics of the writing environment itself.

In the second dimension, referring to the *individual*, Hayes includes four components, related to affective and cognitive aspects and the working and long-term memory of the writer, all of which we summarize below.

A first component refers to *affective* and *motivational* aspects of the person. It includes aspects related to the writer's beliefs and attitudes, predisposition toward the task, estimations of the cost and benefit derived from the task, goal-setting, and so on.

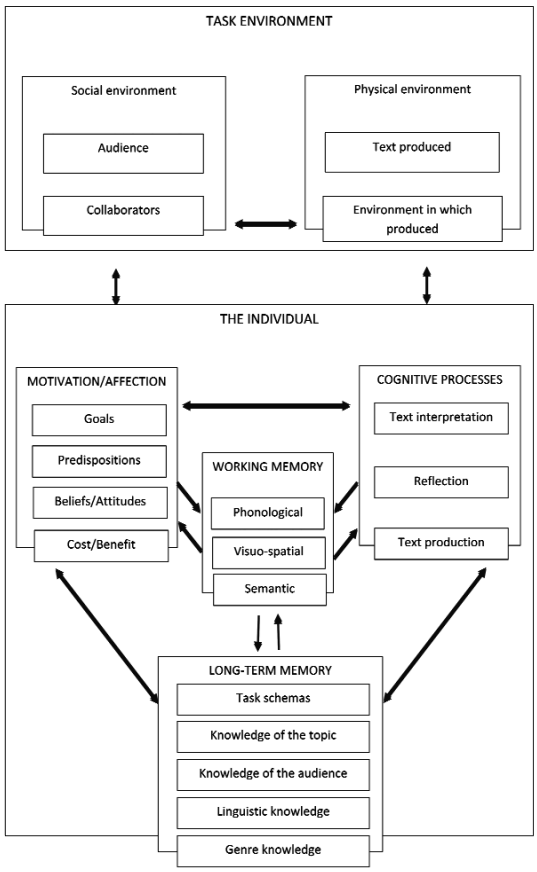
A second component refers to the *cognitive processes* of written composition, and would include three types of process, reflection, interpretation and text production. The *reflection* process refers to a set of mental activities that permit the transformation of some kinds of knowledge into other kinds, while *interpretation* includes the reading and comprehension of the text, with a view to being able to continue in a coherent fashion with what has already been written, or proceed to a conceptual or linguistic review of the text.

The third component, *working memory* (not included in the initial, 1980 model), includes aspects related to phonological, semantic and visuo-spatial processing. This aspect will be a central one in Kellogg's (1996) model, and its main contribution is its experimental verifiability.

And fourthly, the model refers to the *long-term memory* component, which would include a set of different types of knowledge that ensure the possibility of diverse functions within the writing process. Five forms of related are listed: knowledge of the text genre, knowledge of the audience, linguistic knowledge, topic knowledge and task schemas.

As regards the presence of the metacognitive component in this model, Hayes considers *task schemas* as the procedures responsible for guiding and controlling effective text production; these would take on the function exercised in the previous theoretical model (Hayes & Flower, 1980) by monitoring processes. Thus, in the new theoretical proposal, the very nature of the process of control and monitoring of the process changes: from being described as an integral part of the general process of written composition in its strict sense (Hayes & Flower, 1980), it becomes considered as procedural knowledge stored in the writer's long-term memory, and referred to as *task schemas* (Alamargot & Chanquoy, 2001). But

FIGURE 1
HAYES' MODEL (1996)
(from Hayes, 1996, p.3)



despite this different conceptualization, both formulations, monitoring (Hayes & Flower, 1980) and task schemas (Hayes, 1996), are responsible for regulating and controlling the progress of the writing process.

Moreover, both conceptualizations highlight a key problem related to ADHD, concerning difficulties for the self-regulation of behaviour, a prominent aspect within Barkley's theoretical model, and which is altered in this developmental disorder. The self-regulation process makes it possible to modify the activity of writing where necessary, replacing one process by another as required; this, indeed, forms the basis of the recursivity of writing processes (Alamargot & Chanquoy, 2001). This concept is being applied in studies on intervention in both fields – writing and ADHD –, either in isolation or in conjunction (Reid & Lieneman, 2006).

In Hayes' relatively recent theoretical annotations, he summarizes the progress made in the field of writing, arriving at the conclusion that new theoretical proposals have stimulated empirical studies which have, in turn, achieved advances sufficient to support the reformulation and improvement of existing theories. In that revision of his model, he focuses on the most prominent aspects with regard to research developments in the field of writing, highlighting three of them: *working memory* as an essential aspect in the functioning of the cognitive processes involved in writing; *planning* strategies as an important aspect in instructional writing programmes; and the use of *activity theory* as an aid to understanding the social and environmental factors that influence writing (Hayes, 2006).

An observation of the general model from 1996 reveals coincidences with relevant aspects of ADHD, especially with regard to components related to the individual, and specifically to working memory and its role within executive functioning. This construct, present in any written composition task, is becoming one of the most important in the empirical and theoretical development of the ADHD concept, since it is deficient in individuals with this disorder, and constitutes a key element in its recent notable reconceptualization (Barkley, 2007).

In any case, if Hayes gave it importance in his 1996 proposal, in his 2006 revised version he gives it even more prominence, reflecting the fact that the increased theoretical importance of working memory in ADHD and written composition go hand in hand. Moreover, and on the basis of this, more links can be established between LDs in writing and ADHD, with a perspective revolving around the functioning of the central executive, situating the two problems on common foundations, potentially of a neurological nature.

Likewise, and in relation to both ADHD and writing, this model also includes a reference within the individual component to motivational and affective aspects, which, in line with the cyclical model of self-regulation proposed by Zimmerman (2000), are related to processes of self-regulation in the person.

Finally, we should point out that the task environment can also be related to aspects of ADHD, since, for example, the environment in which the task is carried out and the social context are crucial elements in the generation of written composition in children with ADHD, which can be influenced by aspects as specific as the colour of the paper on which the writing is produced (Imhof, 2004).

Kellogg's model

If the relations between ADHD and writing were evident in the above model, in Kellogg's model this relationship becomes considerably clearer. The most notable contribution of this theoretical model concerns its incorporation of an information-processing system together with the written composition process (Alamargot & Chanquoy, 2001), represented by the working memory model, as developed by Baddeley (1986).

In Kellogg's model the architecture of the working memory involves a *central processing executive* and two dependent components, the *visuo-spatial sketchpad* and the *phonological loop*, which permit the visual and phonological retention of the representations (Baddeley, 1986); the writing process includes three basic components: formulation, execution and monitoring, as can be seen in Figure 2.

The *formulation* component includes two processes, planning and translating. The *planning* process refers to goal-setting, the search for information in accordance with those goals, and the organization of the information retrieved. In turn, the *translating* process permits the transformation of these ideas into linguistic structures.

The *execution* component includes *programming* or motor generation of the result of the translation process, and its actual *execution* or graphic expression.

Finally, the *monitoring* component includes two processes. The first of these is text *reading*, which permits the writer to re-read and verify the message during or after the generation of the text; the second process is that

of *editing*, which permits the detection and diagnosis of problems with a view to the subsequent production of a new version of the message once the problems have been solved.

In this model, in a similar way to that of Hayes and Flower (1996) and its more recent modified version (Hayes, 2006), there is indeed a monitoring process, framed within the general writing process, which controls and regulates the sequence of writing processes (Alamargot & Chanquoy, 2001). However, although its name, location and function are identical, the way it works is radically different, since the monitoring process in the Kellogg model is close to the review concept proposed by Hayes and Flower (1996), which could lead to some degree of confusion.In any case, this process would control, through text re-reading and editing, the activation of the necessary writing processes, either for continuing with the text or for modifying the text already written (Alamargot & Chanquoy, 2001).

At the same time, reference to the metacognitive dimension of regulation in this theoretical model can be found in the *central processing executive* component of working memory (Olive, Kellogg, & Piolat, 2008), which enables the model to be used in applied contexts, as a component of intervention in children with ADHD, who, as is well known, present deficiencies in their self-regulation processes; moreover, the inclusion of this dimension related to self-regulation makes it possible to support and develop instructional programmes for the improvement of written composition in children with ADHD, which, although emerging, are doing so only slowly (Reid & Lienemann, 2006). As more and more empirical progress is made, such programmes may come to have as much utility as many others focusing on the self-regulation of behaviours and other types of learning such as mathematics, in the case of children with ADHD (Reid, Trout, & Schartz, 2005).

This theoretical model is notable for certain characteristics of crucial importance for its contribution to the field of writing, namely, its more specific and applicable nature; compared to the previous model then, and in the context of writing and ADHD, it is more empirically testable. This applicability, in general, manifests itself in the field of ADHD, given the importance in the model's structure of working memory – a recognized problem and extremely important aspect in the conceptualization of this disorder – , enabling the development of subsequent empirical studies on the state of research.

Nevertheless, the relations between written composition and ADHD are reflected in other aspects of the model, such as the importance of two processes, planning and organization, with which the child with ADHD has clear problems, and that of the functioning of the central executive, also related to ADHD. Likewise, another notable aspect is monitoring, and more specifically text revision, given the potential for intervention in children with ADHD; this, indeed, justifies the discussion later on in this article of text revision models.

Finally, with regard to execution, the role of graphomotor skills is acknowledged as being of considerable importance in children with ADHD, as is the search for factors that help identify the fine motor function problems of these children when faced with writing tasks, problems which lead to their writing being less legible, with poorer organization and spatial structuring (Adi-Japha et al., 2007; Tucha & Klaus, 2004).

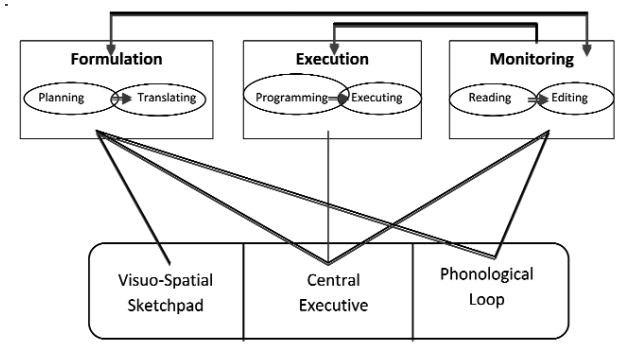
SPECIFIC MODELS OF WRITTEN TEXT REVISION

Having reviewed writing models in general, it would seem appropriate to look at some specific models of text revision, with the aim of understanding in more detail both this process and its relationship with ADHD and LDs in writing. Therefore, we shall attempt to situate specific models of text revision theoretically and consider them in relation to ADHD. Likewise, these models will help us to draw conclusions about intervention in writing contexts.

The Scardamalia and Bereiter model (1985)

The utility of revision as a form of instruction in writing can be clearly seen through Scardamalia and Bereiter's model, given that these authors proposed a technical

FIGURE 2
KELLOGG'S MODEL (1996)
(adapted from Alamargot and Chanquoy, 2001, pp.,19)



procedure of text revision that is easy to teach to writers, and more specifically to writers not given to spontaneous revision.

This revision process is presumably not employed by students with ADHD, for example, and can be of use to them, if correctly taught, to improve their texts. This is especially true when the training and functioning of the revision process takes place in the context of a self-regulation procedure made up of three recursive mental operations, which can be linked together so that they interact throughout the period of revision. The cognitive operations involved in revision are comparing, diagnosing and operating, giving rise to the *CDO procedure* (compare, diagnose, operate) (Arias & García, 2008).

According to their general model of writing (Bereiter & Scardamalia, 1987), two mental representations of the text are constructed and stored in long-term memory, one of the text as produced and the other of the text as desired, it being necessary to activate the *CDO procedure* when an imbalance is perceived between these two texts. The three basic operations of the *CDO procedure* are carried out in the following order: first, that of *comparing*, involving the evaluation of discrepancies between the two texts; second, that of *diagnosis*, to determine the nature of the problem and possible corrections; and finally, *operation* itself, involving execution of the desired corrections with the support of two further components: selection of the strategy necessary for resolving the problems, and generation of the changes in the text.

While the operations proposed in this model would be carried out automatically by any expert writer, in the child with ADHD these self-regulation processes are not activated, hence the importance of the work by Scardamalia and Bereiter (1985) in children affected by this developmental disorder.

And although the process could be considered more as a technique for facilitating text revision than as an explanatory model, the model can serve as a means of making explicit the revision operations and teaching them one by one, to then integrate them and facilitate the use and learning of this revision process, as a technique of exceptional importance, for example, in students with characteristics of ADHD. However, there are as yet no instructional studies that employ this strategy in children with ADHD, despite its apparently sound theoretical foundations (Rodríguez & García, 2006; Rodríguez et al., 2009).

Among the most significant contributions of this model is the fact that it offers precise definitions of the sub-processes involved in text revision, describing two sub-processes: text evaluation (comparing and diagnosing) and text modification, which in turn implies two actions (selection of the correction tactics and generation of changes in the text).

The Butterfield et al. model of text revision

The previous specific model of revision proposed instruction based on self-regulation. In this model of text revision, proposed by Butterfield, Hacker and Albertson (1996), three interactive components are distinguished: the environment and the cognitive and metacognitive system, as can be seen in Figure 3. The approach is reminiscent, then, of another of the forms of intervention most widely used in studies on ADHD: *cognitive-behavioural* treatments. Likewise, this is considered as a more modern version of the Hayes et al., (1987) writing model.

The *environment* component comprises both rhetorical and text-related problems. Space in the long-term memory, which relates rhetorical problems, permits specification of the topic, the audience and the amount of text to be revised. The *cognitive/metacognitive system* comprises working memory and long-term memory. Premeditated processing takes place in the working memory and corresponds to the stages proposed by Hayes et al., (1987): representation of rhetorical and textual problems, detection and diagnosis of problems in the text, and strategies for resolving the discrepancies detected. These steps are limited by the capacity of the working memory, so that where such capacity is limited or inefficiently or unstrategically used (as is the case in children with ADHD), problems may ensue in this revision process (Vanderberg & Swanson, 2007). Finally, long-term memory is used principally for freeing up working memory resources (Chanquoy, 2001).

At the *cognitive level* there are considerable demands, since it is necessary to retain, in relation to the revised text, not only knowledge but also strategies and representations, and this can pose difficulties for students with ADHD and LDs on attempting to revise text, leading sometimes to omission of the process, and hence to poorer quality writing. At this level three knowledge categories are described: topic knowledge, linguistic knowledge, which includes rules and their conventional use, and finally, knowledge of the writing process.

Evaluation strategies permit the writer to re-read problematic fragments, recall the previous text, make predictions about the possible future text and compare ideas, in the same way as control strategies allow the writer to summarize and/or clarify the textual information and correct the text. *Models of knowledge*, understanding of strategies and knowledge are situated at the metacognitive level of the text revision model. The understanding of strategies on the part of writers helps them to know when, where, how and why to use, evaluate and control cognitive strategies. In sum, evaluation and control are understood in this context as automatic processes stored in long-term memory (Alamargot & Chanquoy, 2001).

CONCLUSIONS

In this study we have presented a theoretical review of written composition and text revision, from the perspective of the principal theoretical models. In addition to summarizing these two constructs, we have considered possible connections between them and ADHD and their applicability to the study of this disorder. The resulting synthetic and comparative consideration has allowed us to identify, from different points of view, some relations between ADHD and written composition in general and text revision in particular.

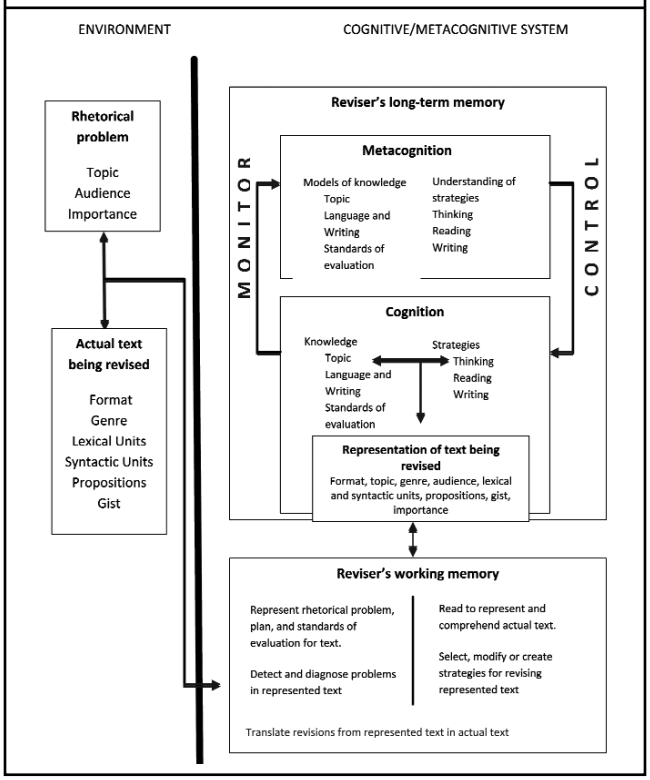
First of all, we can highlight the evolution of writing models, exemplified in the continual revisions of the Hayes model first presented in 1980, reformulated in 1996 and modified most recently in 2006. The latest version was published after the incorporation of new concepts and a revision of the aspects of most importance, and which, given research developments, have taken on increased relevance (Hayes, 2006).

One of the elements that has become more important in research, is prominent in this latest revision, and did not figure in Hayes' (1980) initial model is the role of working memory. This construct, at the same time as increasing its relevance from the point of view of written composition, is especially important in the conceptualization of ADHD and the difficulties associated with it; moreover, it plays some part in the most current theoretical model in ADHD, that of behavioural inhibition (Barkley, 2007).

Furthermore, and although from different points of view, Hayes' model addresses the metacognitive aspects and recursivity of the process, highlighting the importance of self-regulation in written composition. Bearing in mind the well-known significance of self-regulation in ADHD, we can identify here another link, of relevance in initiatives for the instruction of written composition, but on which the empirical research carried out so far has been scarcer than might be expected (Reid & Lienemann, 2006; Reid, Trout, & Schartz, 2005). Hayes himself, in his latest work, and in relation to writing instruction, highlights planning as an important strategy to be developed, and which is beneficial for students with ADHD, who are those least likely to plan their tasks and behaviour (Re, Pedron, & Cornoldi, 2007).

Finally, another of the links between written composition and ADHD provided by Hayes' model concerns the dimension of task environment and environmental factors, which take on such importance in the academic activities of children with ADHD, and should therefore be paid particular attention when those activities involve writing. Indeed, the task environment is highlighted by the author in his most recent revision, within the framework of activity theory (Hayes, 2006). Thus, in these recent annotations to his model, he stresses three aspects shown to be related to difficulties in children with ADHD:

FIGURE 3
BUTTERFIELD, HACKER & ALBERTSON'S REVISION MODEL (1996)
(Adapted from Alamargot & Chanquoy, 2001, pp.110)



working memory, task planning and environmental and contextual aspects.

The significance of working memory in Hayes' model is matched in the second of the models analyzed, that of Kellogg (1996), which incorporates the architecture of working memory, consolidating its theoretical importance in written composition and echoing the relevance it is given on the ADHD continuum (Olive, Kellogg, & Piolat, 2008; Presentación & Siegenthaler, 2005; Riccio, Homack, Jarratt, & Wolfe, 2006; Vanderberg & Swanson, 2007). However, the significance of this model in relation to ADHD goes one step further with the incorporation of the central executive as one of its components in the writing process, thus integrating it with information processing and the architecture of working memory (Olive, Favart, Beauvais, & Beauvais, 2009). The result is a model that is empirically testable, and which will play an essential part in future research.

We have also offered a brief analysis of two models of text revision, those of Scardamalia and Bereiter (1985) and Butterfield, Hacker and Albertson (1996). We mainly emphasize their importance, as regards instruction in written composition and their implications for future techniques and strategies, in the context of applications in ADHD.

Moreover, each one of the models is related to two of the proposals most widely adopted in ADHD intervention, self-regulation and cognitive-behavioural programmes. However, these theoretical relations do not translate at the present time into application initiatives for instruction in written composition with ADHD, despite the apparent implications, and future research should try to remedy this situation (García & Rodríguez, 2007; Rodríguez & García, 2007). The relations between models of writing and of text revision and the constructs currently considered essential in ADHD, such as working memory, attention, planning and self-regulation, are evident in all the models looked at here. Moreover, the revisions of these models have led to an increase in the importance of these constructs in empirical developments. It is logical, therefore, that the problems presented by children with ADHD become evident when they are faced with tasks of written composition (García, Rodríguez, Pacheco, & Diez, 2009).

Summarizing, and considering Barkley's theoretical model on ADHD, there emerge certain analogies and similarities with the writing models discussed here. It only remains to confirm the comorbidity between ADHD and LDs in writing processes, and to provide empirical evidence of it, even though further knowledge – from experimental studies and intervention initiatives – will be needed to understand its nature.

As far as future perspectives are concerned, research in this field should strive towards a comprehensive theoretical model that addresses both ADHD and LDs in the writing context, and which would serve as a sound theoretical basis on which to build testable empirical propositions, or at least approaches that can subsequently be validated, in a similar line to the work being done in relation to other academic competences, such as reading (Miranda, Soriano, & García, 2006; Presentation & Siegenthaler, 2005).

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