

Journal of Learning Disabilities

<http://ldx.sagepub.com/>

Spelling Errors in Text Copying by Children With Dyslexia and ADHD Symptoms

Anna Maria Re and Cesare Cornoldi

J Learn Disabil published online 6 June 2013

DOI: 10.1177/0022219413491287

The online version of this article can be found at:

<http://ldx.sagepub.com/content/early/2013/06/05/0022219413491287>

Published by:

Hammill Institute on Disabilities



and



<http://www.sagepublications.com>

Additional services and information for *Journal of Learning Disabilities* can be found at:

Email Alerts: <http://ldx.sagepub.com/cgi/alerts>

Subscriptions: <http://ldx.sagepub.com/subscriptions>

Reprints: <http://www.sagepub.com/journalsReprints.nav>

Permissions: <http://www.sagepub.com/journalsPermissions.nav>

>> [OnlineFirst Version of Record](#) - Jun 6, 2013

[What is This?](#)

Spelling Errors in Text Copying by Children With Dyslexia and ADHD Symptoms

Journal of Learning Disabilities
XX(X) 1–10
© Hammill Institute on Disabilities 2013
Reprints and permissions:
sagepub.com/journalsPermissions.nav
DOI: 10.1177/0022219413491287
journaloflearningdisabilities.sagepub.com


Anna Maria Re, PhD¹ and Cesare Cornoldi, PhD¹

Abstract

Spelling errors are usually studied in dictations, but teachers report that children with school difficulties often make spelling mistakes when they copy a text too. The present study examines the performance on a text copying task and a text dictation task of two groups of children known for their difficulties in spelling, that is, 22 with symptoms of ADHD and 13 with dyslexia, comparing them with matched controls to see whether children with spelling difficulties make more copying task errors than do controls, whether they make fewer mistakes when copying than when writing under dictation, and whether the pattern of errors remains the same or differs in copy and dictation tasks. Our results show that although children with spelling difficulties made fewer errors in the copying task than under dictation, they still made phonological errors and mistakes relating to accents and duplicates. The pattern of errors differed slightly between the children with dyslexia and those with ADHD, presumably as a consequence of their different underlying weaknesses—related mainly to phonology and orthographic representation in the case of dyslexia and to attentional control in the case of ADHD.

Keywords

ADHD, dyslexia, writing, copy task

Spelling errors under dictation or in text production are frequent in the earlier school grades, with higher rates among children with various learning difficulties. In particular, children with dyslexia very often have difficulty in writing as well as in reading. Their problems seem related to linguistic weaknesses that impair the literacy learning process. Weaknesses in phonological representations and lexical access make it difficult for children with dyslexia to develop an appropriate orthographic representation of the words to be written (Goswami, 1999).

Another group of children who seem to have spelling problems, for partly different reasons, are those with ADHD symptoms. Given the strong degree of comorbidity for ADHD and dyslexia, it could be argued that the spelling difficulties of children with ADHD are simply because they have dyslexia too. It seems, however, that children with ADHD but without dyslexia still tend to make more spelling errors than matched controls; for instance, in a series of studies on expressive writing skills of children with ADHD with no comorbid learning disorders, Re and coauthors (Re, 2006; Re & Cornoldi, 2010; Re, Pedron, & Cornoldi, 2007) found that children with ADHD made more mistakes when invited to produce new texts, but these errors tended to disappear when the children were trained to adopt specific controlled procedures during text production (Re, Caeran, & Cornoldi, 2008). This suggests that the spelling errors were not a result of orthographic weaknesses but rather of

the self-regulatory problems of children with ADHD. Spelling and its precursors were more specifically examined in a study by Kroese, Hynd, Knight, Hiemenz, and Hall (2000) on 78 children aged 8 to 12 years (34 with dyslexia, 31 with ADHD, and 13 typically developing controls) in a battery of tests including cognitive, linguistic, academic, phonemic awareness, and memory tests. Their results showed that the performance of children with dyslexia was significantly worse in the phonological tasks than the performance of the other two groups, which did not differ significantly. The ADHD group's spelling performance was intermediate between that of the dyslexic and control groups; that is, they made fewer mistakes than the children with dyslexia but more than the controls in some measures (*Wide Range Achievement Test* Spelling and Rating Scale total score), suggesting that children with ADHD may be weak in spelling, but for partially different reasons than in the case of children with dyslexia. Spelling difficulties were also identified in two more recent studies. In one, focused on handwriting, Adi-Jafa and collaborators (2007) found that children with ADHD made more spelling mistakes than

¹University of Padova, Padova, Italy

Corresponding Author:

Anna Maria Re, Developmental Psychology Department, University of Padova, Via Venezia 8, Padova, 35131, Italy.
Email: annamaria.re@unipd.it

did controls and their handwriting was more frequently illegible. The children with ADHD were more likely than controls to make mistakes that involved inserting superfluous letters and omitting, substituting, or transposing letters. According to the authors, this pattern of errors stems more from their attentional problems than from any linguistic or phonological issues.

In the other study, Johnels, Kopp, and Gillberg (2012) related behavioral, psycholinguistic, cognitive (memory/executive), and graphomotor measures to spelling skills in school-age girls with ADHD ($n = 30$) and an age-matched group with typical development ($n = 35$). The ADHD group was divided into two subgroups that were comparable in terms of their inattentive or hyperactive-impulsive symptoms, but differed in spelling; that is, one group had poor spelling performance (ADHDPSP, $n = 19$), whereas the other had a typical spelling performance (ADHDTYSP, $n = 11$). The authors found that both ADHD subgroups had equally severe difficulties in graphomotor control–handwriting and in written expression by comparison with the control group. On the other hand, the ADHD subgroup with spelling difficulties had more problems with phonological and orthographic recoding and verbal memory, and were more likely to make commission errors in a continuous performance task (CPT) than controls or the ADHD subgroup with a normal spelling performance. Further analyses on the collapsed ADHD group showed that both digit span and the presence of CPT commissions predicted spelling performance independently of each other. Finally, there was evidence of phonological recoding skills mediating the association between digit span and spelling performance in ADHD. In short, this study shed some important light on the spelling difficulties of children with ADHD, but its findings cannot be generalized because of some limitations. In fact, the sample was very specific and not representative of the ADHD population, a choice task was used to test phonological skills, a questionnaire was administered to the parents to obtain details about the children’s written expression, and information was lacking on the possibility of the ADHDPSP group also having dyslexia.

To sum up, there is some evidence of children with ADHD having spelling problems, and of their problems differing from the spelling problems experienced by children with dyslexia, but further and more in-depth studies are needed, using different tasks, groups, and analytical methods. In particular, concerning the differentiation between children with ADHD and other groups of children presenting difficulties in spelling, the specific consideration of the patterns of errors may be useful. In fact, in the analysis of spelling errors, it seems important to also consider the types of errors made by the child.

Spelling is a multilinguistic skill, and as such it takes several linguistic abilities to accurately produce written words. That is why many distinctions have been proposed

for spelling errors (see, e.g., Ehri, 1986; Frith, 1985; Treiman, 2000), mainly based on developmental models of the acquisition of reading and writing competence. For example, Ehri (1986, 1995) developed a stage theory of reading and writing development, suggesting that children go through a series of qualitatively different stages as they are learning to spell. The earliest spellings bear no relationship to the sounds in the intended word and have been called prealphabetic (*precommunicative*; Gentry, 1982). *Semiphonetic* or *partial alphabetic* spellings represent some of the phonemes in the word (e.g., “l” for *elephant*). *Phonetic* or *full alphabetic* (e.g., “elefut” for *elephant*, “chran” for *train*) provide a more complete representation and may capture certain features of the pronunciation that are ignored in conventional English spelling (Ehri, 1986; Gentry, 1982). During the *morphemic* or *consolidated alphabetic* stage, children increasingly rely on visual and morphological information (e.g., spelling *eighty* as “eightee” instead of the phonetic “ate”), revealing a type of preference that cannot be the object of observation in transparent languages, like Italian.

A classification of writing errors widely accepted in Italy and particularly appropriate when the body of errors is relatively small is based on the distinction between phonological and nonphonological errors (see Tressoldi & Cornoldi, 2000). This classification is based on Frith’s (1985) classical model for learning to read and write, which involves a series of learning stages, some of which are associated with specific types of spelling error. In the first stage, called *logographic*, a child can only associate a particular graphic configuration with a certain concept. In the second stage, called *alphabetic*, a child discovers the concept of phonemes and learns to associate every phoneme with its particular graphic sign pattern. In this stage, errors are of the phonological type because of the incorrect association between a grapheme and the corresponding phoneme. In the third stage, called *orthographic*, a child learns that writing is governed by syntactic and orthographic rules, and no longer works with phonemes but with syllables or other sublexical units, so the writing process becomes more rapid and correct. In the fourth stage, children learn specific lexical entries and are able to read and write words that do not follow the phonological rules (typical writing errors in Italian are represented by illegal fusions and separations). Finally, Tressoldi and Cornoldi (2000) described a fifth stage for Italian spelling requiring a lexicon-based refinement of lexical and phonological analysis, in which the main difficulties are represented by the proper use of last-syllable accents and geminate consonants. Miceli, Benvegnù, Capasso, and Caramazza (1995) have also produced evidence of a specific writing disorder relating to double letters and their consequent autonomous representation in Italian. At this stage, the selection of phonemes and graphemes may be appropriate but overlook details

regarding longer-lasting phonemes (requiring the use of double letters in Italian, as in *correre*, to run) or an accent (which is required only when the accent is on the last syllable in Italian). In sum, the most used classification of spelling mistakes in Italian distinguishes between only three types of error, offering the advantage of providing basic information that can be used in quantitative analyses on a limited amount of written material. The first type of error is *phonological*, where the written string of words sounds different from the one pronounced (e.g., “il bane” rather than “il pane”). The second type of error is *nonphonological*, where the written string of words is incorrect but sounds like the one pronounced (e.g., “ilpane” instead of “il pane”). Concerning this type of error, it is important to bear in mind that although there are many opportunities for making nonphonological errors in opaque languages, the range of nonphonological errors is more limited in such highly transparent languages as Italian. Examples of possible nonphonological errors include splitting a word into two, combining two words into one, and errors in the use of “h” (in Italian, “anno” [year] and “hanno” [they have] are pronounced in the same way) or “q” (in Italian the initial sounds for “quota” and “cuore” are identical). The third type is the error of *refinement* and concerns an appropriate selection of graphemes associated with inappropriate usage of accents and double consonants (e.g., *girafa* for *giraffa*, or *citta* for *città*); these errors take longer to disappear than the other types of error, and they are frequently seen in the case of children with ADHD (Re, 2006; Re et al., 2007).

As already mentioned, literature and assessment procedures have focused mainly on the use of dictation and text production tasks, both of which have some limitations. Dictation may be affected by prosody, dialectal influences, and dictating speed, a problem that seems particularly critical in areas where children and teachers (or other people dictating a text) do not share the same linguistic origins. To give an example, in northern Italian schools, attended mainly by children from northern Italian families and foreign children, a large proportion of teachers come from southern Italy (where it is more difficult to find a teaching post), and the risk of linguistic misunderstandings (and spelling errors because of differences in pronunciation between the north and south of the country) has often been mentioned by northern communities and politicians (Pasolini, 2011). On the other hand, analyses on spelling errors in free text production may be biased by the children’s choice of words; that is, children might try to conceal their weakness in spelling by using only simple, well-known words.

Recently, Tressoldi, Cornoldi, and Re (2012) suggested that the difficulties inherent in procedures relying on dictation and text production could be overcome by adding a new standardized procedure requiring that children copy as many words as possible from a complex text within a

limited amount of time. Using a copy task seemed not only to avoid the above-mentioned difficulties but also to provide a direct measure of the children’s ability to comply with a typical requirement at school, as when they have to copy from the blackboard. Copying a text is an activity that involves a number of cognitive processes. According to the literature (see Adi-Jafa et al., 2007; Tressoldi et al., 2012), copying a text requires that a word be read, memorized in the phonological buffer, and associated with its lexical representation (if possible), and then with its orthographic representation. More specifically, copying involves reading, retrieving orthographic representations from long-term memory, using working memory (to retain the words in short-term memory and check the orthographic representations on the basis of their written forms), controlling attention, and writing operations. Children can make mistakes because they did not precisely match the words letter by letter or because of an erroneous orthographic representation of the word. In the copy task proposed by Tressoldi and coauthors (2012), the conditions for ensuring a precise match letter by letter are limited because the children are asked to proceed as quickly as possible and have only 5 minutes to complete the task.

Writing under dictation involves partly different processes. First of all, children start by listening to (not reading) a word, so auditory discrimination and phonemic analysis are fundamental in the first step of writing under dictation. Then the children cannot find any external support, as in the copy task, but must rely only on their phonological trace and on long-term memory representations. Children have two main options: They can use phoneme-grapheme conversion (used especially by children who are not expert writers, or when writing new words or pseudo-words), or they can draw from a memorized lexicon of ready-to-use orthographic representations of commonly encountered words (Adi-Jafa et al., 2007).

Thus, although dictation is the most widely used procedure for assessing spelling performance, including the copy subtest suggested by Tressoldi and collaborators (2012) in a writing battery may generate important, specific information. Tressoldi and collaborators validated their procedure by demonstrating that the rate of spelling errors in the copy task gradually declines with training (also see Candela, Cornoldi, & Re, 2012; Parker, McMaster, Medhanie, & Silberglitt, 2011). On the other hand, Tressoldi and coauthors (2012) did not clearly demonstrate that a copy task can identify the difficulties encountered by children known to have spelling weaknesses. In fact, to date, the literature has never examined copy task errors in children with spelling difficulties, and there is a paucity of data on the fact that some children make spelling mistakes even when copying a text.

The present study aimed to fill this gap by administering a copy task to children known to have spelling difficulties,

that is, children with dyslexia or ADHD. The first question to answer was whether such children make more spelling errors on a copy task than do controls. The second was whether, in general, children make fewer spelling errors when copying than when writing under dictation; and a related third question was whether the pattern of their spelling errors differs between copying and writing under dictation. These second and third questions were examined in general, comparing controls to children typically liable to spelling errors (i.e., children with dyslexia and ADHD), and also in a specific comparison between the dyslexic subgroup and the children with ADHD. We predicted that the copy task would generally reduce, but not eliminate, group differences in spelling errors, and more specifically that the copy task would affect children with dyslexia and those with ADHD in different ways. In fact, copying a text is a complex task (Lambert, Alamargot, Larocque, & Caporossi, 2011; Tressoldi et al., 2012) involving not only linguistic and phonological processes, such as reading, retrieving orthographic representations from long-term memory, and retaining them in short-term memory, but also attentional processes, such as checking the orthographic representations on the basis of their written forms and maintaining attentional control during the task. Since children with dyslexia and those with ADHD make spelling errors for different reasons (relating mainly to matters of orthographic representation in the former and to distractibility in the latter), the two groups might also be facilitated in different ways by the availability of the text in the copy task, and the resulting pattern of errors could be different. In particular, children with dyslexia could have more difficulty in reading the text and retrieving the correct orthographic representations, but partly overcome these difficulties by means of an accurate control over how a word is written in the text. This facilitation should be particularly evident in the case of material related with nonphonological errors.

Method

Participants

From a large group of 393 pupils attending state schools in the Veneto region of northeastern Italy (Vicenza), 35 children with spelling problems and 35 typically developing controls matched for schooling, age, and estimated IQ were selected on the basis of their school records and their teachers' rating scales. Particular school policies meant that boys were overrepresented in the group of children with spelling difficulties, and the control group also included more boys than girls. The schools were located in the suburbs of Vicenza (Castelgomberto and Poiana Maggiore), where most of the residents are white families employed in the public sector and in industry. All the children came from families whose first language was Italian. The children with

spelling problems formed two subgroups, one of 13 children with a diagnosis of dyslexia, the other comprising 22 children with symptoms of ADHD.

The children with dyslexia had been diagnosed by qualified psychiatrists or clinical psychologists according to the fourth edition text revision of the *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR)*; American Psychiatric Association [APA], 2000). There are no standard procedures for assessing and diagnosing ADHD in Italy, and this condition is still the object of debate, so only some of the children with symptoms of ADHD had been formally diagnosed as having ADHD, whereas others were included in the ADHD group by their teachers and a school psychologist when observation, family reports, and a teacher's rating scale consistently pointed to the presence of ADHD symptoms. In particular, all such children had to meet the diagnostic criteria for ADHD in a *DSM-IV* ADHD symptom checklist called the *SDAI Rating Scale (Scala per i Disturbi di Attenzione/Iperattività per Insegnanti)*; Marzocchi, Re, & Cornoldi, 2010). The *SDAI Rating Scale* is one of the scales most often used in Italy for identifying children with ADHD. It involves teachers rating the child's frequency and intensity of the nine symptoms of inattention and the nine symptoms of hyperactivity/impulsivity described in the *DSM-IV-TR* (APA, 2000) on a 4-point scale from 0 (*no problem*) to 3 (*severe problems*). The interrater reliability of the *SDAI Rating Scale* is $r = .80$ for the Inattention subscale and $r = .74$ for the Hyperactivity-Impulsivity subscale. The test-retest reliabilities are $r = .83$ and $r = .81$ for Inattention and Hyperactivity-Impulsivity, respectively (Marzocchi et al., 2010). For each subscale, the cutoff is at 14 points. All the children included in the ADHD group scored above the cutoff on at least one scale (Inattention or Hyperactivity-Impulsivity). More specifically, 11 children had mainly attentional symptoms, 3 had mainly hyperactive symptoms, and 8 were of the combined type. None of the children in the ADHD group had learning disorders.

Teachers were interviewed to confirm the characteristics of the groups and also asked to rate any general cognitive and learning difficulties, oppositional and aggressive behavior, and anxiety and depressive behavior on a scale of 0 to 3, using the *COM Comorbidity Scale*, which has the same format as the *SDAI Rating Scale* and has also revealed good psychometric properties (e.g., an interrater reliability of $r = .97$; Marzocchi et al., 2010). To exclude the possibility that a spelling problem could be the result of an associated condition rather than to ADHD, a small group of children with such problems were excluded from consideration. Other exclusion criteria were IQ scores of less than 85; the use of medication; a previous diagnosis of a learning disorder, or a suspected math and reading disorder in children with ADHD, or symptoms of ADHD in children with dyslexia; a history of neurological disorders, sensory problems, motor impairments, or any neurodevelopmental disorder other than

Table 1. Characteristics of the Groups: Gender and Mean Age, Spatial IQ, Inattention, Hyperactivity, Reading Scores, and Results of the Student's *t* Test Comparisons Among Groups.

	Controls (32 males, 3 females)		School Difficulty (32 males, 3 females)		<i>t</i> (<i>df</i> = 68)	ADHD (20 males, 2 females)		Dyslexia (12 males, 1 female)		<i>t</i> (<i>df</i> = 33)
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Age (months)	113.77	9.75	113.69	9.47	0.037	114.09	8.28	113	11.53	0.32
IQ (<i>PMA</i> spatial)	118.83	15.85	112.23	15.16	1.78	113.18	12.32	110.61	19.51	0.48
<i>SDAI Rating Scale</i> Inattention	0.94	2.14	14.31	5.5	13.39***	16.91	4.36	9.92	4.41	4.56**
<i>SDAI Rating Scale</i> Hyperactivity-Impulsivity	1.4	2.85	9.31	8.99	4.91***	12.41	9.7	4.08	4.23	2.93**
Reading	37.63	9.5	32.03	11.06	2.72*	35.86	10.27	25.54	9.5	2.96**

p* < .05. *p* < .01. ****p* < .001.

ADHD or dyslexia; and *DSM-IV-TR* criteria for major depression, anxiety, bipolar disorder, psychotic disorder, or mood disorder. To further check the children's reading and intellectual levels, we assessed their reading skills with a lexical decision test (*Prova di decisione lessicale*; Caldarola, Perini, & Cornoldi, 2012), consisting of silently reading a list of words and nonwords and identifying the words as rapidly as possible. We assessed intellectual abilities by administering part of the *PMA* 2 to 4 and 4 to 6 Spatial Reasoning subscales (Thurstone & Thurstone, 1963/1981), which involved finding which one of four different figures could produce a square when combined with a given model, within an allotted time. From the Italian standardization of the *PMA*, we derived a measure of IQ that can be considered only as an approximate estimation because only one subtest was used. Table 1 provides details on the groups.

Tasks and Procedure

For the writing assessment, we adapted two specific tasks included in the *Battery for the Assessment of Writing Skills in Children Between 7 and 13* (Tressoldi et al., 2012), that is, Text Dictation and Text Copy. Based on the text used in the copy task, "Libertà linguistiche e scioglilingua," which presents several orthographic difficulties, we built two equally difficult texts, "Il cuoco" (the cook) and "Il Capitano" (the captain), with the same number of words (103) and similar word characteristics and syntactic complexity. One text was dictated, the other had to be copied.

In the dictation task, the experimenter (who had a local accent and had been trained to dictate clearly and slowly) dictated the text normally, as in a routine classroom dictation. The children were told that if they did not understand a word or forgot a word, they were to skip the missing word and go on, keeping up with the rhythm of the dictation. In the copy task, each child received a sheet of paper with the text and had to copy as many words as possible correctly in 5 minutes. The experimenter stressed the importance of proceeding quickly because the score considered both accuracy and the number of words copied.

In both tasks, the children used their own pens and a page of the workbook they typically used at school. All the tasks were administered at school, to small groups of children in their own classrooms, during a session lasting about an hour.

All children were administered both writing tasks. The order in which the tasks (copy and dictation) were presented and the choice of text to be dictated or copied were balanced across participants.

Results

The procedure recommended in the test manual (Tressoldi et al., 2012) was used to score the children's productions. We computed the total number of spelling errors and then distinguished among three different kinds of error, according to the classification in the manual:

- Phonological errors, where reading the written word would produce a different phonological result from the real word
- Nonphonological errors, where reading the written word would produce the same sound as the real word
- Third category (or refinement) errors, where the right sequence of letters is written, but there are errors relating to double letters or accents on the last vowel

As the amount of written material differed from one participant to another, both for the dictation (because of words being skipped) and for the text copy task, we computed the overall percentage of errors for each child, and the percentages of the three types of error in relation to the total number of words written by each child.

Data Analysis

The analysis of our results is divided into two parts. First we compared the control group to the overall group of children with spelling difficulties to see to what extent these

Table 2. Mean Percentages and Standard Deviations of Errors in the Dictation and Copy Tasks and Student's *t* Test and Mann–Whitney *U* Comparisons Between Controls and Children With Spelling Difficulties.

	Control		Spelling Difficulties		<i>t</i> (<i>df</i> = 68)	<i>p</i>	<i>U</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
Dictation								
% total errors	6.68	3.85	19.02	10.81	6.36	< .001	134.5	< .001
Copy								
% total errors	2.66	2.65	5.12	4.34	2.85	< .01	361.5	.003

Table 3. Mean Percentages and Standard Deviations and Student's *t* Test and Mann–Whitney *U* Comparisons Between Controls and Children With Spelling Difficulties for the Different Types of Errors in the Dictation and Copy Tasks.

	Controls		Spelling Difficulties		<i>t</i> (<i>df</i> = 68)	<i>p</i>	<i>U</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
Dictation								
% phonological errors	2.65	1.89	7.2	3.64	6.54	< .001	134.5	< .001
% nonphonological errors	1.93	1.25	3.68	2.37	3.86	< .001	320	.001
% third category	0.61	0.92	4.2	3.73	5.5	< .001	154.5	< .001
Copy								
% phonological errors	1.79	2.1	2.98	3.02	1.91	.060	440	< .05
% nonphonological errors	0.57	1.11	0.59	1.07	0.93	> .05	610	> .05
% third category	0.27	0.58	1.37	1.92	3.26	.002	384	< .01

difficulties existed in a copy task too. Then we examined the two subgroups of children with spelling difficulties separately to see if any different patterns emerged. General analyses were conducted using ANOVA, and specific comparisons were drawn with Student's *t* test, with an alpha of .05, but the tables also show the actual probabilities to allow for multiple comparisons.

Comparison Between Children With Spelling Difficulties and Controls

Table 2 shows the percentage of errors in the total set of words written by the two groups in the copy and dictation tasks. The values are necessarily small because the percentage of errors was calculated on the total word count (including simple words such as articles, prepositions, and so on, where the likelihood of making a spelling mistake was very low); the measures were discriminatory nonetheless, as revealed by a 2×2 ANOVA (groups \times types of task). In fact, our first question was whether the group with spelling difficulties made more mistakes than controls, and this was the case, $F(1, 68) = 43.65, p < .001, \eta_p^2 = .39$; this was true in general, but also in the specific case of the copy task, $t(68) = 2.85, p < .01$. Our second question was whether fewer errors are made in a copy task than under dictation. Here again, this assumption was confirmed as the ANOVA showed a significant main effect of the type of writing task: $F(1, 68) = 80.44, p < .001, \eta_p^2 = .54$. It is worth noting that

children with spelling difficulties were particularly facilitated in the copy task by having the text in front of them, so there was a greater reduction in the proportion of spelling mistakes they made with respect to the dictation, as shown by the interaction between groups and tasks: $F(1, 68) = 24.47, p < .001, \eta_p^2 = .26$ (see Table 2).

We also examined whether the differences between the spelling difficulties and control groups varied in terms of the types of error made in the two writing tasks. This comparison should be considered with caution because the percentages of spelling errors were very low in some cases. We decided to analyze the error data nonetheless and report them here because they provide some interesting information on an area in need of some preliminary evidence. As shown in Table 3, more errors were made under dictation and the two groups differed significantly in all types of error; in the copy task, on the other hand, the differences were smaller and remained significant only in the case of the third (refinement) type of error, whereas there were only slight differences in the case of phonological errors and the differences disappeared in the case of nonphonological errors, which occurred in very small percentages.

Given the properties of the distributions, we also conducted an analysis treating the data as nonparametric (see Tables 2 and 3, rightmost columns), which replicated the results obtained with the parametric analyses and made the group differences in terms of nonphonological errors in the text copy task more evident.

Table 4. Mean Percentages and Standard Deviations of Errors in the Dictation and Copy Tasks and Student's *t* Test and Mann–Whitney *U* Comparisons Between Children With ADHD and Those With Dyslexia.

	ADHD		Dyslexia		<i>t</i> (<i>df</i> = 33)	<i>p</i>	<i>U</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
Dictation								
% total errors	14.48	6.24	26.71	12.7	3.82	.001	57.5	< .01
Copy								
% total errors	4.34	3.48	6.43	5.4	1.39	> .05	121.5	> .05

Table 5. Mean Percentages and Standard Deviations and Student's *t* Test and Mann–Whitney *U* Comparisons Between Children With ADHD and Those With Dyslexia on the Types of Errors in Dictation and Copy Tasks.

	ADHD		Dyslexic		<i>t</i> (<i>df</i> = 33)	<i>p</i>	<i>U</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>				
Dictation								
% phonological errors	5.83	2.59	9.51	4.07	3.28	< .01	60	< .01
% nonphonological errors	2.58	1.37	5.54	2.57	4.45	< .001	38.5	< .001
% third category	2.75	2.35	6.66	4.39	3.44	< .01	57.5	< .01
Copy								
% phonological errors	2.29	2.34	4.15	3.74	1.82	.078	111.5	> .05
% nonphonological errors	0.56	1.1	0.65	1.07	0.25	> .05	134	> .05
% third category	1.27	1.34	1.56	2.69	0.42	> .05	125	> .05

Comparisons Between Children With Dyslexia and Children With ADHD

We repeated the analyses dividing the group of children with spelling difficulties in two subgroups. We first compared these two groups and also the controls, and then only the two groups with spelling difficulties. A preliminary omnibus $3 \times 3 \times 2$ (group \times type of error \times task) ANOVA on the number of errors confirmed a main effect of task, $F(3, 65) = 56.63, p < .001, \eta^2 = .72$, and showed a main effect of groups, $F(3, 65) = 10.86, p < .001, \eta^2 = .33$, as well as a significant interaction between groups and task, $F(3, 65) = 8.56, p < .001, \eta^2 = .28$.

To further clarify the specific differences between the two clinical subgroups, we drew further comparisons on these two groups alone. A 2×2 (task \times subgroup) ANOVA showed a significant main effect of task: $F(1, 33) = 74.86, p < .001, \eta^2 = .69$. We also found a significant main effect of subgroup, $F(1, 33) = 16.29, p < .001, \eta^2 = .33$, with the dyslexic subgroup making more mistakes than the ADHD subgroup, as well as a significant interaction, $F(1, 33) = 8.32, p < .01, \eta^2 = .20$, resulting from the stronger facilitation effect of the copy task for the children with dyslexia. Table 4 shows the error percentages for the two groups and the results of the group comparisons for the two tasks. The difference was significant for dictation, but not at all significant for the copy task.

The degree to which the children with dyslexia were facilitated by the copy task, by comparison with the other groups, differed slightly according to the type of error (see Table 5). Although the dyslexics made more mistakes under dictation than the children with ADHD for all types of error, no significant differences emerged in the copy task; there was only a tendency for them to make more phonological errors. The rightmost columns of Tables 4 and 5 show the results of the nonparametric analyses, which substantially replicated the results of the parametric analyses.

The discriminatory power of the copy task was further supported when the controls were compared with the two spelling difficulty groups separately. Considering the copy task alone, and comparing controls to children with ADHD and controls to children with dyslexics, the task was still discriminatory. We found significant differences for the total errors in both spelling difficulty groups, but with a different pattern of results in terms of the types of error: the ADHD group made significantly more “refinement” errors than did controls, $t(33) = 3.87, p < .001$, whereas the children with dyslexia made significantly more phonological, $t(33) = 2.76, p < .01$, and refinement errors than did controls, $t(33) = 2.71, p < .01$.

Given the limited number of errors involved, we could not carry out statistical analyses on other subtypes of errors. However, an examination of the protocols enabled us to identify other characteristics of the types of error made by

the children. For example, the analysis of the phonological errors revealed that the most common mistake involved one phoneme being replaced by another (54.51% of errors made under dictation were of this type, and 45.46% in the copy task), relating often to phonologically similar consonants (e.g., “*banchina*” for “*panchina*”). Sometimes phonemes were lost (e.g., “*scostata*” for “*scrostata*”), but this happened less often (33.55% of errors under dictation, 32.95% of those in the copy task) and mainly concerned the loss of a single phoneme. Phonemes were rarely added (e.g., “*salamoglia*” for “*salamoia*”), but this happened more when copying (11.94% of errors under dictation and 21.59% in the copy task). These error patterns were similar in the three groups, except that the ADHD group was more likely to lose phonemes (44.82%) than to make substitutions (34.48%) in the copy task. This result might reflect the tendency of children with ADHD to lose parts of words or even whole words when copying text.

Concerning the nonphonological errors, the children had more difficulty segmenting appropriately words (e.g., they wrote “*ogni qual volta*” for “*ogniquialvolta*”; 80.4%) than handling letters within a word (“*quoco*” for “*cuoco*”; 19.6%), and the three groups—with a lower—presented the same pattern of errors.

As for the last category of errors, we considered errors involving accents and double consonants separately and found the latter (65.35%) more common than the former (34.21%). This result is attributable mainly to the children with spelling difficulties, whose errors mainly involved double letters (77.96% for dyslexics and 54.04% for cases of ADHD). (For the nonphonological and refinement errors, we considered only the dictation task because too few of these types of error were made in the copy task.)

Number of Written Words Copied in the Copy Task

Finally, we counted the number of words copied within the allotted time and found a significant difference between the controls and the two groups with spelling difficulties, $t(68) = 3.28, p < .01$, suggesting that the larger number of mistakes made by the two clinical groups was not a result of a particular speed–accuracy trade-off. We found no significant difference between the ADHD and dyslexic groups, $t(33) = 0.91, p > .05$.

Conclusions

The present study is the first, to our knowledge, to examine the clinical implications of a text copying task and the patterns of spelling performance in typically developing children and in those with dyslexia and ADHD. In the study we first examined whether spelling performance improved when

children known to have spelling difficulties in dictation were administered a copy task. Our results confirmed that children were facilitated by having the correct spelling of the words available (as in the copy task), but the children with dyslexia and those with ADHD still both made significantly more mistakes than did the controls. On the other hand, the generally greater spelling difficulties under dictation of the children with dyslexia by comparison to the children with ADHD tended to disappear in the copy task, suggesting that it was easier for the dyslexics than for the ADHD group to focus the attention needed to check their spelling against the text available for consultation. The similarities between the two clinical groups were particularly evident for errors concerning duplicates and accents, where particular attention is needed to check whether the words include double letters or accents, confirming the finding reported by Re (2006; Re et al., 2007) that children with ADHD are not only generally weak in spelling even when they have no comorbid learning disorders, but they also encounter particular difficulties with this aspect of spelling. There tended to be a difference between the two clinical groups (albeit falling short of statistical significance) for phonological errors, presumably because the poor phonological performance of children with dyslexia prevented them from taking full advantage of having the text available during the copy task. It has been suggested (Tressoldi et al., 2012) that both the orthographic representation and the ability to retain the sequence of phonemes (which corresponds perfectly to the sequence of graphemes in Italian) are crucial when it comes to copying an orthographically complex word. As for the nonphonological errors, which mainly concern a few simple but crucial questions in Italian (e.g., word segmentation, use of an “h”), so the children may be well aware of the risk of error and pay particular attention, it is noteworthy that the copy task had a strong facilitation effect, substantially eliminating this type of error in both groups. This finding suggests that nearly all the children took advantage of being able to check the appropriate spelling when it came to these potential nonphonological errors, whereas they were less careful to check all the other parts of the text, where the risk of error was less obvious (given also the need to work at speed). This is consistent with the observation (see Goswami, 1999; Tressoldi et al., 2012) that, presented with certain crucial words, Italian children are aware that they might make a nonphonological error, even though they may not be able to decide between two different possible spellings.

An exploratory separation of the phonological errors into three different subcategories (losing, adding, and substituting phonemes) showed that the most common error involved one phoneme being replaced with another, followed by phonemes being lost, and last by phonemes

being added. As for the nonphonological errors, we found that children had more difficulty with splitting words and that children with dyslexia and ADHD tended to make more mistakes with double consonants than with accents. Further research on a larger body of written texts could shed more light on the different patterns of errors, by using more than one classification system and assessing more thoroughly how typically developing children and those with dyslexia or ADHD differ in terms of specific types of error. Working on a larger number of errors would also show whether some of the effects seen in the present study might be attributable to the low absolute values for some of the measures. In fact, given the limited number of participants tested and the small amount of written material administered to them in the present study, our findings need to be supported and generalized by further studies on children's copying skills. As the comorbidity of ADHD with other behavioral or emotional problems is very high, further research should also examine whether the same patterns of results can be found in children with ADHD who have also received other diagnoses in comorbidity. In any case, the fact that our group presented a specific ADHD profile gives the possibility of excluding that the observed pattern of results was a result of another associated condition, rather than an ADHD profile.

In conclusion, the present study showed that a text copy task can put in evidence specific difficulties met by groups known for their spelling difficulties and may contribute important, specific information. This result has a series of educational implications. First, concerning assessment, a copy task should be included in spelling batteries in circumstances where dictation is probably not enough to establish a child's spelling ability or when there is a specific interest in knowing children's text copying skills. Second, concerning school curricula, greater attention should be devoted to school activities requiring children to pay attention to the possibility of making errors even when copying a text. Third, concerning intervention for children with spelling difficulties, treatment should include, together with the classical activities (phonological exercises, writing under dictation, etc.), exercises of copying written material, especially for reducing the difficulties resulting from phonological errors, including accents and duplicates. As copying is more simple than writing under dictation, copy activities could precede dictation activities in the case of children with severe difficulties. Fourth, the intervention involving the use of copy tasks could be adapted to the specific characteristics of the children with spelling difficulty, for example focusing the attention of the children with dyslexia on the risk of phonological errors and focusing the attention of the ADHD children on the risk of errors with accents and duplicates.

Acknowledgment

We are grateful to Drs. V. Novello and S. Fabris, who collected the data reported in the present study.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

References

- Adi-Jafa, E., Landau, Y. E., Frenke, L., Teicher, M., Gross-Tsur, V., & Shalev, R. S. (2007). ADHD and dysgraphia: Underlying mechanisms. *Cortex*, *43*, 700–709.
- American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders* (4th ed., text revision). Washington, DC: Author.
- Caldarola, N., Perini, N., & Cornoldi, C. (2012). DLC: una prova di decisione lessicale per la valutazione collettiva delle abilità di lettura [DLC: Lexical decision test for the collective assessment of reading]. *Dislessia*, *9*, 93–108.
- Candela, M. A., Cornoldi, C., & Re, A. M. (2012). L'utilità di una prova di copia per individuare problemi di disortografia [The advantages of a text copy task for the assessment of spelling disorders]. *Dislessia*, *9*, 363–374.
- Ehri, L. C. (1986). Sources of difficulty in learning to spell and read. In M. L. Wolraich & D. Routh (Eds.), *Advances in developmental and behavioral pediatrics* (vol. 7, pp. 121–195). Greenwich, CT: JAI.
- Ehri, L. C. (1995). Phases of development in learning to read by sight. *Journal of Research in Reading*, *18*, 116–125.
- Frith, U. (1985). Beneath the surface of surface dyslexia. In J. C. Marshall, M. Coltheart & K. Patterson (Eds.), *Surface dyslexia and surface dysgraphia* (pp. 310–330). London, UK: Routledge.
- Gentry, J. R. (1982). An analysis of developmental spelling in GNYS AT WRK. *Reading Teacher*, *36*, 192–200.
- Goswami, U. (1999). The relationship between phonological awareness and orthographic representation in different orthographies. In M. Harris & G. Hatano (Eds.), *Learning to read and write: A cross-linguistic perspective* (pp. 134–156). Cambridge, UK: Cambridge University Press.
- Johnels, J. A., Kopp, S., & Gillberg, C. (2012). Spelling difficulties in school-aged girls with attention-deficit/hyperactivity disorder: Behavioral, psycholinguistic, cognitive, and graphomotor correlates. *Journal of Learning Disabilities*. Advance online publication. doi:10.177/0022219412467058
- Kroese, J. M., Hynd, G. W., Knight, D. F., Hiemenz, J. R., & Hall, J. (2000). Clinical appraisal of spelling ability and its relationship to phonemic awareness (blending, segmenting, elision,

- and reversal) phonological memory, and reading in reading disabled, ADHD, and normal children. *Reading and Writing*, 13, 105–131.
- Lambert, E., Alamargot, D., Larocque, D., & Caporossi, G. (2011). Dynamics of the spelling process during a copy task: Effects of regularity and frequency. *Canadian Journal of Experimental Psychology*, 65, 141–150.
- Marzocchi, G. M., Re, A. M., & Cornoldi, C. (2010). *BIA: Batteria per la valutazione dei bambini con deficit di attenzione/iperattività* [Battery for the assessment of children with attention-deficit/hyperactivity disorder]. Trento, Italy: Erickson.
- Miceli, G., Benvegnù, B., Capasso, R., & Caramazza, A. (1995). Selective deficit in processing double letters. *Cortex*, 31, 161–171.
- Parker, D. C., McMaster, K. L., Medhanie, A., & Silbergitt, B. (2011). Modeling early writing growth with curriculum-based measures. *School Psychology Quarterly*, 26, 290–304.
- Pasolini, C. (2011, June 15). Scuola, nuovo blitz della Lega: “Stop ai supplenti meridionali” [School, new Lega blitz: “No teachers from the south of Italy”]. *La Repubblica*. Retrieved from www.larepubblica.it
- Re, A. M. (2006). Disturbo da Deficit di Attenzione ed Iperattività ed abilità di scrittura [Attention-deficit/hyperactivity disorder and writing skills]. *Psicologia Clinica dello Sviluppo*, 1, 123–140.
- Re, A. M., Caeran, M., & Cornoldi, C. (2008). Improving expressive writing skills of children rated for ADHD symptoms. *Journal of Learning Disabilities*, 41(6), 535–544.
- Re, A. M., & Cornoldi, C. (2010). Expressive writing difficulties of ADHD children: When good declarative knowledge is not sufficient. *European Journal of Psychology of Education*, 25(3), 315–323.
- Re, A. M., Pedron, M., & Cornoldi, C. (2007). Expressive writing difficulties in children described by their teacher as exhibiting ADHD symptoms. *Journal of Learning Disabilities*, 40(3), 244–255.
- Thurstone, T. G., & Thurstone, L. L. (1963/1981). *Primary mental abilities* (Italian translation, 1981). Chicago, IL: Science Research Associates.
- Treiman, R. (2000). Children’s written and oral spelling. *Applied Psycholinguistics*, 21, 183–204.
- Tressoldi, P. E., & Cornoldi, C. (2000). *Batteria per la valutazione della scrittura e della competenza ortografica nella scuola dell’obbligo* [Battery for the assessment of writing skills of children from 7 to 13 years old]. Florence, Italy: Organizzazioni Speciali.
- Tressoldi, P. E., Cornoldi, C., & Re, A. M. (2012). *Batteria per la valutazione della scrittura e della competenza ortografica nella scuola dell’obbligo*. [Battery for the assessment of writing skills of children from 7 to 13 years old] (3rd ed.). Florence, Italy: Organizzazioni Speciali.