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French pupils' lexical and grammatical spelling from sixth to ninth grade: a longitudinal study

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6 **French pupils' lexical and grammatical spelling from sixth to**
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15 Short title: French pupils' spelling from sixth to ninth grade
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Abstract

This paper presents the results of a longitudinal spelling study conducted among 496 school children, from sixth grade (the first year of middle school in France) to ninth grade (the fourth and final year of middle school in France). Its first objective is to examine the evolution of both lexical and grammatical spelling skills in a deep orthography and to present new findings on the advanced mastery of spelling skills. Its second aim is to provide insight into pupils' orthographic knowledge and remaining difficulties at the end of French compulsory schooling. When students were sixth graders and when they were ninth graders, pupils were assessed using the same text dictation. The data show that both lexical and grammatical performance increased from sixth grade to ninth grade and that these interact with each other. The qualitative analysis of errors allows points of resistance in the acquisition of French orthography to be highlighted.

Highlights:

Both lexical and grammatical French orthography are complex and take a long time to be totally mastered.

French pupils continue to improve their spelling performance, both grammatical and lexical orthography, between sixth grade and ninth grade.

Lexical and grammatical spelling skills do not evolve independently of each other throughout secondary school.

Spelling problems connected to the specificities of the French writing system persist in ninth grade.

Introduction

Spelling proficiency is highly valued in society, while a “persistent myth of declining” has also existed throughout the French-speaking world for many years (Allal, 1997). Thus, teaching orthography continues to be a huge challenge both for schools and for research, in a society where reading and writing are required more than ever (Fayol & Jaffré, 2014). In France, although time spent in primary and secondary school learning spelling remains substantial, the poor spelling level of pupils and students is regularly pointed out.

Moreover, the few studies designed to analyze the evolution of French pupils’ spelling over time are alarmist. They emphasize that a worsening in students’ performances is mainly observed in the so-called grammatical field, especially the inflectional morphology, requiring grammatical skills. In French, using phoneme to grapheme correspondences and lexical knowledge (i.e., knowledge of the forms of the words we can find in a dictionary) is not enough to write correctly. Indeed, morphological markers which must often be added to the base form of a word are mostly silent. For instance, unlike in English, the plural mark “s” is almost always silent: the pronunciation of the word *dollar* does not change from the singular *dollar* to the plural *dollars*, both pronounced /dɔlar/. The pronunciations of *il joue* (he plays) and *ils jouent* (they play) of the verb *jouer* (to play) are the same, /ilʒu/. One of the conclusions of the study commissioned by the department for evaluation, planning and performance of the French ministry of education (*Direction de l'évaluation, de la prospective et de la performance*) in fifth grade was the significant increase in grammatical errors (e.g., omission of the “s” or the “ent” in a plural form) from 1987 to 2007 and from 2007 to 2015, regardless of gender or socio-cultural origin (Andreu & Steinmetz, MEN-DEPP, 2016).

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3 However, this increase was less pronounced for children from privileged social backgrounds
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5 and for children who had never repeated a grade.
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8 To our knowledge, only two cross-sectional studies give an overview of the
9
10 development of spelling skills of 11 to 15 years old students in French middle schools. In the
11
12 first one, Chervel and Manesse (1989) dictated to students a difficult literary text (a 17th
13
14 century text by Fénelon with complex morphosyntactic structures and unfamiliar
15
16 vocabulary) and they compared the results of students in 1987 with those of students of the
17
18 same age who took the same dictation exercise at the end of the 19th century. Manesse and
19
20 Cogis (2007) used the test in 2005, thus making it possible to compare the performances of
21
22 about 3000 students over time, that is from 1987 to 2005. In this cross-sectional study, the
23
24 authors demonstrated a clear increase in the number of grammatical errors over a 20 years
25
26 period, especially when a number agreement is required on an adjective or a verb, while
27
28 lexical performance remained stable. However, in 1987 and in 2005, the orthographic score
29
30 improved regularly from fifth to ninth grade. In 2005, the global enhancement between sixth
31
32 and ninth grade could be estimated at about ten percent, but the difference between the
33
34 improvements in grammatical performance and those in lexical performance was not
35
36 estimated. The second cross-sectional study was conducted by the *Direction de l'évaluation*
37
38 *et de la prospective* (DEP, 1996) in 1995 using dictation texts of the 1920s. The texts were
39
40 dictated to 12 to 14-year old students (sixth, seventh and eighth grade, first to third year of
41
42 middle school). Once again, the field of grammar was highlighted as a lingering problem in
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44 the eighth grade.
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54 In summary, both studies highlighted that the spelling ability of pupils in 2005 was
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56 worse than the performance of pupils of the same age 20 or 70 years prior to this date,
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58 although they always made regular progress from the beginning to the end of middle school.
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3 It should be noted that these assessments were carried out with a literary, not necessarily
4 easily understandable, text. This worsening in students' performances is such an educational
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8 issue in France that teaching grammatical spelling was more clearly than ever introduced in
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10
11 the recently published high school curriculum: "Spelling skills remain a constant concern in
12
13 high school" (French Ministry of Education, 2019, p. 7). Teachers are now explicitly required
14
15 to teach the agreements in the nominal group and between the verb and its subject, and to
16
17 do grammar lessons and grammatical analyses with students from 9th grade.

20
21 All in all, the social cost of the now proven decline in spelling skills and the fact that
22
23 spelling performance is a good predictor of the quality of the texts that students will be able
24
25 to produce in the future (Daffern et al., 2017) justify further studies on both lexical and
26
27 grammatical spelling performances by pupils in middle school in order to design well
28
29 targeted instructional models.

33
34 Unlike longitudinal studies, and despite their strong focus on spelling performance
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36 description, these cross-sectional studies do not help either to observe the evolution of
37
38 spelling skills of individuals over several years or to study the relation between lexical and
39
40 grammatical performance over the same period. To our knowledge, there is no longitudinal
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42 study available on French spelling performance during middle school attendance. To fill this
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44 gap, we conducted a longitudinal study. It consisted in having students take a dictation of
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46 the same text in their first year and then in their fourth year of middle school (sixth grade
47
48 and ninth grade) to observe spelling performance in a text similar to those written by the
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50 students on a daily basis, that is with accessible syntax and vocabulary. Notably, the text
51
52 used is not literary but it contains both lexical and grammatical French difficulties highlighted
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54 by previous studies (e.g., Lucci & Millet, 1994), and numerous plural items.
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3 Our purpose is to detail the evolution of spelling skills and difficulties in the French
4 language. First, this will begin with a short overview of French orthography and how it
5 works. A second part will be an overview of current knowledge on acquisition and on the
6 links between lexical and grammatical compounds. Finally, we will present our study.
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12 **1. Linguistic approach of the French spelling system**

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16 As many other alphabetic systems, French spelling is related to the spoken language
17 according to two main principles : the phonographic principle which allows the
18 correspondences between graphic units (graphemes) and oral units (phonemes) and the
19 semiographic one, enabling to use letters to represent significant forms (for instance the
20 plural). It is therefore a mixed system (Jaffré & Fayol , 2005).
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30 Nevertheless, French spelling has some peculiarities which make its acquisition
31 especially difficult and resulted in a non-transparent spelling, compared to other European
32 spellings such as the italian or the Spanish ones. Three of these peculiarities have to be
33 highlighted: 1) It is characterized by a high rate of polyvalence of graphemes; 2) it is
34 characterized as well by the presence of many non-phonographic graphemes (in link with
35 history or derivational morphology); 3) flexional morphology has specific features, it largely
36 uses a number of non-phonographic silent graphemes (e.g., “s” or “t”, marks of agreement
37 for the person, “e” for the gender, “s” or “nt” for the plural) and results in a lot of
38 homophonic forms, especially for the forms of verbs ending with /e/.
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53 **1.1. A high rate of polyvalence of graphemes**

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55 The alphabetic French writing system contains many phoneme-to-grapheme
56 correspondences. With about 30 phonemes matching more than 130 phonograms, there are
57 several ways to spell out many of them, especially vowels. For instance, /o/ can be written
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3 “o” (65%), “au” (22%) or “eau” (11%); /e/ can be spelled “é” (44%), “e” (29%), “er” (19%) or
4
5 “ai” (3.5%) (Peereman, Lété, & Sprenger-Charolles, 2007). Accents were introduced into the
6
7 French writing system to distinguish vocalic sounds which did not exist in Latin, but their
8
9 introduction did not prevent other graphemes, including digraphs or trigraphs, from being
10
11 used for the same phoneme.
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17 When several graphemes are possible, one is generally more frequent than the
18
19 others (“o” is overall the most common grapheme for /o/) but sometimes two graphemes
20
21 may be used with nearly the same frequency (e.g., “an” and “en” for /ã/, in *enfant-/ãfã/*
22
23 (child)). Moreover, depending either on the location in the word or on the grammatical
24
25 category, the frequency may vary: “eau” is the most common way of writing /o/ when
26
27 ending a word, and “é” is the most frequent end for /e/ in verbs. Conversely, some
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29 graphemes can be read in different ways. For example, “ent” is read /ã/ at the end of nouns
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31 or adverbs (e.g., *vent-/vã/* (wind)) but is silent at the end of verbs (present tense, sixth
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33 person (e.g., *ils suivent-/ilsujiv/* (they follow)). This leads to difficulties even in reading, but
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35 difficulties are far more important in spelling tasks.
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43 **1.2. Many non-phonographic graphemes**

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45 One of the important specificities of the French writing system is its graphemes with
46
47 no phonographic equivalent. These graphemes can be present at the beginning of a word
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49 (e.g., “h” initial in *hâte-/at/* (hast)) but they are usually found in word endings. These
50
51 graphemes may be related to etymology or history (the last two letters of *temps-/tã/* (time),
52
53 from Latin *tempus*). Sometimes the spelling of words has been changed for etymological
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55 reasons, as in *compte-/kõt/* (account), “m” and “p” being introduced to distinguish the word
56
57 from *conte-/kõt/* (a tale; both coming from Latin *computare*; Catach, 1995, p. 273; see
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3 Coulmas, 2003, for similar examples in English : e.g., French *dette*, from Latin *debitum*, and
4
5 *samon*, from Latin *salmonem*, modified in *debt* and *salmon* in order to reflect Latin spelling).
6
7
8 This does not mean that users make the link between the silent letter or grapheme and the
9
10 origin of the word, however. Some mute letters have been added by analogy; for example,
11
12 to enrich a word which could appear to be too short (Cazal & Parussa, 2015; see Walter,
13
14 2001, for examples in English).
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18 Some silent letters are in connection with derivational morphology and convey links
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20 with other words from the same family - the “t” from *chat*-/ʃa/ (cat) is present in *chatte*-/ʃat/
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22 (female cat) and *chaton*-/ʃatɔ̃/ (baby cat); the “t” from *petit*-/pəti/ (small) is present and
23
24 pronounced in *petite*-/pətit/ (small, feminine form) or *petitesse*-/pətitɛs/ (smallness). Silent
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26 letters may also be remnants of a former state of a language. For instance, the words
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28 *grammaire* or *année*, pronounced nearly everywhere today /ɡʁamɛʁ/ and /ane/, were once
29
30 pronounced /ɡrāmɛʁ/ and /āne/), the first “m” and “n” being used with the “a” to transcribe
31
32 the nasal vocalic phoneme /ã/. Pronunciation of these words changed with the so-called
33
34 denasalization phenomenon, whereas spelling did not.
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41 As a consequence, most French words cannot be written easily based only on
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43 phoneme-to-grapheme mappings (Véronis, 1988) and lexical knowledge is often required.
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45 The French writing system is recognized as a highly opaque (non-transparent) system, far
46
47 more complex in spelling than in reading (e.g., Ziegler, Jacobs, & Stone, 1996).
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51 **1.3. Specific features of French flexional morphology**

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55 One of the most important specific features of the French writing system lies in its
56
57 final silent grammatical letters which result from a morphological erosion process. In the
58
59 past, French was spoken by Germanic settlers whose accent weakened word endings (Jaffré
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3 & Fayol, 2006). French has a rich inflectional morphology, but the plural endings of nouns,
4
5 adjectives and verbs are no longer pronounced.
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8 **1.3.1. Silent nominal and adjectival plural marks**

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10 As we saw above, the "s" plural marker for nouns and adjectives is silent. Thus, the
11
12 singular and plural forms of nouns are usually homophones. The two forms of the noun *chat-*
13
14 /ʃa/ (cat, singular) and *chats-/ʃa/* (cats, plural, the "s" being inherited from Old French and its
15
16 two-case declension) are pronounced in exactly the same way. It is the same for the
17
18 adjective: for example, *agréable /agreabl/* (pleasant, singular) is pronounced like *agréables*
19
20 (plural). In contrast, in another Romance language, Italian, the plural is marked in both the
21
22 oral and the written form: *gatto-/gatto/* (cat) / *gatti-/gatti/* (cats).
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28 **1.3.2. Homophonic forms spelled in different ways**

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30 Verbs with an oral infinitive form ending with /e/ have 3 different written conjugated
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32 forms in the present tense which are pronounced in the same way. The verb *trouver-/truve/*
33
34 (to find) is an example: *je/elle/on trouve* (I find, she/one finds), *tu trouves* (you find), *ils/elles*
35
36 *trouvent* (they find) are all pronounced /truv/. Some verbs where the oral form of the
37
38 infinitive ends with /ʀ/ operate the same way, such as *cueillir-/kæjiʀ/* (to pick up) or *ouvrir-*
39
40 */uvriʀ/*(to open): *on/j'ouvre, tu ouvres, ils ouvrent* (one opens, I/you/they open), where all
41
42 three of them are pronounced /uvʀ/ (Martinet, 1979). This applies to many regular verbs.
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44 Furthermore, the verbal form can have a nominal homophone pronounced in the same way,
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46 both in their singular forms: *il juge* (he judges) / *le juge* (the judge) and in their plural forms:
47
48 *ils jugent* (they judge) / *les juges* (the judges) are all pronounced /ʒyʒ/. The singular forms
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50 can be spelled in different ways, although they are pronounced in the same way: *un appel* (a
51
52 call) and *il appelle* (he calls) both pronounced /apel/. The frequently used verb *voir* (to see)
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3 has two possible nominal homophones when conjugated in the present tense (*je vois, il voit,*
4 *ils voient*, all pronounced /vwa/): *voix-/vwa/* (voice) and *voie-/vwa/* (way), *voies-/vwa/*
5
6 (ways) in the plural form (see Bosman, de Graaff, & Gijssels, 2006, for comparable examples in
7
8 Dutch).

13 1.3.3. The /e/ and /ɛ/ verb endings puzzle

16 The other main difficulty in French is undoubtedly the spelling of /e/ and /ɛ/ verb
17
18 endings. Here, mastering basic letter-sound correspondences is not sufficient because of the
19
20 neutralization of the two vowels /e/ and /ɛ/, which tends today to be pronounced in a
21
22 similar way in most places in French-speaking countries (Brissaud, Negro, & Fisher, 2012).
23
24 There are no less than nine commonly used different spellings for /truve/: *trouver* (infinitive,
25
26 to find); *trouvé, trouvée, trouvées, trouvés* (past participle, found); *trouvais, trouvait,*
27
28 *trouvaient* (imperfect tense, 1st, 2nd, 3rd and 6th persons respectively, found); and *trouvez*
29
30 (present tense, 5th person, you find)ⁱⁱ. This generalized homophony is the result of historic
31
32 evolutions; for example, “er” and “ez” have been pronounced in the same way since the 16th
33
34 century, following the muting of final consonants (Pellat & Andrieux-Reix, 2006).
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40 Overall, in the French writing system morphemes definitely have something to do
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42 with spelling (Bryant, Deacon, & Nunes, 2006) and the difficulties related to inflectional
43
44 morphology are well identified-silent marks of agreement for the person, gender and plural;
45
46 verbo-nominal homophony and /e/-/ɛ/ endings. French is therefore a special case among the
47
48 writing systems of the world. It falls within the same category as English in the orthographic
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50 continuum of languages which ranges from the more phonographic to the more
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52 semiographic systems, albeit for different reasons.
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3 The specific linguistic characteristics of the French language we have just presented
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5 explain why both lexical and grammatical aspects must be assessed to obtain a general
6
7 overview of spelling skills.
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10 11 12 **2. Spelling development**

13 14 15 **2.1. From graphemes to morphology**

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17 A significant amount of work has been carried out on the acquisition of orthographic
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19 knowledge, in connection with reading, since the 1990s. The variety of types of knowledge
20
21 used when spelling stands out (Berninger, 1994). In all alphabetic systems, the first type
22
23 used is the knowledge of sound-to-letter correspondences that is the phonological
24
25 component (e.g., Sprenger-Charolles, Siegel, Béchenec, & Serniclaes, 2003). However, at
26
27 least in opaque systems like the French one, this knowledge is not sufficient and two other
28
29 categories of orthographic knowledge are also necessary to achieve proper spelling: lexical
30
31 knowledge (the knowledge that a certain word is written in a particular way, for instance
32
33 *femme-/fam/* (woman), *monsieur-/mæsjo/* (sir) or *enfant-/ãfã/* (child)) and grammatical
34
35 knowledge (corresponding in this paper to the inflectional part of morphology, i.e.,
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37 graphemes most of the time with no phonographic counterparts). However, acquiring these
38
39 two kinds of knowledge is a slow and difficult process for children.
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49 Children essentially acquire lexical orthographic knowledge through decoding and
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51 spelling activities. Thus, this acquisition depends on decoding skills (Share, 1995) and could
52
53 also be influenced by visual processing of written words (Bosse, Chaves, Largy, & Valdois,
54
55 2015). Some persistent orthographic difficulties are also clearly linked to linguistic
56
57 characteristics such as grapheme inconsistency. For example, Fayol, Grimaud and Jacquier
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3 (2013) observed that at the end of an intensive explicit teaching of lexical orthographic
4 patterns the hardest graphemes for second grade children to memorize were the **double**
5 **letters** and the phoneme /ã/ for which two graphemes (“an” and “en”) are used with
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9
10 approximately the same frequency.
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13 Applying the grammatical knowledge of syntax and morphology, especially
14 morphological regularities, is the other orthographic proficiency that is very hard and long to
15 acquire. As a matter of fact “the acquisition of grammatical skills requires abstract thinking
16 about the way language works and the corresponding graphic options available” (Jaffré &
17 Fayol, 2006, p. 85). The next sections will supply some elements about the complex
18 acquisition of grammatical knowledge, before highlighting the connection between different
19 kinds of orthographic knowledge during acquisition.
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31 ***2.2. Acquisition of French written morphology***

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35 Regarding morphology, French deserves particular attention in two areas falling
36 within the inflectional morphology: 1) number and gender marks (especially “s” for plural
37 nouns and adjectives, “nt” for plural verbs, “e” for most of the feminine adjectives) and 2)
38 homophonous /e/ verbal endings (e.g., “é”, “er”, and “ez”). The question is: how is the
39 gradual automatization of the agreement rules processed?
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47 **2.2.1. The acquisition of number and gender marks**

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50 In their review devoted to the acquisition of number agreement, Van Reybroeck and
51 Hupet (2012) grouped the work carried out into three sets of research: the establishment of
52 stages of development, the identification of various cognitive mechanisms supporting
53 learning, and the contribution of morphological, syntactic and semantic information to the
54 implementation of grammatical agreement.
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3 Regarding the first set, Totereau, Fayol, and Barrouillet (1998) suggested three stages
4
5 of development of the spelling of nominal and verbal numbers in French. **In the first stage,**
6
7 having been taught grapheme-to-phoneme rules, young children tend to omit the silent
8
9 plural ending and thus to make more spelling mistakes with plural than with singular words.
10
11 **In the second stage,** they understand the meaning of the “s” nominal mark for the plural, so
12
13 they use it for nouns and extend it to adjectives and verbs. **In the third stage,** they discover
14
15 and use “nt” for verbs with an overgeneralization for nouns. This developmental model was
16
17 established from the first to fifth grade but other studies showed that the use of plural
18
19 marks was not yet stabilized at the end of primary school attendance. According to
20
21 Alamargot et al. (2015), agreement is on the way to being automated in fifth grade but it is
22
23 only entirely automated by twelfth grade. Exploring the cognitive mechanisms at work when
24
25 spelling number agreement and the cognitive cost of mastering agreements in French, Largy,
26
27 Fayol and Lemaire (1996; see also Largy & Fayol, 2001) brought to light the variety of
28
29 resources and knowledge to be taken into account. This includes syntactical structures and
30
31 place of the verb. These authors showed that it is easier for adults to write a verb in the
32
33 plural when singular and plural forms differ in their pronunciation - (for instance: *ils*
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35 *finissent*-/ilfinis/ (they finish), the oral form of which is different from *il finit*-/ilfini/ (he
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37 finishes), is easier to write than *ils mangent*-/ilmãž/ (they eat) where the oral form is similar
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39 to *il mange*-/ilmãž/ (he eats)). But the age for the automation of agreement processes
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41 remains a vague notion and may be task-dependent.
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52 Concerning the acquisition of the gender mark “e”, there is a clear lack of data, but it
53
54 seems acquired neither at the end of primary schooling (Cogis & Brissaud, 2019) nor at the
55
56 end of middle school (Brissaud, 2015). Finally, there is an interesting debate about number
57
58 and gender agreements. Do the marks really result from a rule being processed, or are
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1
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3 words' singular and plural forms (or masculine vs. Feminine forms) treated as entirely
4
5 different words? Actually, specific and very frequent instances seem to be recovered from
6
7 memory, especially in young children (Cousin, Largy, & Fayol, 2002), but inflectional forms
8
9 mostly depend on syntactic context and high level grammatical skills seem to be mainly
10
11 related to knowledge of grammatical information (Nadeau & Fisher, 2009).
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14 15 **2.2.2. The acquisition of /e/-/ɛ/ verb endings**

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17
18 A cross-sectional study from third grade to eighth grade provides a developmental
19
20 view of /e/-/ɛ/ verb endings in French (Brissaud & Chevrot, 2011). In first grade, pupils
21
22 mainly use a phonologically based rule; they use the “é” grapheme, the most frequent
23
24 spelling found at the end of words. In third grade, the use of the “er” morphogram appears
25
26 as a typical ending of the verb category (e.g., for the sentence /ilzɔ̃gɑ̃/ (they have won),
27
28 third graders could spell *ils ont gagner* instead of the right spelling *ils ont gagné*); from
29
30 fourth grade onwards, students understand that the verb is a varying unit and their spelling
31
32 repertory expands; they go back to the “é” grapheme which allows the agreement (*ils ont*
33
34 *gagnés* instead of *ils ont gagné*). The strong tendency towards making the agreement with
35
36 the unit situated just before the verb (usually, but not always, the subject) declines at the
37
38 beginning of middle school, although errors by adults are still reported (Fayol, Hupet, &
39
40 Largy, 1999; Lanoë, Lubin, Houdé, Borst, & De Neys, 2017). This evolution is interpreted by
41
42 the authors as a progressive morphologization. A longitudinal study conducted from sixth to
43
44 eighth grade confirmed this developmental view of /e/-/ɛ/ verb endings (Jaffré & Brissaud,
45
46 2006). This scenario is rather similar to the tests made on the acquisition of endings of the
47
48 past tense in English (Bryant et al., 2006). The pupils proceed by experimenting and making
49
50 successive adjustments, progressing in their understanding (see also Bahr, Sillian, Berninger,
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3 & Dow, 2012). Clearly, the correct written forms are not stabilized straight away; rather,
4
5 there are intermediate phases.
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8 The great variety of types of knowledge and the numerous cognitive and linguistic
9 factors (agreements with no oral counterpart and homophonic phenomena, overload) that
10 come into play make grammatical acquisitions complex. Spelling when writing is very
11 resource-consuming. The difficulties learners have to deal with are beginning to be
12 understood, but a detailed description of acquisition dynamics is still to be made.
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21 **2.3. Relationships between different types of orthographic knowledge acquisition**

22 The role of morphology in the acquisition of literacy has been regularly highlighted,
23 especially in alphabetic languages with a non-transparent written system as English (e.g.,
24 Rastle, 2019) and French (e.g., Casalis, Deacon, & Pacton, 2011). It has been shown that very
25 young children are able to use morphological information without being taught how to
26 (Deacon & Leung, 2013; Treiman & Cassar, 1996; for more transparent orthographies, see
27 for instance Lehtonen & Bryant, 2005). Research has also shown that it is worth teaching
28 morphological awareness, which has been demonstrated to be a better predictor of reading
29 fluency and comprehension at a later age, than knowledge of phonology (Nunes, Bryant, &
30 Barros, 2012). In her integrative review, Carlisle (2010) insists upon the need to develop
31 methods for teaching morphological awareness in relation to other components of literacy
32 development, such as that explored by Nunes and Bryant (2006).
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51 Therefore, even if the dominant discourse remains centered on the alphabetic
52 principle, it seems that the coordination of multiple knowledge sources is important to
53 acquire the almost opaque alphabetic written systems (Bowers & Bowers, 2018; Castle,
54 Rastle, & Nation, 2018). However, few studies have examined how the various types of
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3 knowledge (e.g., lexical and morphological) interact with each other. As far as English is
4
5 concerned, two studies using Triple Word Form Theory as a conceptual framework analyzed
6
7 Standard English spelling performance levels. In the first study, spelling errors of several
8
9 hundred students in first to ninth grade (collected in the 1990s) were analyzed quantitatively
10
11 and qualitatively (Bahr, Sillian, Berninger, & Dow, 2012). Spelling errors were classified into
12
13 phonological, orthographic, and morphological categories. The authors showed that as grade
14
15 level increased the number of orthographic and phonological errors significantly decreased,
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17 whereas morphological errors increased in relative frequency until fifth grade. Moreover,
18
19 students experienced difficulties in the spelling of homonyms.
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25 Daffern (2017) analyzed the coordination of phonological, orthographic and
26
27 morphological scores in a cross-sectional study carried out on third to sixth grade Australian
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29 children. She found correlations among the three components of spelling. She observed a
30
31 reduction in the number of errors for every component as grade increased and a substantial
32
33 increase in performance between fifth and sixth grade in the phonological and
34
35 morphological components of spelling. However, morphological spelling remains difficult to
36
37 master in sixth grade, with inflectional suffixes being mastered before derivational ones. In
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39 addition, she highlighted substantial differences in performance across all three subscales
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41 for students in the lower percentiles compared to students in the higher percentiles.
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48 As far as French is concerned, Morin, Alamargot, Diallo and Fayol (2018) recently
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50 investigated the nature of the skills involved in two kinds of spelling: lexical (corresponding
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52 to both phonological and orthographic components in English in the two studies quoted) and
53
54 grammatical (corresponding to the inflectional part of morphology), with 244 children from
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56 third to fifth grade. They sought to identify different acquisition profiles, based on children's
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58 lexical and grammatical development. They found that performance was higher for lexical
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3 than for grammatical spelling. Both associations (lexical performance correlated with the
4 grammatical one) and dissociations (contrasting scores) have been observed, especially in
5 third grade. In the case of a dissociation (34.4% of pupils), poor grammatical performance
6 was coupled with good or very good lexical performance. The opposite profile was only
7 found for 4 pupils (1.64%). Notable improvements were observed between third grade and
8 fifth grade, with the lexical and grammatical aspects being more correlated in fifth grade
9 than in third grade.
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20 **3. Relevance of the study**

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22 In summary, the spelling acquisition of opaque orthographies seems to follow “a
23 gradual but complex trajectory” (Daffern, 2017), with a prominent individual variability.
24 According to a few cross-sectional studies, it seems that lexical and grammatical skills do not
25 improve independently during primary school education: significant correlations were
26 systematically observed between lexical and grammatical performance. Furthermore,
27 individuals with a dissociation between their lexical and grammatical performance almost
28 always have good lexical skills and poor grammatical skills, whereas the reverse pattern is
29 extremely rare. These results suggest an asymmetric dependency between lexical and
30 grammatical skills. However, further data is clearly needed to explore this hypothesis,
31 especially with longitudinal studies and studies in the secondary school. Few spelling studies
32 have addressed this age group for French children, and there is no available longitudinal
33 study of this type for the French language.
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52 The present longitudinal study has been conducted to give a better overview of
53 French spelling acquisition during secondary schooling. Our hypotheses are the following: 1)
54 there is a significant and positive evolution of French spelling performance between the
55 sixth and the ninth grade, with a more substantial evolution for the grammatical component
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3 (this is still low in the sixth grade) than for the lexical one (relatively well-mastered in this
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5 same grade); 2) there is a relationship between lexical and grammatical skill acquisition
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7 because the two skills do not improve independently. More precisely, we propound the
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9 hypothesis of an asymmetric dependency between lexical and grammatical skills, as is the
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11 case in primary school (Morin et al., 2018); 3) difficulties, especially grammatical ones,
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13 remain at the end of ninth grade and these are in connection with specificities of French
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15 spelling.
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22 **Method**

23 **1. Participants**

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29 496 students (257 girls and 239 boys) attending 10 public secondary schools of the
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31 Academy of Grenoble (France) took part in the longitudinal study. 168 students (33.9% of
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33 the sample) were from two large urban secondary schools of Grenoble area, receiving most
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35 of underprivileged and medium class population, 205 students (41.3% of the sample) were
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37 from smaller institutions located in medium-sized cities with mixed population, 103 (20.8%
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39 of the sample) were in secondary schools located in rural areas and 20 students (4%) were in
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41 specialized classrooms for special education needs (cognitive or behavioral peculiarities).
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44 Among the 476 students in normal classrooms, 31 (6.5%) reported being diagnosed with
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46 dyslexia.
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51 Participants took the first dictation when they were in the sixth grade, that is after
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53 more than five years of real reading instruction. The recruitment was done in the context of
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55 the ORTHOLEARN project (led by Sylviane Valdois, funded by the ANR (French National
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57 Research Agency) and the CNRS (National Center for Scientific Research), a broader study
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3 involving 960 sixth graders from eleven secondary schools). Three years later, a new team,
4 including one researcher from the ORTHOLEARN project, used the same text to have the 496
5 available students take the dictation again (464 students were unavailable for various
6 reasons, the essential ones being the exclusion of one secondary school that refused to
7 participate, students' or parents' refusal, relocation, grade repetition). The mean age of
8 participating students was 11 years and 10 months (SD = 5.6; range 10 years 4 months – 13
9 years 3 months) in sixth grade and 14 years and 7 months (SD = 5.6; range 13 years 2 months
10 – 16 years 0 months) in ninth grade. None of the participants had repeated a year between
11 sixth grade and ninth grade.
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26 **2. Material**

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29 The spelling performance of students was estimated with a text dictation task. The
30 text was written on purpose from the ROC test, *Repérage orthographique collectif* (collective
31 spelling monitoring, see Appendix 1)ⁱⁱⁱ, designed to identify poor spellers in fourth to seventh
32 grade. The ROC text was modified to include more grammatical spelling difficulties, such as
33 verbal plurals. The text dictated in sixth grade (Appendix 1) consisted of 67 words, and
34 contained the most frequently used tenses in written texts (present, infinitive and past
35 participle). In ninth grade, the dictation was the same text plus another paragraph of 45
36 words with additional lexical and grammatical difficulties (see Appendix 1).
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50 **3. Procedure**

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53 The first collection of dictations took place between February and June 2013 (sixth
54 grade). The second collection was carried out from January to March 2016 (ninth grade).
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59 More time was needed for sixth grade pupils, because the project included more students
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3 and more individual tests. The procedure was the same during both collections. Students
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5 were first asked to listen carefully. The entire text was read aloud once by the experimenter.
6
7 Then the whole first sentence was re-read once. Then each segment of the sentence (see
8
9 Appendix 1) was dictated to the students. Each segment was slowly repeated twice and
10
11 students had to write it down. The same procedure was repeated for each sentence. At the
12
13 end of the dictation, neither the experimenter nor the pupils reread the entire text before
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15 the sheets of paper were collected. Students were then asked to do other tasks
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20 (questionnaires) not presented in this article.
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23 ***4. Scoring and data analyses***

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27 We calculated a common global score by summing the total number of words spelled
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29 correctly in the common part of the dictation (out of 67 words) to be able to strictly compare
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31 the same results in the sixth grade and in the ninth grade. For ninth graders, a specific ninth
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33 grade global score, including all the ninth grade dictation, was also calculated (out of 112
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35 words).
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40 The common lexical score was calculated on 22 items of various frequencies (see
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42 Appendix 1) and this comprised 12 nouns, 7 adjectives and 3 invariant adverbs. The specific
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44 ninth grade lexical score also included 11 new items: 5 nouns, one adjective, 3 invariant
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46 adverbs, one indefinite pronoun and one preposition and was calculated on a maximum
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48 score of 33 items.
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52 The common grammatical score was calculated on 13 items (6 “s” plurals at the end
53
54 of a noun, an adjective or a pronoun; 4 “ent” plurals at the end of verbs; 1 “er” end of an
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56 infinitive verb; 1 “e” feminine mark and the plural pronoun “ceux” (those) which is
57
58 homophonic to “ce” (this)). The specific ninth grade grammatical score also included 9 new
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3 items (2 “s” plurals; 1 “e” feminine mark; 1 “er” end of an infinitive verb; 2 “é” ends of a past
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5 participle; 2 “t” ends of verbs (*décrit* et *voit*) and “est” (is) which is homophonic to “et”
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7 (and)). Details of all items and their insertion into the global text are provided in Appendix 1.
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10 11 12 **Results**

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15 First, we present results on the global scores, lexical scores and grammatical scores
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17 according to grade. The hypothesis that enhancement between sixth and ninth grades would
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19 be stronger on the grammatical score than on the lexical one was tested with a mixed model
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21 analysis. Correlation and regression analyses were conducted to study the dependency
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23 between lexical and grammatical scores, in each grade and between grades. Then we
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25 concentrated on persistent difficulties by focusing on the items showing more than 25% of
26
27 errors in ninth grade. The score data were analyzed with the R computing environment (R
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29 Core Team, 2018; RStudio version 1.1.456) by means of a generalized linear mixed model
30
31 using the glmer function and specifying family=binomial.
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40 **1. Performance enhancements between sixth and ninth grades**

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44 Mean and median scores (standard deviations are given in brackets) of the dictation
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46 are presented in Table 1. The global scores increased significantly from sixth grade (79.5%)
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48 to ninth grade (88.4% for the common part, $t(495) = 21, p < .001$; 86.7% for the entire
49
50 dictation, $t(495) = 17.1, p < .001$), revealing an enhancement of spelling skills among French
51
52 students between sixth and ninth grade.
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57 A mixed model analysis was performed to evaluate the specific enhancement of both
58
59 lexical and grammatical scores between sixth and ninth grades. Grade and type of scores
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3 (lexical vs. grammatical scores on the common part¹) were the two within-subject variables.
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5 As gender difference is frequently observed for orthographic performance (e.g., Berninger,
6
7 Nielsen, Abbott, Wijsman, & Raskind, 2008; Katusic, Colligan, Barbaresi, Schaid & Jacobsen,
8
9 2006), we also included gender as a between-subject variable. Initially, a maximal random
10
11 effects structure was specified, which included all subject and item random intercepts and
12
13 random slopes (Barr, Levy, Scheepers, Tily, 2013). As this model failed to converge, following
14
15 Barr et al., (2013) suggestions, we first removed random interactions and then dropped
16
17 random slopes associated with the smallest variance, until the model converged. The
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19 converged mixed model² included random intercepts for participants and items, random
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21 slopes for participants according to grade and type and random slope for items according to
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23 grade.
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30 The results (see Figure 1) revealed main effects of grade ($z = 11, p < .001$), type ($z =$
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32 $3.8, p < .001$) and gender ($z = -3.7, p < .001$). Grammatical scores were lower than lexical
33
34 ones and girls obtained higher scores than boys. The interaction between gender and grade
35
36 was significant ($z = -2.6, p < .01$), suggesting that the enhancement between grades is larger
37
38 for girls than for boys. The interaction between gender and type was also significant ($z = -3.1,$
39
40 $p < .01$), suggesting that the difference between lexical and grammatical scores is larger for
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42 boys (25%) than for girls (19%). Neither the interaction between grade and type nor the one
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44 between the three variables were significant (respectively, $z = -1.4$ and 1.3).
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58 The same results were obtained when using the scores on the entire dictation for ninth grade
59 ² `glmer (score ~ grade * type * gender + (1 + grade + type || participant) + (1 + grade || item), data =`
60 `orrm, family = "binomial")`

Table 1: Mean/and median/ global spelling performance, lexical and grammatical scores (standard deviations) of the 496 sixth grader and ninth grader participants, expressed as a percentage of correctly spelled items

| | Common part 6 th -9 th | All 9 th dictation |
|--------------------|--|-------------------------------|
| Global spelling | percent on 67 words | percent on 112 words |
| sixth grade | 79.5/81.4/ (13.5) | |
| ninth grade | 88.4/89.6/ (10.1) | 86.7/88.4/ (10.9) |
| Lexical scores | percent on 22 items | percent on 33 items |
| sixth grade | 76.8/81.8/ (14.3) | |
| ninth grade | 88.7/90.9/ (10.8) | 81.5/84.8/ (9.7) |
| Grammatical scores | percent on 13 items | percent on 22 items |
| sixth grade | 49.3/46.2/ (28.3) | |
| ninth grade | 72.6/76.9/ (26.3) | 72.0/77.3/ (24.0) |

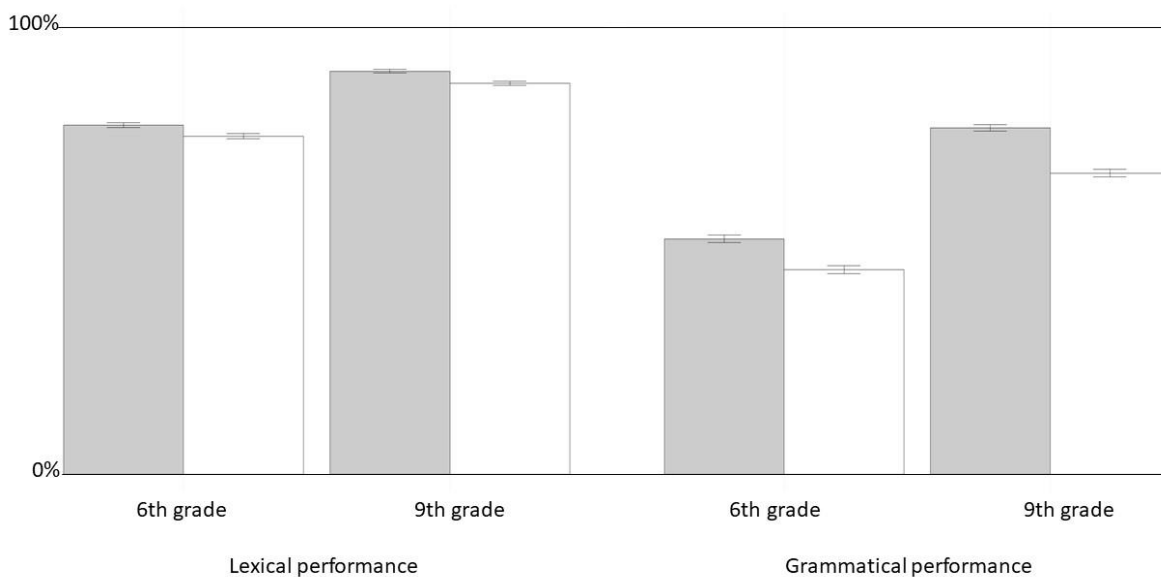


Figure 1 : Mean lexical and grammatical performance (and standard errors) of girls (grey bars) and boys (white bars) as a function of grade.

2. Relation between lexical and grammatical performance across grades

Correlations (Table2) are presented to reveal the relations between global, lexical and grammatical scores. All correlations are highly significant. Concerning the intra-grade correlations, trivially the global scores are highly correlated with both lexical and grammatical scores (from .80 to .89). The correlations between lexical and grammatical scores are significant but seem smaller (.48 in sixth grade and .69 in ninth grade), suggesting that at these grade levels some students could still present a dissociation between their lexical and grammatical performances. This was also true at earlier grades (Morin et al., 2018).

Table 2: Correlations between global, lexical and grammatical scores in sixth grade (scores on 67, 22 and 13 items respectively) and ninth grade (scores on 112, 33 and 22 items respectively). Partial correlations controlling for gender effect are presented above the diagonal.

| | | 6th | | | 9th | | |
|-----|-------------|--------|---------|-------------|--------|---------|-------------|
| | | global | lexical | Grammatical | global | lexical | Grammatical |
| 6th | Global | -- | .83*** | .80*** | .72*** | .64*** | .70*** |
| | Lexical | .83*** | -- | .48*** | .60*** | .61*** | .54*** |
| | grammatical | .81*** | .49*** | -- | .65*** | .52*** | .70*** |
| 9th | Global | .72*** | .61*** | .66*** | -- | .86*** | .89*** |
| | Lexical | .65*** | .61*** | .53*** | .87*** | -- | .69*** |

| | | | | | | | |
|--|-------------|--------|--------|--------|--------|--------|----|
| | grammatical | .71*** | .54*** | .71*** | .89*** | .69*** | -- |
|--|-------------|--------|--------|--------|--------|--------|----|

*** $p < .001$

The inter-grade correlations are all significant and quite homogeneous, with the lowest r values for the lexical-grammatical correlations (.52 and .54) and the highest r value for the correlation between global scores (.72). To specify the dependency between lexical and grammatical performance between grades, two regression analyses were conducted, one for each of the individual scores of ninth grade (hereafter referred to as lexical-9 and grammatical-9). In each analysis, the global sixth grade score (hereafter called global-6) was entered at the first step to control the influence of general orthographic skills. It is expected that a large part of the variance in ninth grade performance should be explained by general orthographic skills in sixth grade. The sixth grade score corresponds to the score to be explained (lexical-6 to explain lexical-9, grammatical-6 to explain grammatical-9) was then entered at the second step and the other score (grammatical-6 to explain lexical-9, lexical-6 to explain grammatical-9) at the third step, as potential additional predictors. The detailed results are shown in Table 3. The analysis of lexical-9 confirmed that lexical-6 is significant but also revealed that grammatical-6 is still significant at the final step, predicting a small but significant part of the variance of lexical-9. The three scores of sixth grade together explained 44.9% of the variance on lexical-9 ($F(3,492) = 133.2, p < .001$). The analysis on grammatical-9 also showed that lexical-6 explained a small but significant part of the variance, after control of the variance explained by both global-6 and grammatical-6. The three sixth grade scores together explained 56% of the grammatical-9 variance ($F(3,492) = 208.62, p < .001$). These regression analyses suggest that lexical and grammatical performances do not evolve independently during education in secondary school.

Table 3: Results of the regression analyses on the lexical and grammatical scores in ninth grade predicted by the 3 different scores in sixth grade.

| 9 th lexical score | | | | 9 th grammatical score | | | |
|-------------------------------|--------------|-------------------------|-----------------------------|-----------------------------------|--------------|----------------------|-----------------------------|
| | ΔR^2 | Beta (final step) | $t(492)$ (final step) | | ΔR^2 | Beta (final step) | $t(492)$ (final step) |
| Step 1 global | .420*** | .165 | 1.55 | Step 1 global | .497*** | .200 | 2.10* |
| Step 2 lexical | .017*** | .366 | 5.03*** | Step 2 grammatical | .058*** | .480 | 7.93*** |
| Step 3 grammatical | .012** | .221 | 3.26** | Step 3 lexical | .004* | .143 | 2.20* |

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

To observe the stability of the dissociation between lexical and grammatical performance over grades at an individual level, we first identified the sixth graders presenting a clear lexical-grammatical dissociation, that is showing one score lower than the 25th percentile and the other score higher than the 50th percentile. Then we followed these students in ninth grade. We found that 33 (6.7%) of the sixth graders had a low grammatical score but a good lexical one. The reverse dissociation (a low lexical score but a good grammatical one) was rarer in sixth graders, with only 13 students (2.6%) presenting this pattern. Three years later, the profiles of the 33 students with a good lexical-poor grammatical pattern, varied a lot. Ten of them still had a grammatical score below the 25th percentile, but the dissociation with the lexical score was then clear for only two of them (the lexical score had deteriorated for the other eight). Sixteen presented a grammatical

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3 score above the 25th but below the 50th percentile, with most of them still presenting a good
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5 lexical score. Finally, seven reached a grammatical score above the 50th percentile in ninth
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7 grade and maintained their lexical score at the same level. The future of the 13 students
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9 from sixth grade who presented a good grammatical-poor lexical pattern is more
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11 homogeneous: nine of them achieved both lexical and grammatical scores above the 50th
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13 percentile in ninth grade. In summary, it seems that lexical and grammatical performances
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15 do not evolve independently of each other during secondary school attendance. However,
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17 progress concerning grammatical orthography may appear later and may be harder to
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19 obtain than lexical orthography progress, suggesting an asymmetric relationship.
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28 **3. Exploratory analysis of persistent errors**

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30 In this section, we first explore the main characteristics of lexical errors and second
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32 those of grammatical ones. For each type, we first discuss the principal difficulties for both
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34 sixth and ninth graders. Then, we focus on the errors that persist into ninth grade. We
35
36 considered the percentage of correct responses for each of the items (see Appendix 2 for
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38 lexical items and Appendix 3 for grammatical items) and described errors on the items that
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40 are still difficult for ninth graders to spell (items written with an error by at least 25% of the
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42 students, see Appendix 4).
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48 **3.1. Lexical item error analysis**

49 *Frequency, consistency and length effects*

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53 Despite the fact that lexical items (Appendix 2) and grammatical items (Appendix 3)
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55 are various and are not strictly built for a comparison between different categories, one
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57 could ask whether some characteristics of the items could influence their spelling. Trivially,
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3 for lexical items it is expected that frequently seen items will be better learnt, and thus
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5 better spelled. Indeed, the 10 most frequent items are correctly spelled by 89% of sixth
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7 graders, and the 10 rarest items by only 64% (these percentages are 95% and 80%
8
9 respectively for ninth graders). The phoneme-to-grapheme consistency could still be a
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11 relevant factor in sixth grade (83% versus 75% correct for the most consistent and the most
12
13 inconsistent items respectively) but not in ninth grade (84% versus 90%). Concerning item
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15 length, the 10 longest items are correctly spelled at 72%, and the 10 shortest items at 80% in
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17 sixth grade. These percentages are respectively 83 and 86% for ninth graders, suggesting
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19 that item length is probably not a central factor to explain persistent spelling difficulties.
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25 *Persistent lexical difficulties: accents, double letters and homophones*
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28 Concerning the persistent lexical difficulties, two of the worst spelled items were two
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30 long words *précisément* - /pʁesizemã/ (precisely) had only 38.3% correct spelling (33.1% in
31
32 sixth grade), and *perfectionn(é)* - /pɛʁfɛksjɔne/ (sophisticated), only 73.4% correct spelling
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34 (39.1% in sixth grade), without considering errors on the final “é”, which could be classified
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36 as a grammatical error. The third worst spelled is a short word *vieil*-/vjɛj/ (old, masculine
37
38 adjective); old (masculine) is currently written *vieux* but exceptionally *vieil* when placed
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40 before a noun that begins with a vocalic phoneme, like *homme*-/ɔm/ (man)), with 37.1%
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42 correct spelling (not written in sixth grade).
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48 Concerning *précisément* and *perfectionné*, the most frequent errors (reported in
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50 Annexe 4) are linked to the use of the acute accent and the presence of double letters. For
51
52 the item *vieil*, the only phonologically plausible error was *vieille* (38.6%). This is a more
53
54 frequent homophone (feminine version of the adjective, old). The other frequent errors
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56 highlight difficulties in spelling the phoneme /j/: *Vielle* and *viel* (both pronounced /vjɛl/,
57
58 together account for 45.7% of errors).
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3 Overall, the results show that lexical performance continues to improve between
4 sixth grade and ninth grade. The analysis of persistent lexical errors suggests at least four
5 persistent orthographic difficulties for French ninth graders: the accentuation on the letter *e*,
6 especially when it appears in the middle of a word and has to be pronounced /e/ or /ɛ/
7 (Lucci & Millet, 1994), the presence or absence of **double** consonantal letters (with no rule to
8 explain this), the spelling of the semi-vocalic phoneme /j/ and the issue of homophones
9 (Bahr, Sillian, Berninger, & Dow, 2012).
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23 **3.2. Grammatical item error analysis**

24 *The use of the plural mark according to an item's grammatical class*

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26 For grammatical items, it seems that the plural mark is more frequently spelled on
27 nouns than on adjectives at both grades: respectively 65% versus 31% in sixth grade, and
28 78% versus 58% in ninth grade. The percentages of correct responses for verbs ending with
29 "é" and "er" (/e/) are respectively 76% and 75% in ninth grade (in sixth grade, only one verb
30 ending with "er" figured, and this was correctly spelled by 63% of the students). The "nt"
31 plural mark at the end of verbs is correctly spelled by 70% of sixth graders when the plural
32 form is phonologically different from the singular form, but this plural mark is correctly
33 spelled by only 47% of the same pupils when the plural form is phonologically the same as
34 the singular form. This tendency is still present in ninth grade, with respectively 88% versus
35 68% correct spellings.
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52 *Grammatical persistent difficulties: silent graphemes and homophony once again*

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54 Concerning grammatical persistent difficulties, four items with persistent errors are
55 the plural marks on an adjective (*verts-/vɛʀ/, microscopiques-/mikroskopik/, perfectionnées-*
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3 /pɛʁfɛksjɔne/, *bariolés-/barjole/*; green, microscopic, sophisticated, multicolored), one is the
4 plural mark on a noun (*immeubles-/imæbl/*, buildings). It is important to remember that in
5 French, the plural mark “s” at the end of words is silent; thus the singular and plural forms of
6 most nouns and adjectives are homophones and heterographs. It seems that ninth graders
7 persistently missed this plural mark especially on adjectives. However, the grammatical class
8 of the items may not be the only pertinent variable. Indeed, one other variable could be
9 important: the distance from the item and the determiner providing the oral plural mark.
10 Indeed, three of the plural adjectives were placed far from the determiners. Moreover, the
11 only noun for which the plural mark is persistently missed (*immeubles*, buildings) is used
12 without a determiner and comes after the preposition *d’-/d/*, which does not provide any
13 clues. In this case, to add the correct plural mark one has to think about the meaning (never
14 a single building in a town).

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Two other items with persistent errors are the feminine mark on an adjective (*perfectionnées-/pɛʁfɛksjɔne/*, *peuplée-/pœple/*; sophisticated, populated). As for the plural mark “s”, the feminine mark “e” at the end of words is not pronounced in these items. It is noteworthy that the feminine mark seems to be the strongest persistent difficulty, missed by nearly 50% of ninth graders.

Two other items that give rise to persistent errors are the plural of verbs ending in “ent” (*brillant-/brij/*, *voient-/vwa/*; (they) shine, (they) see) with the same phonological form as the singular (*brille-/brij/*, *voit-/vwa/*; (he) shines, (he) sees). The principal error was the omission of the plural mark. The word *voient* has the characteristic of being a homophone of several other French words. The diversity of the errors made on this particular item clearly reflected this difficulty. The other frequent error on the item *brillant* is *brilles-/brij/* (a plural mark is present but is not appropriate for verbs). This mistake could mean that some ninth

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3 graders could still overgeneralize the “s” plural mark to verbs. It could also mean that some
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5 ninth graders still have difficulties in distinguishing verbs from nouns or adjectives (Le Levier,
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7 Brissaud, & Huard, 2018).
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11 Two other items with persistent errors (*raconter*-/rakɔ̃te/, *informé*-/ɛ̃fɔ̃rme/; to tell,
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13 informed) concerned the production of /e/ verb endings. 74.2% of ninth graders wrote the
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15 infinitive ending “er” correctly in *je vais vous raconter*-/ʒəvɛ̃vurakɔ̃te/ (I’m going to tell you).
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17 The most frequent error was *je vais vous racontez*, where we can hypothesize that the
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19 agreement was made with the unit *vous* situated just before the verb (the “ez” ending error
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21 was almost absent for the other infinitive *ils vont regarder*-/ilvɔ̃rəgarde/ (They are going to
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23 look at)). Seventy-two percent of ninth graders correctly wrote the past participle when it
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25 contained no morphological marks (*informé*). The most frequent error was the infinitive
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27 form *informer*.
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36 Overall, the analysis of grammatical errors suggests that homophones represent
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38 persistent orthographic difficulties for French ninth graders, as is the case for English spellers
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40 (Bahr et al., 2012). Other frequent difficulties are more specific to French spelling and are
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42 related to the almost systematic absence of pronunciation of the plural and feminine marks.
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48 Discussion

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51 The aim of this study was to document the development of lexical and grammatical
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53 spelling skills of middle school pupils aged between 12 and 15, by means of a longitudinal
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55 study, an approach unavailable until now.
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3 Our first hypothesis was that there would be a significant and positive evolution of
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5 the global spelling performance between the sixth and ninth grades. We found that pupils
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7 made significant progress between the sixth and ninth grades; the global 8.9% improvement
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9 in the success rate is comparable to that reported by Manesse and Cogis (2007), estimated
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11 as around 10%. Our study showed an effect of gender on orthographic enhancement, a well-
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13 established result in the literature in this field. More precisely, our longitudinal data allowed
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15 us to establish that the general enhancement between grades is smaller for boys than for
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17 girls and that the difference between lexical score and grammatical score is larger for boys.
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22 Our study also provides a more accurate picture of individual progress. The overall
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24 results for lexical spelling reveal that significant progress (11.9%) is made between the sixth
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26 and ninth grade and that, contrary to our hypothesis, growth between sixth and ninth grade
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28 is not significantly larger for the grammatical score than for the lexical one. In addition, the
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30 correlation and regression analyses suggest that lexical and grammatical performances do
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32 not evolve independently during secondary school attendance (second hypothesis) as was
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34 shown by Morin et al. (2018) for younger pupils in third and fifth grade. Two almost
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36 complementary explanations could accommodate this dependency. First, general cognitive
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38 skills probably influence the entire orthographic performance enhancement. Second, a good
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40 lexical orthographic knowledge could directly help the pupil to acquire a better grammatical
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42 knowledge, or the converse could be true. Overall, the dependency between lexical and
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44 grammatical performance suggests that lexical and grammatical knowledge are not acquired
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46 independently. Consequently, grammatical orthographic acquisition cannot simply be
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48 viewed as the command of grammatical rules learned totally independently of lexical
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50 orthographic knowledge. The observation of dissociation profiles also suggests an
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52 asymmetric relationship between lexical and grammatical skill acquisition. Children clearly
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3 presenting a dissociation between lexical and grammatical skill in sixth grade have been
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5 isolated (children above the 50th percentile for one skill (GRAM+ or LEX+), and below the 25th
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7 percentile for the other (lex- or gram-)), and their performances were observed in ninth
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9 grade. Like Morin et al. (2018), we found more LEX+ and gram- children in sixth grade (6.7%)
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11 than lex- and GRAM+ children (2.6%). The spelling progress of the LEX+ gram- children is
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13 more uncertain, and less homogeneous than that of the GRAM+ lex- children. It is as though
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15 grammatical skills help more to overcome lexical difficulties than the reverse. In other
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17 words, we found it more alarming to have a grammatical weakness than a lexical one in sixth
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19 grade. When the weakness is only lexical, the grammatical skill could promote progress. This
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21 observation suggests an asymmetrical relationship between grammatical skills and lexical
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23 ones which cannot be explained either by models based upon the learning of rules or by
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25 models based on memorization.
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35 According to our third hypothesis, the difficulties remaining at the end of ninth grade
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37 are in connection with the specificities of French spelling. The qualitative analysis of lexical
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39 errors has brought at least two persistent difficulties to light: double letters and the acute
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41 accent of the letter “e” in the middle of words (see also Manesse & Cogis, 2007). These
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43 errors, observed from second grade up persist into later life, despite highly systematic and
44
45 explicit teaching (Fayol et al., 2013). Furthermore, we know that double letters are difficult
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47 to memorize, even for adults (Pacton et al., 2014). This difficulty was also highlighted in a
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49 survey conducted among teachers — almost one in two of them admitted finding **double**
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51 **letters** difficult (groupe RO, 2012). The other persistent error in ninth grade relates to the
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53 acute accent of the letter *e*, particularly in the middle of words; for example, in *précisément*
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55 (precisely) and *perfectionné* (sophisticated), the difficulty for the latter is preventing oneself
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3 from using accents in syllables ending in a consonant. The percentage of this type of error
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5 increases in ninth grade. This result reflects that of Lucci and Millet (1994) who found that
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7 the majority of spelling errors concerns diacritical marks. As an explanation for such a
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9 number of errors, their hypothesis is that the accents are not subject to special vigilance in
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11 current society, and that consequently students do not pay attention to them.
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15 With regard to grammatical spelling, despite this being a cause of particular concern
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17 in society a great deal of progress is being made between sixth and ninth grade for plural
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19 marking, the main errors being omission of silent markings. These results are in line with
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21 other studies underlining the difficulty faced by spellers because of homophony-
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23 heterography phenomena (Bahr et al., 2012; Fayol & Jaffré, 2008, 2014; Jaffré & Fayol,
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25 2006). Significant progress is observed for nominal and adjectival plural markings (from 64.8
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27 to 88.6% for nouns and from 30.8 to 57.4% for adjectives), and also for verbal plurals. The
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29 same cannot be said of the “e” feminine mark which seems to be the most persistent
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31 mistake for nearly 50% of the ninth graders (see the two last words in the table given in
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33 Appendix 3: 46.8% are missing the final “e” in *perfectionnées* (sophisticated) is and 54.4%
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35 the final “e” in *peuplée* (populated)).
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43 The results obtained counterbalance somewhat the developmental scenario of
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45 Totereau et al. (1998). First, the “s” mark at the end of nouns is not systematically used in
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47 sixth grade, contrary to the implications of their model. One possible explanation is that
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49 plural nouns in the dictation are in all likelihood more difficult than the nominal items used
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51 by Totereau et al.: *pupilles-/pypij/* (pupils) and *jumelles-/zymel/* (binoculars) are uncommon
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53 nouns, referring to objects which are rarely handled or cannot be handled. Second, our
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55 study highlights a specific difficulty regarding the plural of adjectives which continues in
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57 ninth grade. This difficulty was already identified in sixth grade (Totereau, Brissaud, Reilhac,
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3 & Bosse, 2013). It cannot be attributed to the length of words (since *verts* (green, plural) is
4 no better spelled than *microscopiques* (microscopic, plural)) or to the presence/absence of
5 an audible signal next to the adjective (*yeux-/jø/* (eyes) is clearly a plural (one eye is said *oeil-*
6 */œj/*) and then could serve as a signal for writing *verts*). Although pupils often refer to the
7 meaning of the phrase to find the plural, they find it easier to put the "s" on nouns, which
8 concretely refer to objects ("I put an "s" because there are several things"), than to put it on
9 the adjectives that qualify these objects (while there are several *immeubles* (buildings), it is
10 less obvious to pick up on the plural nature of the fact that they are *bariolé* (multicolored).
11 We could even hypothesize as to a "color adjective effect" here, given that the special
12 treatment of this type of adjective when taught in French schools, whereby the exceptions
13 are strongly highlighted, creating confusion as to overall adjective use. The agreement of
14 color adjectives is, moreover, one of the difficulties that one in three teachers admits
15 experiencing (Groupe RO, 2012). A "homophone effect" could also potentially be suspected
16 – however, pupils make very few errors in the word *vert* (green, singular; they do write *vert*,
17 as opposed to *vers* (toward) or *verre* (glass), the three of them been pronounced */vɛʀ/*).
18 Nonetheless, we could think that the pupils' reflex would be related to the issue of
19 homophony, studied thoroughly at school, to the detriment of their being able to detect
20 number agreement. The interviews conducted with 150 ninth grade pupils about their
21 spelling choices in the dictation allowed this hypothesis to be made (Le Levier, Brissaud, &
22 Huard, 2018).

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25 In terms of the verbal plural, it was observed that speech has a significant effect on
26 agreement, with an appreciable difference depending whether or not the third-person plural
27 is different when spoken (from 47 to 68.5% vs. 70.3 to 87.6%). This effect, which can also be
28 seen in adults (Largy & Fayol, 2001), is still clear in ninth grade. The analysis of persistent
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3 errors (other than the absence of the “nt” ending) again raises the homophone-heterograph
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5 problem which is frequently seen in French when writing *voient*-/vwa/ (they see), which are
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7 all existing homophones (from the most frequent error: *voit*, *voie*, *vois*, these three cover
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9 about 80% of errors, see Appendix 4).
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13 With respect to verb forms ending in /e/, our study confirms that pupils know how to
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15 choose between “é” and “er” (Brissaud & Chevrot, 2011 ; Mout & Brissaud, 2013). It is,
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17 however, easier to write a form ending in “er” in sixth grade than a form ending in “é”
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19 (*informer* 62.7% vs. *perfectionnées* about 20%). In ninth grade, pupils manage more or less
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21 equally well to spell the two target items in more complex syntactical contexts (“er” in *ils*
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23 *vont regarder* (they are going to look at): 77.2%; “er” in *je vais vous raconter* (I am going to
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25 tell you): 74.2%; “é” in *il l’a toujours considéré* (he always viewed him): 78%; “é” in *personne*
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27 *n’est informé* (nobody is informed): 71.8%). When the target item is not “é” but “és” or
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29 “ées”, choosing the following morphographs is a difficult issue for pupils. The accumulation
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31 of marks on the past participle form (“é” + feminine + plural) still constitutes a difficulty in
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33 ninth grade. Overall, the feminine mark appears to be dealt with less well than the plural
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35 mark (Cogis & Brissaud, 2019). Our study confirms that the polyfunctionality of graphemes
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37 and the homophonic-heterographic features that are characteristic of the French writing
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39 system require an explicit teaching method throughout middle school. That said, progress
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41 recorded in this study assuages the alarmist environment surrounding falling standards in
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43 spelling.
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51 52 **Limitations of the study**

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55 Some methodological choices of the present study need to be discussed. The text
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57 was dictated slowly. Every sentence was read at least three times and each segment was
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59 repeated slowly at least twice to give the pupils enough time to write and think about their
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3 spelling. However, students were not allocated time to re-read their text. This method
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5 probably has the advantage of approaching pupils' automated knowledge and of avoiding
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7 the influence of re-reading strategies, which can vary considerably from one student to
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9 another. Nevertheless, this method might be considered as a limitation of the study because
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11 it differs from the everyday classroom situation, where most of the time students have time
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13 to re-read their written productions. Future studies might well use the first text as well as a
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15 second, revised production, to obtain a finer measurement of how orthographic knowledge
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17 is used by pupils.
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23 A second limitation is that spelling is assessed with a text selected by researchers.
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25 Instead, students could be invited to write their own texts about a simple and well-targeted
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27 instruction. In such a case, words would be freely chosen by the participants, and it could be
28
29 hard to test advanced hypotheses. Thus the choice of a dictation appears to be a good
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31 compromise to assess secondary students' spelling. These methodological choices raise the
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33 more general question of what is a good measure of orthographic knowledge. In many
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35 studies, participants are asked to write either words or isolated sentences. But the
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37 management of spelling could seem quite different – and more demanding - in a text. If the
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39 aim of learning to spell is to write correct texts, then spelling should be assessed in the
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41 context of texts.
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48 **Teaching suggestions**

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51 The structure of French spelling itself seems to be a major source of difficulties, with
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53 its numerous cases of homophonic words spelt in different ways, especially in the
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55 grammatical field, which is socially overemphasized. As Bowers and Bowers (2018) said for
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57 English, the French writing system is morphophonemic, not just alphabetic. Indeed, mastery
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3 of the phonographic dimension is not enough to write French properly. Taking into account
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5 the morphology of the words makes the French written system much more transparent
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8 (Peereman & Sprenger-Charolles, 2018). Pending an ambitious reform of French spelling, it
9
10 seems necessary that teachers should be conscious of this particularity, to be able to
11
12 effectively help those for whom orthography is not easily set up.
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15 Thus, the morphological principle, an important organizing principle of the French
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17 writing system, should be valued and worked on in school. Indeed, the early ability to use
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19 morphemes in reading and spelling has been found to be a good predictor of later literacy
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21 skills (Nunes, Bryant, & Barros, 2012) and the relation between morphological awareness
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23 and spelling ability has been demonstrated in French (Casalis, Deacon, & Pacton, 2011) as in
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25 other languages (e.g., in Dutch: Rispens, McBride-Chang, & Reitsma, 2008; in Chinese: Tong,
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27 McBride-Chang, Shu, & Wong, 2009). However, there is a debate regarding the age at which
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29 the impact of morphological awareness on spelling become evident. In English, a clear
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31 relation between morphological awareness and literacy acquisition is especially evident only
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33 in the later grades of primary school (Castles, Rastle, & Nation, 2018) and it has been
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35 suggested that it is because in the first grades, children are essentially exposed to short
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37 monomorphemic words. In French, too few studies have explored this issue but we can
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39 hypothesize that morphological awareness could be useful earlier, especially for spelling.
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42 Indeed, even short frequent French words often contain silent letters which are
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44 morphological marks.
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52 Our results led us to recommend the maintenance of a more explicit instructional
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54 style in sixth and ninth grade when teaching homophones and heterographs. The
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56 accumulation of marks, for instance on the past participle form (e.g., the three marks: “é” +
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58 feminine “e” + plural “s” in *perfectionnées, sophisticated*) requires several stages of
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3 reasoning which are difficult to build together even though the pupils know how to solve
4 them separately. Teaching the identification of grammatical marks, their condition of use,
5 and their distribution in sentences, appears to be necessary, especially if we consider the link
6 between an explicit strategy for grammar and the teaching of writing (Myhill, Jones, Lines &
7 Watson, 2012; Brissaud & Fayol, 2018). This is true not only for French, but also for many
8 languages with a writing system faced with homophonic words or endings spelt in a different
9 way, depending on the grammatical status. In Greek, morphological knowledge is needed to
10 spell inflectional morphemes (Nunes, Aidinis, & Bryant, 2006). Furthermore, Dutch has verb
11 spellings that are grammatically determined (Bosman, de Graaff, & Gijzel, 2006), and English
12 has a major apostrophe problem (Bryant, Devine, Ledward, & Nunes, 2002).

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15 A more explicit instruction is particularly needed for the learning of the “e” feminine
16 mark. Our data confirmed that it is not over at the end of middle school (Brissaud, 2015).
17 The agreement of the adjective, in spite of all the lessons of grammar or spelling, remains
18 rather opaque for students at the end of ninth grade. Yet, without identification of the
19 lexical item in context, this remains difficult. Teachers should help pupils use the formal
20 designation of parts of speech (adjectives, nouns, verbs, etc.) when they try to solve
21 agreement problems (Nadeau & Fisher, 2014).

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24 The production of all these silent marks, which often requires a grammatical
25 reasoning, is all the more difficult in text writing, when attention is monopolized by the
26 multiple aspects of text production. Another teaching suggestion is not to confine oneself to
27 proposing exercises that allow students to automate agreement. Teachers could
28 systematically ask students to write short texts during grammar lessons including the marks
29 learned or revised, so that students can gradually practice spelling in writing and learn how
30 to control the presence of socially valued grammatical marks.

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3 These results also suggest that speech should be taken as a basis on which to work,
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5 firstly on audible agreement marks (*vivent, agrandissent*), and then on plural marks where
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7 no change from the singular can be heard when pronounced (*brillant*). This idea challenges
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9 the traditional order in which French conjugation is taught and certain ideas received, for
10
11 example the assumption that third group verbs are more difficult to learn than first group
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13 verbs. However, most third group verbs distinguish the third-person singular from the third-
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15 person plural (*boit/boivent* pronounced /bwa/ vs. /bwav/). Two common third group verbs –
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17 *voir* (to see) and *croire* (to believe) – are exceptions to this rule. Their plurals do not differ
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19 audibly: *voit* and *voient* (third-person singular and plural, respectively, of *voir*) are
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21 pronounced in the same way (/vwa/), just like *croit* and *croient* (third-person singular and
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23 plural of *croire*, both pronounced /krwa/), which most likely explains generalization errors
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25 like "ils croivent" pronounced /krwav/ (instead of *ils croient*) and "ils voyent" pronounced
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27 /vwaj/ (instead of *ils voient*). Particular attention should be given in middle school to these
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29 two very commonly used verbs.
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42 To conclude, our study shows that secondary school is a place of progress regarding
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44 both lexical and grammatical spelling. Moreover, the longitudinal study shows that these
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46 two skills go on interacting with each other during secondary school education.
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48 Furthermore, it highlights the complexity of the knowledge and skills used when spelling
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50 French. Finally, the present study suggests the importance of detecting students with a
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52 grammatical weakness at the beginning of secondary school attendance and continuing to
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54 work on spelling in connection with text production after Grade 9.
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Notes

i "é" and "ai" tend to be pronounced in the same way (/e/) in a large part of the French-speaking world, further to the neutralization of the two different vowels (closed /e/ and open /ɛ/) in a rich and uneconomic vowel system.

ii In fact, there are ten. The last one is *trouvai* (past tense, 1st person, I found), not used in spoken French, but still occasionally used at school when writing stories, although the 3rd and 6th persons are more frequently used. A recent study reveals that the absence of neutralization (i.e., a distinct pronunciation for the imperfect tense and the past participle) does not necessarily guarantee the correct selection of verb endings (Brissaud, Negro, & Fisher, 2012).

iii This test has been designed by Michel Zorman and collaborators. It can be downloaded on www.cognisciences.com

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ANNEXE 1: Text details

Original ROC test dictation.

Je vais vous raconter l'histoire d'un gentil petit garçon qui s'appelle Jo. Il habite chez son oncle, un vieux monsieur qui vit dans un bourg. Cet enfant possède un don extraordinaire. En effet, grâce à ses yeux verts, il voit beaucoup plus loin et précisément que tout le monde ! Dans ses pupilles se trouvent des jumelles intégrées, microscopiques et invisibles.

6th/9th grade common dictation. The 22 items of the lexical score are underlined, the 13 items of the grammatical score are in bold. Segmentation for dictation (see procedure) is represented by /

Je vais vous raconter l'histoire / d'un gentil petit garçon / qui s'appelle Jo. Il habite chez son oncle, / un vieux monsieur. / Ils **vivent** dans une cité. / Cet enfant possède un don extraordinaire. / En effet, / ses yeux verts / **voient** beaucoup plus loin / et plus précisément / que **ceux** de tout le monde ! / Dans ses pupilles / qui s'**agrandissent** et qui **brillent**, / on devine / des jumelles microscopiques perfectionnées. (I am going to tell you the story / of a kind little boy / called Jo. / He lives at his uncle's, / an old gentleman. / They live in a city. / This child has an extraordinary gift. / Indeed, / his green eyes / can see much further / and better than anybody's! / In his pupils / which get bigger and light up, / you can make out / sophisticated microscopic binoculars.)

1
2
3 **Additional 9th grade dictation** (11 additional lexical items and 9 additional
4
5 grammatical items)
6

7
8 Dans la ville peuplée d'immeubles bariolés, / personne n'est informé de ce don, /
9
10 sauf son oncle, qui l'a toujours considéré comme son fils. / Alors, souvent, Jo et le vieil
11
12 homme vont regarder ensemble par la fenêtre / et Jo décrit ce qu'il voit.
13
14

15
16 (In the city full of multicolored buildings, / nobody is informed of this gift, / except his
17
18 uncle, who has always thought of him as his son. / Jo and the old man often go and look out
19
20 the window together / and Jo describes what he can see.)
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ANNEXE 2: Lexical items ranked by the score at 9th grade : read and spoken

frequencies (expressed as millions of occurrences, Lexique 3, www.lexique.org: New, Pallier, Brysbaert, & Ferrand, 2004), phoneme-to-grapheme consistencies (Manulex-infra: Peereman, Lété, & Sprenger-Charolles, 2007), theoretical percent of correct spelling at grade 5 according to the EOLE scale (Pothier & Pothier, 2003), percentages of correct spelling obtained at grades 6 and 9; in bold, 9th grade percentages lower than 75%.

| dictation | item | Reading Frequency (lexique.org) | Spoken Frequency (lexique.org) | P-G consistency (Manulex- infra) | % correct grade 5 (EOLE) | Mean score (%) at 6 th grade | Mean score (%) at 9 th grade |
|-----------|---------------|---------------------------------------|--------------------------------------|---|--------------------------------|--|--|
| 9th | ville | 311.69 | 277.98 | 76.52 | 98 | | 99.4 |
| 6th-9th | oncle | 121.96 | 124.11 | 84.34 | 79 | 96.6 | 99.2 |
| 6th-9th | petit | 653.78 | 573.72 | 82.36 | 100 | 97.2 | 98.6 |
| 9th | homme | 852.23 | 781.11 | 61.86 | 100 | | 98.2 |
| 6th-9th | monde | 732.43 | 823.62 | 77.58 | 97 | 93.1 | 97.8 |
| 6th-9th | enfant | 381.96 | 287.26 | 59.24 | 100 | 96.2 | 97.8 |
| 6th-9th | yeux | 955.68 | 315.89 | 67.38 | 85 | 92.2 | 97.6 |
| 9th | fils | 247.64 | 480.15 | 71.07 | 100 | | 97.4 |
| 6th-9th | vert | 59.12 | 24.74 | 70.59 | 100 | 51.6 | 97.2 |
| 6th-9th | beaucoup | 461.42 | 626 | 54.07 | 97 | 89.7 | 96.8 |
| 6th-9th | histoire | 292.23 | 295.32 | 77.94 | 97 | 88.5 | 96.6 |
| 9th | souvent | 286.96 | 135.54 | 68.45 | 97 | | 96.4 |
| 9th | sauf | 83.99 | 108.54 | 71.46 | 97 | | 96 |
| 6th-9th | garçon | 186.96 | 188.41 | 77.47 | 100 | 95.6 | 95.8 |
| 6th-9th | jumelle | 1.96 | 0.72 | 63.17 | 94 | 87.7 | 94.4 |
| 6th-9th | microscopique | 0.88 | 0.62 | 74.76 | 90 | 58.3 | 93.8 |

| | | | | | | | |
|---------|----------------|---------|---------|-------|----|------|------|
| 6th-9th | loin | 452.36 | 248.34 | 100 | 90 | 87.1 | 92.1 |
| 6th-9th | monsieur | 286.76 | 583.45 | 54.17 | 68 | 74.8 | 89.1 |
| 6th-9th | pupille | 2.43 | 2.04 | 82.63 | | 78.8 | 88.5 |
| 6th-9th | gentil | 37.36 | 134.11 | 46.54 | 88 | 73.8 | 86.7 |
| 9th | fenêtre | 199.39 | 70.2 | 80.29 | 70 | | 86.5 |
| 9th | toujours | 1093.78 | 1072.36 | 75.38 | 59 | | 86.3 |
| 9th | personne | 312.16 | 577.6 | 62.11 | 95 | | 85.9 |
| 6th-9th | effet | 173.18 | 99.17 | 42.64 | 57 | 61.5 | 85.9 |
| 9th | ensemble | 145.07 | 253.47 | 68.61 | 86 | | 84.7 |
| 6th-9th | extraordinaire | 36.01 | 23.71 | 83.9 | 72 | 71.2 | 84.5 |
| 6th-9th | vieux | 273.31 | 180.08 | 72.86 | 81 | 78.8 | 84.1 |
| 6th-9th | cit   | 20.68 | 14.55 | 59.49 | 51 | 79.2 | 81.2 |
| 6th-9th | don | 30.27 | 35.47 | 96.84 | 72 | 64.9 | 80.4 |
| 9th | immeuble | 50.88 | 24.54 | 80.37 | 73 | | 79 |
| 6th-9th | perfectionn   | 1.62 | 5.61 | 62 | 70 | 39.1 | 73.4 |
| 6th-9th | pr  cis  ment | 34.8 | 12.8 | 72.03 | 63 | 33.1 | 38.3 |
| 9th | vieil | 51.22 | 34.69 | 87.32 | 45 | | 37.3 |

ANNEXE 3: Grammatical items ranked by the score at 9th grade: mean scores in percentages; in bold, 9th grade percentages lower than 75% .

| dictation | item | Item category | Mean score (%) at 6 th grade | Mean score (%) at 9 th grade |
|-----------|----------------|------------------------|--|--|
| 9th | est | | | 94 |
| 6th-9th | vivent | Verb G1 plural present | 77.6 | 91.1 |
| 6th-9th | jumelles | Plural noun | 65.9 | 90.3 |
| 6th-9th | ils | Pronoun plural | 64.1 | 88.9 |
| 9th | voit | Verb G3 sing present | | 87.1 |
| 6th-9th | pupilles | Plural noun | 63.7 | 86.7 |
| 6th-9th | s'agrandissent | Verb G1 plural present | 62.9 | 84.1 |
| 9th | considéré | Verb past particip | | 78 |
| 9th | regarder | Verb infinitif | | 77.2 |
| 9th | décrit | Verb G3 sing present | | 74.2 |
| 6th-9th | raconter | Verb infinitif | 62.7 | 74.2 |
| 9th | informé | Verb past particip | | 71.8 |
| 6th-9th | voient | Verb G1 plural present | 45 | 68.5 |
| 6th-9th | brillant | Verb G1 plural present | 49 | 68.5 |
| 6th-9th | ceux | | 38.1 | 65.3 |
| 9th | bariolés | Plural adjective | | 59.1 |
| 6th-9th | verts | Plural adjective | 43.1 | 58.9 |
| 6th-9th | perfectionnées | Plural adjective | 26.8 | 58.5 |
| 9th | immeubles | Plural noun | | 55.8 |
| 6th-9th | microscopiques | Plural adjective | 22.6 | 54.8 |
| 6th-9th | perfectionnées | Feminine adj. | 19.6 | 53.2 |
| 9th | peuplée | Feminine adj. | | 45.6 |

Note: G1 = first group (verbs, infinitif form ending with "er"); G3 = third group (verbs)

ANNEXE 4: Persistent errors at grade 9

Lexical persistent errors on the 3 items showing more than 25% of errors at grade 9:

For each item, percentages of phonologically plausible and non-phonologically plausible errors on the total number of errors, and percentages of the most frequent errors, are given.

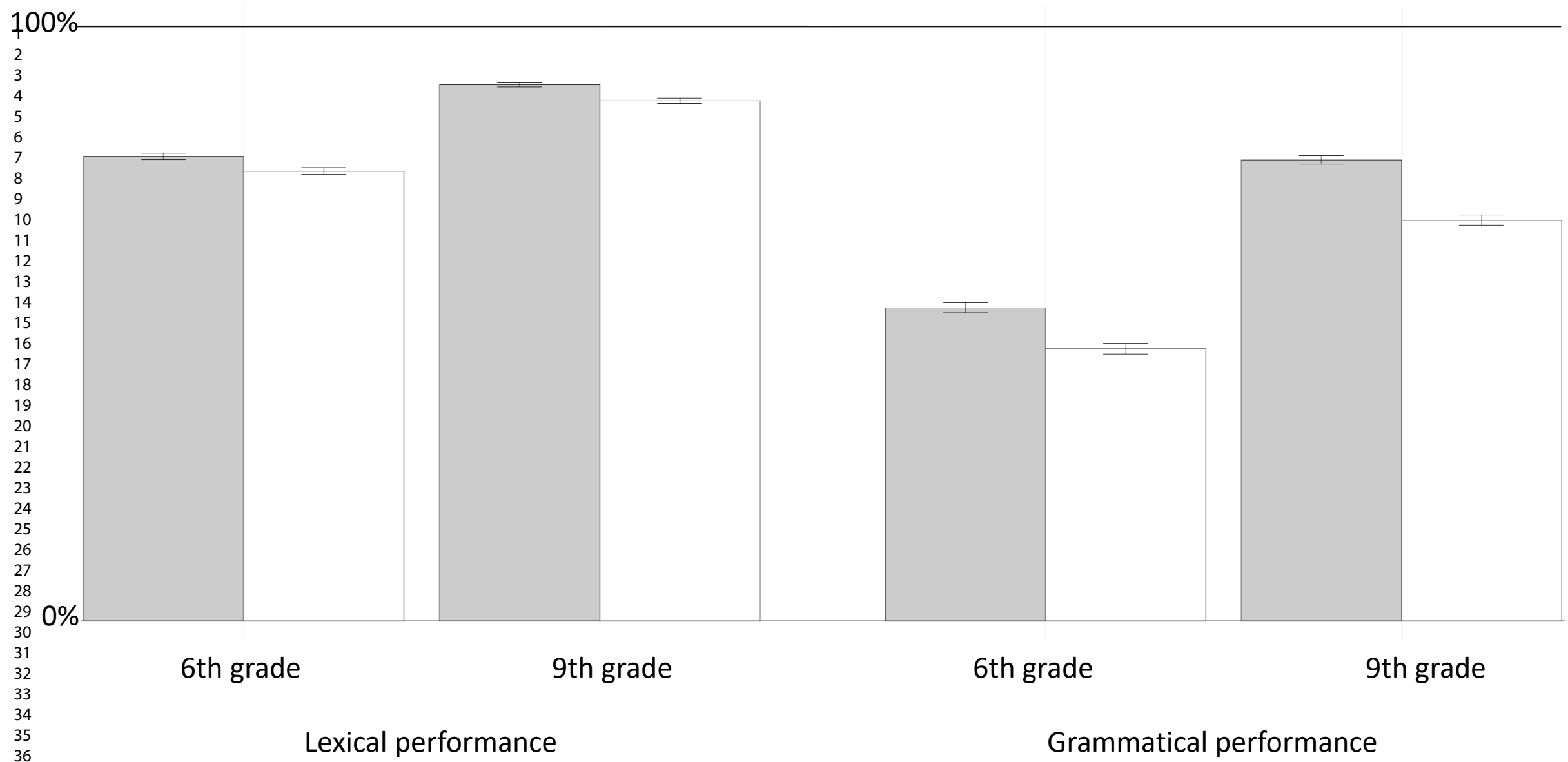
| | précisément | perfectionn(é) | Vieil |
|-------------------------------------|--------------------|----------------------|---------------|
| Phonologically plausible errors | | | |
| TOTAL | 14.4% | 53.8% | 38.6% |
| Most frequent | précisément: 7.2% | perfection(é): 40.2% | vielle: 38.6% |
| 2 nd most frequent | préssisément: 1.6% | perfeciionn(é): 1.5% | |
| 3 rd most frequent | précisément: 1.3% | perfexion(é): 1.5% | |
| Non-phonologically plausible errors | | | |
| TOTAL | 85.6% | 46.2% | 61.4% |
| Most frequent | précisément: 42.2% | perféctionn(é): 22% | vielle: 29.3% |
| 2 nd most frequent | precisement: 9.2% | pérféctionn(é): 2.3% | viel: 16.4% |
| 3 rd most frequent | préssisément: 6.2% | pérféction(é): 1.5% | veille: 5.1% |

Grammatical persistent errors on the 10 items showing more than 25% of errors at grade 9:

For each item, classification and percentage of the most frequent errors

| Item | Most frequent error classification | | Other frequent errors |
|---------------|------------------------------------|--|---------------------------|
| Voient | Singular form (voit) | | voie: 27.1%; vois (16.8%) |

| | | | |
|-----------------------|---|------|------------------|
| | | 4.8 | |
| brillant | Singular form (brille) | 3.7 | brilles: 20.5% |
| Verts | Plural mark (s) omission | 00% | |
| microscopiques | Plural mark (s) omission | 00% | |
| perfectionnées | Feminine mark (e) omission | 00% | |
| perfectionnées | Plural mark (s) omission | 00% | |
| peuplée | Feminine mark (e) omission | 00% | |
| immeubles | Plural mark (s) omission | 00% | |
| bariolés | Plural mark (s) omission | 00% | |
| raconter | /e/ verb ending (racontez) | 5% | raconté (18.0%) |
| informé | /e/ verb ending (informer) | 2.9% | informés (21.4%) |
| Décrit | Person mark on /i/ Verb ending (décris) | 6.4% | décrite (21.1%) |
| Ceux | Homophone: ce | 6.4% | se: 30.8% |



100%
2
3
4
5
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7
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11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
0%
30
31
32
33
34
35
36
37
38
39
40
41