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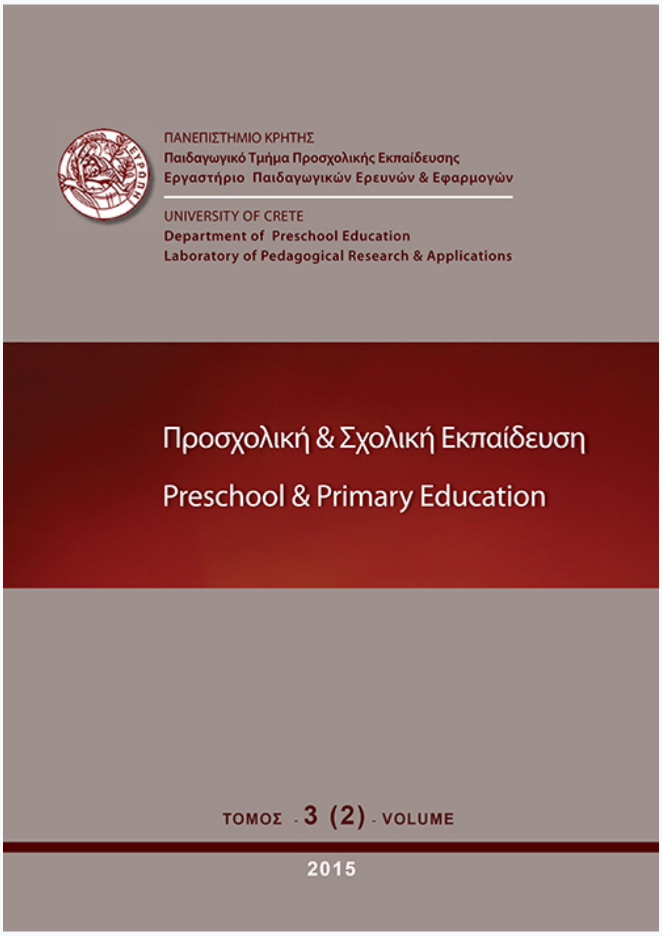

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The cognitive profiles of poor readers/good spellers and good readers/poor spellers in a consistent orthography: A retrospective analysis

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Abstract. Reading and spelling are closely related to each other, but empirical evidence shows that they can also dissociate. The purpose of this study was to examine the cognitive profiles of good readers/poor spellers and poor readers/good spellers in a relatively consistent orthography (Greek). One hundred forty children were administered measures of phonological awareness, rapid automatized naming, phonological short-term memory, and orthographic knowledge in grades 1 and 2. Their performance in reading and spelling was assessed in grade 4. Two small groups of children exhibited a dissociation between reading and spelling: seven children were identified as poor readers/good spellers and 11 children as good readers/poor spellers. The former group experienced severe deficits in both rapid naming and phonological awareness. The latter group experienced mild deficits only in orthographic knowledge. Although inefficient orthographic knowledge affects their spelling accuracy (Greek is inconsistent in the direction of spelling), it does not impact their reading fluency because they can recognize words by relying on partial cues.

Keywords: reading, spelling, dissociation, phonological awareness, rapid naming, orthographic knowledge, orthographic consistency

Introduction

Reading and spelling have long been considered two sides of the same coin: to read an individual needs to convert print to sounds, and to spell an individual needs to convert sounds to print. The close connection between reading and spelling has been documented by many studies in different writing systems (e.g., Babayiğit & Stainthorp, 2010; Cardoso-Martins & Pennington, 2004; Conrad, 2008; Ehri, 1997; Georgiou et al., 2011; Leppänen, Niemi, Aunola, & Nurmi, 2006; Vaessen & Blomert, 2013). In a meta-analysis, Swanson, Trainin, Necoechea, and Hammill (2003) reported that the average observed correlation between word reading and spelling was 0.70. Not surprisingly, good readers tend to be good spellers and poor readers tend to be poor spellers. However, the imperfect relationship between the two leaves the door open to situations of dissociation in which poor readers could be good spellers and good readers could be poor spellers (see Kamhi & Hinton, 2000; Perfetti, Rieben, & Fayol, 1997, for a review). A few studies have shown that these two

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performance patterns are not as rare as initially thought and may each be exhibited by as many as 3-7% of children (Fayol, Zorman, & Lété, 2009; Moll & Landerl, 2009; Wimmer & Mayringer, 2002). Nevertheless, not much is known about the cognitive processes underlying these performance patterns and whether they are the same across languages varying in orthographic consistency. Thus, the purpose of the present study was retrospectively to examine the cognitive profiles of good readers/poor spellers and poor readers/good spellers learning to read and write in a relatively consistent orthography (Greek).

According to the first dissociation, some children who experience difficulties in spelling can read quite well. Two competing hypotheses have been proposed to account for this type of performance pattern. Frith (1980) and Seymour and Porpodas (1980) argued that some good readers may be poor spellers because of their inefficient orthographic processing during reading. Bruck and Waters (1988), in turn, argued that good readers/poor spellers have insufficient knowledge of grapheme-phoneme correspondences for both reading and spelling. To examine the underlying cause of this deficit, researchers scrutinized the misspellings of these children. If the difficulty of good readers/poor spellers is caused by the greater ambiguity of the grapheme-phoneme correspondences (and lack of word-specific orthographic knowledge), they should produce proportionately more phonetically accurate misspellings than poor readers/poor spellers. In contrast, if the difficulty is due to inadequate knowledge of grapheme-phoneme correspondences, good readers/poor spellers should produce an equal number of phonetically accurate misspellings as poor readers/poor spellers and both groups should perform less well than good readers/good spellers. The misspellings should be phonetically accurate if children have adequate knowledge of grapheme-phoneme correspondences but do not know the appropriate spelling of a given word (e.g., write "fad" instead of "fat"). In contrast, the misspellings should be phonetically inaccurate if children have poor knowledge of grapheme-phoneme correspondences (e.g., write "fet" instead of "fat").

In her study, Frith (1980) found that good readers/poor spellers made significantly more phonetic errors than poor readers/poor spellers. In addition, good readers/poor spellers deployed different reading strategies than good readers/good spellers: whereas good readers/good spellers used all the cues available in a word, good readers/poor spellers relied on "partial cues" to read. Based on these findings, Frith (1980) concluded that poor spellers do not pay attention to all details of letter identity and sequence in words. If minimal cues are used for reading, reading can still be efficient but, at the same time, limited information becomes available for spelling, which requires high-quality orthographic representations. Since 1980, several studies have replicated Frith's findings in children and adults (Holmes & Castles, 2001; Holmes & Ng, 1993; Holmes & Quinn, 2009; Masterson, Laxon, Lovejoy, & Morris, 2007). However, there are discrepant findings about the cognitive profiles of good readers/poor spellers. Wimmer and Mayringer (2002), for example, found that German-speaking good readers/poor spellers performed significantly worse than good readers/good spellers in phonological short-term memory and phonological awareness. In contrast, Holmes and Quinn (2009) found no significant differences between the two groups in either phonological awareness or phonological short-term memory.

According to the second dissociation, some children experience reading difficulties in the presence of adequate spelling. Lovett (1987) identified in her study a group of 10-year-old English-speaking Canadian children who were slow (albeit accurate) readers, but as accurate in spelling as normal fluent readers. Wimmer and Mayringer (2002) also found that 4% of their sample in Study 1 and 6% of their sample in Study 2 were slow readers with no reliable spelling deficits. Dysfluent rather than inaccurate reading in consistent orthographies such as Finnish, German, Greek or Spanish is the norm rather than the exception because these languages have consistent grapheme-phoneme correspondences that allows even poor readers to read accurately, albeit slowly (e.g., Davies, Cuetos, & Glez-Seijas, 2007; Eklund, Torppa, & Lyytinen, 2013; Papadopoulos, Georgiou, & Kendeou, 2009; Wimmer, 1993).

It is, however, surprising that children with high-quality orthographic representations (as indexed by their good spelling) can be dysfluent readers. Naturally, one would wonder how could children use their orthographic knowledge for spelling, but not for reading? Previous studies have shown that orthographic knowledge is positively related to reading fluency: Children with good orthographic knowledge tend to be fluent readers (e.g., Boets, Wouters, Van Wieringen, De Smedt, & Ghesquière, 2008; Georgiou, Parrila, & Papadopoulos, 2008). According to Wimmer and Mayringer (2002), this paradox originates from a phonological speed deficit in dyslexia. Good phonological recoding skills help children develop their orthographic representations, which is in line with the premises of the self-teaching hypothesis (Share, 1995). However, because of their overreliance on phonological recoding, children do not move quickly from a sequential processing stage to a parallel processing stage of letters. Thus, they are slow readers, albeit accurate readers/spellers. In turn, Moll and Landerl (2009) suggested that this performance pattern may be due to unexpectedly slow access to orthographic representations. As spelling is generally slower than reading, a domain-specific deficit in the speed of access to orthographic representations that would impact word recognition speed may not impact children's spelling accuracy.

The purpose of the present study was retrospectively to examine the cognitive profiles (phonological awareness, phonological memory, rapid naming and orthographic knowledge) of good readers/poor spellers and poor readers/good spellers in Greek. Given that Greek is consistent in the direction of reading (95.1% consistency of grapheme-to-phoneme mappings), but relatively inconsistent in the direction of spelling (80.3% consistency of phoneme-to-grapheme mappings) (Protopapas & Vlachou, 2009), we would expect to find more good readers/poor spellers than poor readers/good spellers. If good readers/poor spellers have poor quality orthographic representations (Frith, 1980), they should perform significantly worse than both good readers/good spellers and poor readers/good spellers on a measure of orthographic knowledge. Likewise, they should perform poorly on phonological awareness because phonological recoding is a self-teaching mechanism for the construction of orthographic representations (Share, 1995). Finally, similar to the findings of previous studies (Lovett, 1987; Moll & Landerl, 2009; Wimmer & Mayringer, 2002), we expected poor readers/good spellers to have rapid naming deficits. We did not have a hypothesis for phonological short-term memory because the findings of previous studies were rather mixed (Holmes & Quinn, 2009; Wimmer & Mayringer, 2002).

Method

Participants

One hundred forty-nine grade 1 Greek-speaking children (71 males and 78 females; Mean age = 80.15 months, *SD* = 3.26) attending 12 public, inner-city schools were selected on a voluntary basis to participate in our study. One hundred thirty-six (65 males and 71 females; Mean age = 116.22 months, *SD* = 3.27) were followed until grade 4 and were assessed three times (in grades 1, 2, and 4). Thirteen children (8.72% of the sample) withdrew from the study either because they moved to a different school district and could not be located or because parents withdrew their consent. All participating children were native speakers of Greek, Caucasian, with no documented intellectual, sensory or behavioural difficulties.

To select the children who demonstrated reading or spelling difficulties we used the children's grade 4 reading fluency or spelling accuracy scores. The poor readers/good spellers' group consisted of seven children (5 females; mean age = 113.85, *SD* = 2.12) who scored below the 16th percentile on at least two of the three reading fluency measures (word reading efficiency, phonemic decoding efficiency, and text reading speed) and had average performance on spelling (above the 25th percentile). The good readers/poor spellers' group consisted of 11 grade 4 children (6 females; mean age =118.45, *SD* = 2.33) who scored below the 16th percentile on the spelling task, but achieved an average score on at least two of the three reading fluency tasks. Finally, a good readers/good spellers' group (called hereafter "controls") consisted of 36 children (18 females; mean age = 116, *SD* = 3.09) who performed within average range (35th - 75th percentile) on reading fluency and spelling. The characteristics of the three groups are presented in Table 1. Kruskal Wallis test showed significant differences between the three groups on the screening measures (all *p*s < 0.001). Follow-up post-hoc comparisons using Mann-Whitney U test showed that the poor readers/good spellers differed from the controls only on the reading measures and the good readers/poor spellers differed from the controls only on the spelling task. These findings indicate that the poor readers' and the poor spellers' group presented a single deficit in reading or spelling, respectively.

Table 1 Means (*M*) and standard deviations (*SD*) and Mann-Whitney U test's comparisons (z) on the screening measures in grade 4 for each group

	Poor Readers/ Good Spellers *n* = 7		**Good Readers/ Poor Spellers** *n* = 11		**Controls** *n* = 36		**PRe vs C**	**PSp vs C**
	M	*SD*	*M*	*SD*	*M*	*SD*	z[1]	z[1]
WRE	39.71	8.16	55.63	6.76	61.03	4.11	4.16***	2.45
PDE	25.57	3.95	36.79	5.31	38.31	3.45	4.13***	1.50
TRS	0.79	0.06	0.52	0.11	0.45	0.05	4.15***	1.79
Spelling	34.33	6.41	19.73	6.96	42.03	6.97	2.25	4.98***

Notes: WRE = Word Reading Efficiency; PDE = Phonemic Decoding Deficiency; TRS = Text Reading Speed; PRe = poor readers/good spellers; PSp = good readers/poor spellers; C = control group.
[1] = Bonferonni adjustment applied for multiple comparisons (to attain an alpha level of .05 has to be less than .0125 for the four comparisons in each pair). *** *p* < .001

Measures

Phonological Memory

Digit Span. The forward digit span task was adopted from the Wechsler Intelligence Scale-Third Edition (WISC-III, Wechsler, 1992; Georgas, Paraskevopoulos, Bezevegis, & Giannitsas, 1997 for the Greek adaptation). Participants were asked to listen carefully to a string of digits and then repeat these digits orally in the same order they heard them (e.g., 8-1; 6-1-2). There were two practice items and 16 test items (eight pairs of items of increasing length). Testing was discontinued after two consecutive errors at the same difficulty level. A participant's score was the number of correct items. Cronbach's alpha reliability coefficient in our sample was .92.

Nonword Repetition. Participants were asked to listen carefully to a nonword (e.g., *mase*) and then repeat it. The task consisted of three practice items and 23 test items. The first nine items required the repetition of two-syllable nonwords, the next four items the repetition of three-syllable nonwords and the last ten items the repetition of multisyllabic nonwords (from four to eight syllables). Testing was discontinued after four consecutive errors. A participant's score was the number of correct items. Cronbach's alpha reliability coefficient in our sample was .95.

Phonological Awareness

Elision. This task required children to listen to a word presented by the tester and then say the word without one of the sounds in the word. There were three practice items and 29 test items: four test items required the participant to say the word without saying one of the syllables and the remaining 25 items required the participant to say a word without saying a designated sound in the word. The position of the phoneme to be removed varied across those 25 items. Testing was discontinued after three consecutive errors. A participant's score was the number of correct items. Cronbach's alpha reliability coefficient in our sample was .94.

Blending. This task required children to listen to a series of separate sounds and then put the separate sounds together to make a whole word. There were five practice items and 20 test items: three test items required the participant to put together two syllables to make a word, five test items required the participant to put an onset and a rime together to make a word, and the remaining 12 items required the participant to put individual sounds together to make a word. The number of phonemes to be blended varied from 2 to 10. Testing was discontinued after three consecutive errors. A participant's score was the number of correct items. Cronbach's alpha reliability coefficient in our sample was .91.

Rapid Automatized Naming (RAN)

Colour Naming. Children were asked to name as quickly as possible five colours (blue, black, green, red, or yellow) presented on a laptop computer screen and arranged semi-randomly in five rows of ten. The total time to name all 50 stimuli was recorded and used as the participant's score. Prior to timed testing, each participant was asked to name the colors in a practice trial to ensure familiarity. The names of colours in Greek are "μπλε" (/*ble*/) for blue, "μαύρο" (/*mavro*/) for black, "πράσινο" (/*prasino*/) for green, "κόκκινο" (/*kokino*/) for red, and "κίτρινο" (/*kitrino*/) for yellow. Because only few naming errors occurred they were not considered further. Wolf and Denckla (2005) reported test-retest reliability for Colour Naming to be .90.

Digit Naming. Children were asked to name as quickly as possible six digits (4, 7, 8, 5, 2, 3) that were displayed on a laptop computer screen in semi-random sequence six times each for a total of 36. The total time to name all 36 stimuli was recorded and used as the participant's score. Prior to timed testing, each participant was asked to name the digits to ensure familiarity. The names of digits in Greek are "τέσσερα" (/*tesera*/) for four, "επτά" (/*epta*/) for seven, "οκτώ" (/*okto*/) for eight, πέντε (/*pende*/) for five, "δύο" (/*ðio*/) for two, and "τρία" (/*tria*/) for three. Because only few naming errors occurred they were not considered further. Wagner, Torgesen, and Rashotte (1999) reported test-retest reliability of .91 for Digit Naming for children aged five to seven.

Orthographic Knowledge

Orthographic Choice. The Orthographic Choice task was adapted in Greek (see Georgiou et al., 2008) from the work of Olson and colleagues (e.g., Olson, Forsberg, Wise, & Rack, 1994; Olson, Wise, Conners, Rack, & Fulker, 1989). The students viewed on an A4 page thirty pairs of letter strings that sounded alike, but were spelled in a correct and in an incorrect (pseudohomophone) form (e.g., <αγόρι> – <αγόρη>, /agori/ → boy - boi) and were asked to circle the one that was spelled correctly. Because of the consistency of the Greek orthography, the selected correct words and their pseudohomophones differed only in terms of the vowels (/i/, /o/, and /ε/) included in the words. A participant's score was the number of correctly circled real words. Cronbach's alpha reliability coefficient in our sample was .72.

Grade 4 Measures

Reading Fluency. Reading fluency was assessed with three measures: word reading efficiency, phonemic decoding efficiency, and a text reading fluency task. The first two measures were developed in Greek following the Test of Word Reading Efficiency (Torgesen, Wagner, & Rashotte, 1999). In word reading efficiency, the children were asked to read as fast as possible a list of 104 words increasing in difficulty, divided into four columns of 26 words each. The words were selected from the children's grade 1 to 6 language textbooks. In phonemic decoding efficiency, the children were asked to read as fast as possible a list of 63 nonwords increasing in difficulty. The nonwords were developed by substituting letters in real words with some others or by switching the position of existing letters in real words. A short, 8 word/nonword practice list was presented before each subtest. In each task, the participant's score was the number of correct words/non-words read within a 45-second time limit. Test-retest reliability coefficient has been reported to be .94 for word reading efficiency and .86 for phonemic decoding efficiency (Georgiou et al., 2008).

The text reading fluency task was adapted in Greek from the Grey Oral Reading Test (Wiederholt & Bryant, 2001; see Georgiou et al., 2008, for details on the adaptation). The participants were asked to read two short passages as fast and as accurately as possible. The time taken for each participant to read the two short passages was recorded. A participant's score was the number of words read in both passages per second. Wiederholt and Bryant (2001) reported test-retest reliability for GORT to be .93.

Spelling. Spelling was assessed with a standardised spelling test developed by Mouzaki, Protopapas, Sideridis, and Simos (2007). The participants were asked to write 60 real words of increasing difficulty. A target word was spoken, then a sentence containing the word read out and finally the target word was repeated by the examiner and children were asked to write it on a sheet of paper. Testing was discontinued after six consecutive errors. Children's scores were based on the number of words spelled correctly. According to the test instructions, stress errors and stress omissions were not taken into account. The maximum score was 60. Cronbach's alpha reliability in our sample was .94.

Procedure

All participants were tested individually in their respective schools during school hours by trained experimenters. In grades 1 and 2, children were administered measures of phonological short-term memory (given only in grade 1), phonological awareness, RAN, and orthographic knowledge. Testing lasted approximately 40 minutes. Reading fluency and spelling were assessed at the end of grade 4. Testing lasted roughly 20 minutes. Parent's written consent for each child was obtained prior to testing.

Results

The statistical analysis was completed in two steps: First, we compared the three groups on the cognitive processing skills in grades 1 and 2. Because the poor readers' and poor spellers' groups comprised a small number of children, non-parametric statistics were used. Second, we performed an individual's profile analysis in which the performance of each poor reader or speller on the cognitive processing skills was compared to that of the control group's mean.

Table 2 presents the descriptive statistics on the cognitive processing skills separately for each group, as well as the results of group comparisons using the Mann-Whitney U test. The results of these comparisons showed first that the poor readers/good spellers differed from controls on both measures of RAN and orthographic knowledge, as well as on a measure of phonological awareness (blending). In turn, good readers/poor spellers performed significantly poorer than controls on orthographic choice in grades 1 and 2 and on blending in grade 2. No differences between the three groups were found on phonological short-term memory.

Table 2 Means (*M*), standard deviations (*SD*) and Mann-Whitney U test's comparisons (z) on the grades 1 and 2 measures for the three groups

Measures	Poor Readers/ Good Spellers		Good Readers/ Poor Spellers		Controls		PRe vs C	PSp vs C
	M	*SD*	*M*	*SD*	*M*	*SD*	z	z
Grade 1								
Digit span	5.14	1.46	5.40	1.17	6.17	1.58	1.50	1.51
NW repetition	10.43	2.93	12.70	3.80	13.31	3.77	1.92	.68
Elision	11.43	7.89	10.82	7.01	14.92	7.26	1.12	1.47
Blending	10.57	5.71	12.36	3.75	14.83	6.56	2.06*	1.65
RAN_Colors	82.79	26.70	65.39	25.17	63.41	12.57	2.14*	.88
RAN_Digits	43.99	19.24	28.60	10.63	26.13	3.88	2.93**	.05
Orth_Choice	15.71	8.22	20.36	3.93	23.67	3.41	2.98**	2.45*
Grade 2								
Elision	19.85	8.39	19.45	3.69	21.81	5.38	1.87	1.53
Blending	11.14	4.49	12.45	3.72	15.31	3.78	2.63*	2.02*
RAN_ Colors	70.21	28.76	56.55	16.08	50.65	7.96	2.53*	1.16
RAN_Digits	29.59	7.41	23.77	3.86	21.56	3.59	2.89**	1.66
Orth_Choice	22.86	4.01	23.18	4.81	26.50	2.97	2.37*	2.68**

Notes: NW = Non word; Orth = Orthographic; RAN = Rapid Automatized Naming; PRe = poor readers/good spellers; PSp = good readers/poor spellers; C = control group. * $p < .05$; ** $p < .01$

The above analyses focused solely on between-group differences. In order to examine whether we could identify individuals with different patterns of relative strengths and weaknesses across the tasks, we created a performance profile for each poor reader/speller across the tasks. Table 3 presents the results of this analysis. For the purpose of this analysis, we assigned: (1) a *minus* sign into each cell where the individual's score was 1.5 *SD* below (for the accuracy measures) or above (response time measures) the control group's mean; (2) a *zero* if the individual's performance was between 1.5 *SD* above/below and the control group's mean; (3) a *plus* sign if the individual's performance was at or above (accuracy measures)/below (response time measures) the control group's mean but less than 1.5 *SD* above/below it; and (4) two *pluses* if the individual's performance was at or more than 1.5 *SD* above/below the control group's mean.

Table 3 shows that most of the poor readers/good spellers suffered from a RAN deficit. Five out of seven individuals classified as poor readers/good spellers in grade 4 achieved a score of 1.5 *SD* above the control group's mean on at least one of the RAN tasks. It is notable that two of these children obtained a score above 1.5 *SD* on all RAN tasks assessed in both grades. No poor reader/good speller obtained a score at or below the control group's mean on the RAN tasks at any grade. Many of the poor readers/good spellers experienced also serious weaknesses in blending: four of them met the criterion of a very low performance (below 1.5 *SD*) in both grades. Deficits in elision were not as pronounced; three of the individuals (ids 1, 3, 4) obtained a score at or above the control group's mean in grade 1 or 2, and only the one individual (id 5) with severe weaknesses on all tasks also had a deficit in elision. Orthographic processing deficits were also evident in poor readers/good spellers; three children performed at least 1.5 *SD*s below the control group's mean in grade 1 and three in grade 2.

Table 3 The cognitive profile of poor readers/good spellers (PReGSp) and good readers/poor spellers (GRePSp) in grades 1 and 2

	Phonological Awareness				Rapid Automatized Naming				Orthographic Knowledge		Phonological Memory	
Tasks	El_1	El_2	Bl_1	Bl_2	Colours_1	Colours_2	Digits_1	Digits_2	OC_1	OC_2	DS_1	NWR_1
PReGSp ID												
1	+	++	+	+	0	0	0	0	0	-	0	0
2	-	0	-	-	0	0	-	-	0	0	0	0
3	+	+	0	0	-	-	-	-	-	-	0	0
4	0	++	-	-	0	-	-	-	0	0	+	0
5	-	-	-	-	-	-	-	-	-	-	-	-
6	0	0	0	-	0	0	-	0	-	0	0	0
7	0	0	-	-	0	0	0	0	0	0	0	0
GRePSp ID												
8	+	+	+	+	+	-	0	0	0	0	0	+
9	0	+	0	0	+	0	+	-	0	0	0	+
10	-	0	0	0	-	-	-	0	-	-	0	0
11	0	0	0	0	+	0	+	0	0	0	+	0
12	0	0	-	-	+	+	+	0	0	0	0	0
13	0	0	0	0	0	0	0	-	-	-	0	0
14	0	+	-	-	0	0	0	0	-	0	0	0
15	0	+	+	+	+	0	+	0	+	0	0	++
16	-	0	0	0	0	+	+	+	0	0	0	0
17	+	0	0	0	0	+	+	+	+	0	0	0
18	+	+	+	+	+	+	+	0	0	+	0	+

Notes: PReGSp ID = Poor Reader/Good Speller Identification Number; GRePSp ID = Good Reader/Poor Speller Identification Number; El = Elision; Bl = Blending; OC = Orthographic Choice; DS = Digit Span; NWR = Nonword Repetition; 1 = grade 1; 2 = grade 2.

The good readers/poor spellers did not show as many weaknesses in the cognitive processing tasks as poor readers/good spellers. Most poor spellers showed weaknesses on orthographic choice; three of them obtained a very low score (1.5 *SD* below the control group's mean), whereas only one of the poor spellers (id 18) obtained a score in orthographic choice at or above the control group's mean. The next notable weakness shown by poor spellers was in blending; two individuals (ids 12, 14) obtained a score 1.5 *SD* below the control group's mean in both grades 1 and 2. The performance of participant 18 is particularly noteworthy because he demonstrated no significant weaknesses in any measure other than a low score in orthographic choice in grade 1.

To summarize, variability in the individuals' performance profile in grades 1 and 2 was evident. On the one hand, poor readers/good spellers demonstrated mainly RAN deficits. On the other hand, good readers/poor spellers showed deficits mainly in orthographic choice followed by a smaller deficit in blending. Phonological short-term memory deficits were shown only by one child with poor reading/good spelling who performed poorly on all tasks assessed in grades 1 and 2.

Discussion

The purpose of this study was to examine the cognitive profiles of Greek-speaking children who were either good readers/poor spellers or poor readers/good spellers. This is important in light of evidence that the dissociation between reading and spelling affects 3 to 7% of the children (Wimmer & Mayringer, 2002). The findings supported our first hypothesis that more children would experience specific spelling difficulties (8.08% of our sample) than specific reading difficulties (5.14% of our sample). This was expected because Greek is more inconsistent in the direction of spelling than in the direction of reading (see Protopapas & Vlachou, 2009).

The natural follow-up question is what cognitive processes account for these performance patterns. To answer this question, we retrospectively examined the cognitive profiles of the children within each group on phonological and orthographic processing skills. It is obvious from Table 3 that more cognitive difficulties were associated with the poor readers/good spellers than for the good readers/poor spellers. In line with Moll and Landerl's (2009) observation we found that the latter group behaves more or less like the control group and experiences only mild difficulties in orthographic knowledge. This suggests that poor spellers are able to develop word-specific orthographic knowledge, but they are not as efficient in doing so as typically developing children. Partial orthographic knowledge may be adequate for reading words fluently, but it is not sufficient for accurate spelling in Greek (Loizidou-Ieridou, Masterson, & Hanley, 2010; Protopapas, Fakou, Drakopoulou, Skaloumbakas, & Mouzaki, 2013; see also Seymour & Porpodas, 1980). An alternative explanation could be that these children experience deficits in morphological awareness, which has been found to be a strong predictor of spelling, but not reading fluency in Greek (Ioannou, Diamanti, Mouzaki, & Protopapas, 2012; Manolitsis & Grigorakis, 2012; Nunes, Aidinis, & Bryant, 2006). Unfortunately, we did not assess morphological awareness in our study.

In contrast to Bowers and Wolf's (1993) proposition that RAN may impact the development of orthographic knowledge, our findings showed that the mild orthographic processing deficit of good readers/poor spellers was not accompanied by a RAN deficit. In contrast, the intact phonological awareness skills of good readers/poor spellers support Frith's (1980) argument that poor spellers continue to use a phonological strategy for spelling, even after the age of 8, although they use orthographic patterns in order to read efficiently in a visual way. Although the good readers/poor spellers did not seem to have a cognitive profile that is deviant from that of the controls, these findings do not exclude the possibility that a different linguistic profile between these two groups exists. In other words, it is still under question whether the spelling errors of the good readers/poor spellers are different from the spelling errors of good readers/poor spellers. Certainly, an analysis of the spelling errors of the different groups should be performed in the future.

On the other hand, in line with our hypothesis, poor readers/good spellers experienced pronounced deficits in RAN. Five out of seven poor readers (71%) performed at least 1.5 *SD* below the control group's mean on RAN Digits in grade 1 and four of them continued to experience the same difficulty in grade 2. However, the performance of these children in blending appears to be equally affected (57% of them had deficits in both grades). Most of the children with a deficit in blending also had a deficit in RAN Digits in both grades. This suggests that to be able to read fluently in later grades, children not only need to access the phonological representations of graphemes, but they should also blend the retrieved phonemes quickly. The profile of these children is in line with the double-deficit hypothesis (Wolf & Bowers, 1999), according to which children with deficits in both phonological awareness and RAN have the most severe reading problems. Evidence in support of the double-deficit hypothesis has been provided by several studies in consistent orthographies (Escribano, 2007; Papadopoulos et al., 2009; Torppa, Georgiou, Salmi, Eklund, & Lyytinen, 2012; Wimmer, Mayringer, & Landerl, 2000). Although poor readers/good spellers performed significantly poorer than controls on orthographic knowledge, this difference is likely driven by the larger variability in scores observed in orthographic knowledge in the poor readers' group. In general, it seems that the poor readers/good spellers group have faced early on in their lives a wider range of cognitive deficits than the good readers/poor spellers' group. This pattern of findings is in line with previous research for the profile of poor readers in Greek (Mouzaki & Sidieridis, 2007; Papadopoulos, 2013; Papadopoulos, Kendeou, & Shiakalli, 2014; Protopapas & Skaloumbakas, 2007) and also supports the argument that "… reading may lend itself to a greater variety of knowledge sources and procedures than spelling" (Fletcher-Flinn, Schankweiler, & Frost, 2004, p. 640).

Some limitations of the present study are worth mentioning. First, our sample size was small. This impacted the kind of analysis we could run and reduced the power in our analyses. Future studies should replicate these findings with a larger sample. Second, differences between the groups were found in blending, but not in elision (see Moll & Landerl, 2009, for similar non-significant findings in elision). In light of findings that phoneme segmentation, more so than any other phonemic awareness task, predicts spelling acquisition and characterizes poor spelling performance (e.g., Dolores, 1983; Nation & Hulme, 1997; Tunmer, 1991), our phonemic awareness tasks may have not been optimal. Finally, we assessed only lexical orthographic knowledge in our study. Given that sublexical orthographic knowledge (e.g., word likeness) is also important for reading fluency (Tims, 2013), or that print exposure could be an intermediate variable between orthographic knowledge and word reading (Cunningham & Stanovich, 1990), future studies should examine the profile of poor readers or spellers on these constructs as well.

To conclude, our findings add to a small body of studies examining the dissociation between reading and spelling (e.g., Fayol et al., 2009; Frith, 1980; Moll & Landerl, 2009). We showed that dysfluent reading originates from deficits in RAN and phonological awareness (blending). In turn, poor spelling is due to the lack of word-specific orthographic knowledge. Poor spellers have the ability to build orthographic representations (an ability that is further supported by intact phonological recoding skills; see Papadopoulos et al., 2009; Porpodas, 1999), but they do not do it as efficiently as good spellers. Two pieces of evidence support this explanation: first, their misspellings are not qualitatively different than those made by good spellers (Harris & Giannouli, 1999; Loizidou-Ieridou et al., 2010), and second, their orthographic processing performance is not profoundly poorer than that of controls.

Finally, our findings have some important educational implications. Although reading and spelling seem to be two sides of the same coin, it seems that they should be treated differently during intervention based on the side that has the most serious vulnerabilities. Phonological awareness training or encouraging poor spellers to read words as fast as they can, could be ineffective if the reading side of their literacy profile is intact. In contrast, poor readers, even if they are good spellers, should be encouraged to capitalize their phonological representations into word reading (Ehri, 2014) and to read words as fast as they can by using partial cues (e.g., subword orthographic-phonological connections) in order to enhance their orthographic processing skills.

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