Chapter 5
An Epidemiological Survey of Specific Reading and Spelling Disabilities in Arabic Speaking Children in Egypt

Wessam Mohamed, Karin Landerl and Thomas Elbert

Abstract While the relationship between reading and spelling disabilities has been reported for many European orthographies, very few studies have been conducted on other types of orthographies. The current chapter studies the relationship between reading and spelling deficits in Arabic based on an epidemiological survey of these deficits in Arabic-speaking children in Egypt. We screened a sample of 1106 Arabic-speaking third graders for their reading and spelling abilities. The prevalence rate for combined deficits in reading as well as spelling was high (12.6 %), but very low for isolated deficits in reading (0.9 %) or spelling (1.1 %). Importantly, we observed less dissociation of reading and spelling in vowelized Arabic compared to shallow orthographies such as German. This finding has implications for word processing in Arabic and it highlights the need for further studies of both typical and atypical development of literacy skills in Arabic-speaking children.

Keywords Arabic · Dyslexia · Reading · Spelling-dissociation · Incidence-fluency · One-minute test · Bilingualism

5.1 Introduction

No orthography appears to be immune to literacy disorders. Whereas the majority of children master their literacy skills effortlessly, in all orthographies, some children show impairments in converting sounds to their corresponding written units (Boets et al. 2006; Hoien et al. 1995), a central symptom of dyslexia. Dyslexia has been

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characterized by an unexpected difficulty in reading despite adequate opportunities, intellectual ability, and motivation (Jiménez et al. 2009; Shaywitz and Shaywitz 2001).

5.1.1 Are Reading and Spelling Two Sides of the Same Coin?

According to ICD-10, (World Health Organization 2000), spelling difficulties are frequently associated with a specific reading disability and they often persist into adolescence even after some progress in reading has been made. This is likely due to the fact that the two components of literacy, reading and spelling, are closely linked yet not identical. Empirical evidence shows that the correlation between word reading and spelling in English ranges between 0.77 and 0.86 (Ehri 1997). Such high correlations indicate that very similar processes are measured in these tasks even when different materials for reading and spelling are used. This is true among younger (first to sixth graders) as well as college students (Ehri 1997). This suggests that a single orthographic lexicon is probably used for reading and spelling processes (Leppänen et al. 2006; Lerkkanen et al. 2004) . Furthermore, both reading and spelling require in part the same phonological and visual skills.

Although the association between reading and spelling development is strong, there exist a considerable number of children with striking dissociations. This has been documented by the ICD-10 diagnosis of a specific spelling disability for individuals with intact reading skills. Moreover, observations of dissociations in both directions (good reading/poor spelling and poor reading/good spelling) have been reported in French (Fayol et al. 2009) and in German (Moll and Landerl 2009; Wimmer and Mayringer 2002). In English, empirical evidence suggesting separate mechanisms for spelling and reading was provided by Bryant and Bradely as early as 1980. According to their studies, both dyslexic and non-dyslexic beginning readers read more words accurately than they were able to spell. However, some children were able to spell some words but unable to read them with a prevalence rate of 3 and 13 % for dyslexic and non-dyslexic children, respectively. In a similar study, Gough et al. (1992) found that non-dyslexic beginning readers were sometimes able to spell words they were unable to read (on average 10 %). Also, they were able to read words on one occasion but not on another (10 %) and, sometimes, they spelled words inaccurately on one occasion, but not on another (11 %). Neuropsychological case studies of patients after brain damage describe clear alexia without agraphia (for review, see Coslett 2000) as well as clear agraphia without alexia (e.g., Beauvois and Derouesne 1981).

In alphabetic orthographies, reading is commonly thought to precede spelling during development (Leppänen et al. 2006). This is probably due to a certain amount of asymmetry between the consistency of grapheme-to-phoneme and phoneme-to-grapheme conversion in most alphabetic writing systems. In languages like Spanish, German, Dutch, or Greek, there is, mostly, one way to pronounce one grapheme but there is sometimes more than one graphemic representation for

a phoneme (Abu-Rabia and Taha 2004). Also, reading requires recognition of orthographic representations only, while spelling requires full retrieval of the correct letter sequence from orthographic memory (Moll and Landerl 2009).

5.1.2 Reading and Spelling in Arabic

The Arabic writing system is primarily consonantal with short vowels (as well as other phonological material) represented by optional diacritics. All diacritics mapping phonemic material are regularly mapped onto the phonemes they represent. (For a detailed description of Arabic language and orthography, see Saiegh-Haddad & Henkin-Roitfarb, in this collection.) Only when these diacritics are marked (vowelized or vocalized script) can the Arabic orthography be described as *orthographically transparent* (Elbeheri and Everatt 2007; Saiegh-Haddad 2005). Evidence shows that vowelization functions as a significant facilitator of reading accuracy and reading comprehension in beginning and more advanced Arabic learners (Abu-Rabia 1997, 2001, 2002; Abu-Rabia et al. 2003; Taouk and Coltheart 2004).

Paradoxically, the diacritical system in Arabic, although useful in decreasing phonological ambiguity, might constitute a source of difficulty for the beginning reader while mastering Arabic word-decoding skills necessary for the development of the phonological (non-lexical) route. This could be attributed to the complexity of the vowelization system which requires use of visuo-spatial processing (Meyler and Breznitz 1998). When texts are not vowelized, as is the case in most modern written and printed literary texts, the reader has to depend on context and/or morphology and syntax in order to identify words (Abu-Rabia 1998).

Arabic is also considered a typical case of *diglossia* (Ferguson 1959; Hudson 2002). This phenomenon refers to the use of two varieties of the same language in the same speech community, one for *High* and another for *Low* functions. In Arabic, as a typical case of diglossia, the spoken and the written languages are substantially different in terms of vocabulary, phonology, syntax, and grammar. (For more on diglossia and its implications for literacy acquisition, see in this collection, Laks & Berman, for linguistic distance, Myhill for a cross-linguistic perspective, Khamis-Dakwar & Makhoul for assessment, and Saiegh-Haddad & Spolsky for educational problems and prospects.) This linguistic distance implies that Arabic native speaking children learn to read a language with which they have relatively little familiarity (Abu-Rabia 2000; Saiegh-Haddad 2003, 2004, 2005, 2007, 2011, 2012; Saiegh-Haddad et al. 2011).

Reading development in Arabic can have interesting theoretical and practical implications because reading acquisition starts with the use of a shallow vowelized orthography and very soon, around the fourth or fifth grade, transitions into reading in an unvowelized deep orthography. Research has shown that, in the early stages, children rely on a grapheme-to-phoneme conversion mechanism rather than on whole-word recognition. The former process can only be used when Arabic script is presented vowelized (Taouk and Coltheart 2004) and it facilitates early decoding by

reducing phonological ambiguity (Share and Levin 1999). In turn, this accelerates an earlier transition from the phonological-recoding phase to the orthographic phase (Share 1995). On the other hand, the diacritical system itself requires learning and thus it might constitute a source of difficulty for the beginning reader while mastering Arabic word decoding. In addition, the Arabic orthography is characterized by letter similarity, groups of letters that share a basic shape but vary by the number and location of dots, and by allography, use of different letter shapes according to position within the word (see Saiegh-Haddad & Hekin-Roitfarb, in this collection). These orthographic features have been argued to slow the process of reading in Arabic. (For more on orthographic and other linguistic aspects of Arabic word processing, see in this collection, Eviatar & Ibrahim: Chap. 4, Boudelaa: Chap. 2, and Hansen: Chap. 3.) Given letter similarity and allography, reading problems in Arabic might arise in the phonological-recoding phase (Abu-Rabia and Taha 2004; Azzam 1993) especially among poor readers (Abu-Rabia 1995). Another factor that might affect basic phonological recoding processes in Arabic is Arabic diglossia and specifically the phonological distance between Spoken Arabic and Standard written Arabic (Saiegh-Haddad 2003, 2004, 2005, 2007, 2012).

In a study of the development of reading and spelling processes in Arabic- speaking children in grades 1 through 6, Azzam (1993) analyzed the profiles of the children's reading and spelling errors. The results showed that, in Arabic, a logographic visual phase (Frith 1985) is first adopted for reading. Importantly, alphabetic and orthographic strategies were found to develop first in spelling and later in reading. For Azzam (1993), to acquire basic literacy in Arabic, the use of an alphabetic strategy may be enough for accurate reading, while accurate spelling requires at least the use of orthographic strategies if not full grammatical/semantic skills. Taking this into consideration, it might be predicted that the interdependence between reading and spelling diminishes in later stages of literacy acquisition in Arabic for two reasons. First, dissociations between reading and spelling in Arabic are pronounced during the transition from the logographic to the alphabetic phase (Abu-Rabia and Taha 2004). For instance, beginning learners, especially first graders, were shown to have a clear lack of knowledge of Grapheme-Phoneme Correspondence (GPC) rules due to many factors such as allograhic variants, diglossia phonemes and probably most importantly teaching methods. This result was also extended to second graders where children showed sequencing errors while reading (Azzam 1993). Second, alphabetic strategies are required for accurate reading, while orthographic strategies are required for accurate spelling. Thus, there is a difference in the strategies required for fluent reading and spelling (Azzam 1993).

5.2 Isolated Deficits in Reading or Spelling

Dyslexia is reported to be the most common type of learning disability and is estimated to affect 80% of all individuals identified as learning disabled (Shaywitz and Shaywitz 2001). In English-speaking countries, the prevalence of dyslexia is

estimated to range between 5 and 17% of school-aged children, with as many as 40% of the entire population of the United States, for instance, reading below grade level (Shaywitz and Shaywitz 2001). At first sight, reading and spelling disabilities appear to associate. Generally, good readers (GR) are good spellers (GS) while poor readers (PR) are poor spellers (PS). However, two observations conflict with such a simple view, and show that reading and spelling can dissociate (Fayol et al. 2009). As early as 1980, Frith described a group of 12-year-old English speakers who unexpectedly spelled poorer than they could read. Comparing their spelling errors to that of GR-GS and PR-PS showed that those GR-PS spelled phonetically, but could not recall the exact letters of specific words (Frith 1980). These observations have been confirmed and extended to include other children and adults who have a good grasp of GPC and are able to spell phonetically, but have difficulties remembering word-specific information (e.g., Holmes and Castles 2001). In contrast to the former dissociation, a second dissociation (PR-GS) has been rarely reported. For example, Lovett (1987) described a group of 10-year-old English-speaking Canadian children who were good spellers, but poor (mainly slow, not inaccurate) readers. This type of dissociation was reported not only for English but also, and even more so, for shallow orthographies with regular grapheme–phoneme relationships such as German. In these orthographies, it has been shown that the main problem of dyslexic children concerns fluency not accuracy (Wimmer and Mayringer 2002). Accordingly, it was suggested that speed rather than accuracy may be the most appropriate diagnostic measure in these orthographies (Moll and Landerl 2009). Evidence for this dissociation was proposed by Wimmer and Mayringer (2002) who examined the dissociation in two samples of German-speaking third and fourth graders. They identified 4.3 and 6.4% of children with a single reading fluency deficit (poor readers/good spellers) and 7.9 and 6.8% of children with a single spelling deficit (good readers/poor spellers), respectively. In a recent study, Moll and Landerl (2009) replicated these findings in a representative sample of 2029 German-speaking elementary school children. Results showed equally high prevalence rates for isolated deficits in reading (7%) or spelling (6%). Moreover, in a sample of 1453 French-speaking fifth graders, Fayol et al. (2009) observed equal prevalence ratios (4%) of isolated reading and spelling deficits. Interestingly, using a fluency index rather than an accuracy index sheds light on this dissociation. The results of the research discussed above show that in the case of slight phonological deficits that are associated with fast processing, children can still read accurately and rapidly using incomplete orthographic representations which are mostly sufficient to distinguish between words, but not able to attend to the orthographic forms of words and memorize incomplete representations that impair their spelling performance (Fayol et al. 2009; Moll and Landerl 2009; Wimmer and Mayringer 2002). In contrast with this deficit, the isolated reading deficit may be attributed to the efficiency of their phonological abilities and the slowness of their processing which combine and enable them to store precise orthographic representations. Therefore, poor readers-good spellers are able to read pseudo-homophones[1] suggesting a re-

[1] Pseudo-homophones are pseudo-words that are phonetically identical to an existing word; for example, groan/grone and crane/crain.

liance on intact orthographic representations in word reading (Moll and Landerl 2009), which support both their accurate reading and spelling performance, but not their fluency (Fayol et al. 2009). Thus, a rapid naming deficit in this group suggests problems in fast visual-verbal access (Moll and Landerl 2009).

While the incidence of dyslexia and the relationship between reading and spelling skills among school students have been investigated in European orthographies, little empirical research has been reported for Arabic speakers. To our knowledge, a single attempt (by Farrag et al. 1988) has been made to estimate the prevalence of specific reading disability in Egyptian second and third graders; incidence ranged from 1 to 8 %, depending on the selection criterion applied. Eight percent of the children were labeled as backward readers,[2] while 3 % of the children whose IQ was 90 or above received the diagnosis of specific reading disorder. Three years later, children with specific reading disorder were reassessed and only 1 % read three years developmentally behind their expected grade level.

To date, only a handful of studies have compared the assessment of reading problems using measures of reading fluency rather than traditional measures of reading skills as word decoding accuracy (Meisinger et al. 2010). Hence, the present study aims to investigate the relationship between fluent word reading and spelling in an epidemiological sample of 1106 Arabic-speaking third grade children in Egypt.

5.2.1 The Current Study

The current study aimed to probe the prevalence rates of specific reading and spelling deficits in a large and representative sample of 1106 Arabic-speaking children in grade 3. This approach further enabled the investigation of associations and dissociations between reading and spelling skills. Specifically, we aimed to identify children who show a normal development in their general cognitive abilities (measured by a non-verbal IQ test), but are severely impaired in reading fluency and/or spelling. To label a child as severely impaired in reading and/or spelling, we applied a cut-off score of 2 years behind grade level in literacy measures. This was possible as we had investigated the level of reading and spelling in first graders at the same schools in an earlier study (Mohamed et al. 2010).[3] This 2-year criterion helped in the identification of children whose IQ is within the normal limits, but who show delay assessed not just by their below grade-level performance (below 16th percentile). To illustrate, the 16th percentile was used as a cut-off score to label a child as having a reading delay, while a child who scored below the norm of first graders was to be labeled as severely impaired or developmentally delayed in reading. Having these two cut-off scores enabled us to compare our results with the only study reported for Arabic, which used the same developmental delay criteria for their

[2] Backward readers were labeled when a reader's IQ was below 90.

[3] In a previous study, the authors validated literacy measures on Arabic-speaking children from first through third grade. In the current study we use means of first graders as a cut-off score to determine third graders who perform 2 years behind their grade level in reading and spelling.

sample of fifth and sixth graders (Farrag et al. 1988). To calculate the prevalence rates of dissociations between reading and spelling, we applied the same criteria used in previous studies (Moll and Landerl 2009; Wimmer and Mayringer 2002). Again, this enabled us to compare our results to previous findings.

5.2.2 Method

5.2.2.1 Participants

A representative sample of 1106 third-grade elementary school children were screened for their reading and spelling abilities as well as for their general level of cognitive functioning. It is assumed that, in about three years of formal tuition, even children with poor literacy background and development would have had a good chance to develop reasonable non-lexical and lexical procedures for their reading and spelling (Moll and Landerl 2009). Moreover, the third grade is crucial in the Egyptian educational system for the assessment of academic achievement including literacy skills.[4] Mean age of the participants was 8.2 years with an *SD* of 0.57. Children were randomly selected from different school types with particular consideration given to their relative distribution in the country. Hence, the sample included 26 public schools (368 boys, 340 girls), six private schools (142 boys, 116 girls), three Language schools[5] (34 boys, 23 girls), and one Experimental school (38 boys, 45 girls). Schools were selected to represent the different districts in Beni-Suef, a city in the North Upper Egypt Region marked by a comparatively high birth-rate.

Children were assessed 3 months after the beginning of the academic year. Children who did not attend kindergarten were excluded from the study. Only children with an IQ of 85 or above and without any evidence for neurological, sensory, or motor impairment were included in this study. Parental consent forms were sent home and the verbal consent of children was obtained.

We operationalized specific reading or spelling disabilities based on the criteria of Jiménez et al. (2009) as follows: (a) low performance on literacy measures, (b) poor academic performance in literacy skills based a teacher's rating report, and (c) an IQ within the normal range, in order to exclude students with broader intellectual deficits. A cut-off score of *2-years-behind grade level*, which indicates a marked developmental delay, was used to label children who are severely impaired in reading and/or spelling.

[4] In the Egyptian educational system, "grading" policy is used according to which students are moved to higher grades even if they did not score well enough especially in the first and second grade. A student cannot be graded unless s/he achieves a certain cut-off score in the third grade.

[5] Both Language and Experimental schools offer a type of schooling whereby children are intensively presented to a second language other than Arabic, their mother tongue from kindergarten. In these schools, it is mainly the English language that is used as the language of instruction in most of the classroom subjects, except for History. While the fees in Language schools are fully afforded by parents of the children, fees of the Experimental schools are mostly sponsored by the government.

5.2.2.2 Tasks

One Minute Reading Test. The 1 min reading test has been proven to be an efficient and practical way to assess reading performance, especially in orthographically transparent languages (Willburger and Landerl 2009). The Arabic script serves as a transparent orthography when presented in a vowelized form. Therefore, we used a 1 min reading test which was designed to provide an assessment of the accuracy as well as the fluency of reading. The test provides a score for correct words read aloud in only 1 min and was modeled after the Ein-MinutenLeseflüssigkeitstest designed by Willburger and Landerl (2009). Two sheets were presented to the child including either words or pseudo-words. Each sheet contained 136 items to be read aloud, which were presented in eight columns with slightly increasing difficulty with respect to word frequency and length. Practice items were given to the participants before reading the test items. Both sheets were presented in fully vowelized Arabic including verb inflections, but case-marking nunation[6] was disregarded in this test. A test-retest method (with a 1 month interval) with 109 children showed reliability coefficients of 0.95 and 0.73 for word and pseudo-word lists, respectively. Criterion-related validation was also used to demonstrate the validity of the test. This was accomplished by comparing test scores with the teacher's subjective ratings of the students' performance in reading and spelling on a three-point scale of good, average and poor. In a random sub-sample of 83 students, test performance was found to highly agree with the teacher's categorization of readers as good, average, and poor. An ANOVA showed a significant group effect for the word reading test, F (2, 81) = 5.80, $p < 0.01$, and the pseudo-word reading test, F (2, 81) = 5.43, $p < 0.01$, respectively. Post hoc comparisons (Scheffé-Test) showed that poor readers, as estimated by teachers' ratings, received the lowest scores on word and pseudo-word lists, respectively, (mean = 2.6 and 1.2) as compared to average readers (mean = 9.6 and 4.5) who in turn received significantly lower scores than good readers (mean = 23.2 and 12.6; all p-values < 0.01). Moreover, the scores that teachers gave to the children on a scholastic Arabic language achievement test was positively correlated with the scores of the children on our one-minute reading test, $r = 0.35$ and 0.34, $p < 0.01$ for word and pseudo-word reading, respectively (see Mohamed et al. 2010, for further details).

Spelling Test. The test was designed based on the *Salzburger Lese- und Rechtschreib-Test* (SLRT) by Landerl et al. (1997). The final version of our test consisted of 36 sentences, each including one target word that had to be written to dictation. Sentences were read aloud with a consideration of the word-final syntactic vowelization (*ʔiÀra:b endings*). (For a discussion of phonemic and syntactic vowelization in Arabic, see Saiegh-Haddad and Henkin-Roitfarb, in this collection.) Chosen sentences to be spelled out were formed in terms of standards[7] that have

[6] nunation"/*tanwi:n*/is the addition of a final nun to a noun or adjective to indicate that it is fully declinable and syntactically unmarked for definiteness.

[7] Standards for spelling were provided in the teacher's guide for teaching Arabic in Egypt.

to be fulfilled by third graders to be good spellers. The criteria for Arabic spelling in the first 3 years had been thoroughly analyzed, and was provided by the teacher's guide for teaching Arabic in those years. Accordingly, target words for the test were selected based on the specific spelling skills that students should master in each grade. In order to get a differentiated impression of children's spelling skills one point was given for each grapheme that was written correctly (max. = 204). A test-retest reliability assessment (with a 1 month interval) among 43 children showed a coefficient of 0.92, $p < 0.01$ for grapheme spelling accuracy. As with the previous test, criterion-related validation was used that probed whether the test was capable of distinguishing between good, average, and poor spellers, based on teachers' observations and ratings of a random sub-sample of 84 students. ANOVA showed a significant group effect, $F(2, 82) = 12.28$, $p < 0.01$. Post hoc comparisons (Scheffé-Test) confirmed that poor spellers, as estimated by the teachers' ratings, received the lowest scores (mean = 68.4) as compared to average spellers (mean = 92), who in turn received a significantly lower score than good spellers (mean = 149.91, $p < 0.01$). Moreover the children's performance on a scholastic Arabic language achievement test was positively correlated with the scores on our spelling test, $r = 0.47$, $p < 0.01$ (see Mohamed et al. 2010, for further details).

General Ability. Children's general ability was assessed using "The Non-verbal Pictorial Mental Abilities" test (Saleh 1978). This test measures non-verbal deductive reasoning abilities between the ages of 8 through 18 years. The test takes 10 min to administer and may be applied in a group format. It contains 60 pictorial items, and children are asked to cross out the odd picture (Saleh 1978). Stimuli are drawn from the Egyptian environment but may be used in other Arab countries as well (Elbeheri et al. 2006).

5.2.3 Procedure

First, the "Non-verbal Pictorial Mental Abilities" test was administered in a group format following typical school conditions; next the spelling test was given. Care was taken to make sure that the students did not copy from each other. An Arabic teacher read the sentences aloud one by one and children were asked to write down the target word correctly. Once the dictation task was completed, the response sheets were collected. Then, two separate one-minute word and pseudo-word reading tests were individually administered in a quiet place (the library). Administration of the two tests was counterbalanced. Children were encouraged to read the words aloud as fast as they could by giving them a practice trial of six items in each test. Their attention was specifically directed towards the diacritics, which would help them to read the vowelized script correctly. Then, they were allowed 1 min measured by a stopwatch for each sub-test.

5.2.4 Results

Mean scores of correctly read items in 1 min for the full sample of third graders was 26.5 ± 17.4*SD* for words and 12.6 ± 9.7*SD* for pseudo-words. For spelling, mean scores of correctly spelled graphemes were 159.0 ± 48.5*SD*. Children's mean IQ was 101 ± 13*SD*. Figure 5.1 presents box plots for the literacy measures for boys and girls separately in each school type. ANOVAs for each of the literacy measures with the between subjects factors of school type and gender revealed significant effects of school type on word reading: F (3, 1098) = 56.6, $p < .001$ η2 = 0.13; pseudo-word reading: F (3, 1098) = 63.3, $p < 0.001$, $\eta^2 = 0.15$; and spelling: F (3, 1098) = 48,5, $p < 0.001$, $\eta^2 = 0.12$. No gender differences and no interactions between school type and gender were observed. Post-hoc Scheffé tests for school type indicated that for all three literacy variables (word and non-word reading and spelling) speed performance among children attending public schools was significantly lower ($p < 0.001$) than among students of the other three school types. For pseudo-word reading, students from private schools showed significantly lower speed ($p < 0.05$) than children from the experimental school.

Correlations between the test scores are presented in Table 5.1. Word and pseudo-word reading were strongly correlated (0.87) and were therefore combined into a reading fluency score that will be used for further analysis. Table 5.1 also demonstrates a strong association between reading and spelling in Arabic. The relation between general ability measured by the non-verbal IQ test and all literacy skills was only moderate, but still significant probably due to the large sample size.

The correlation between reading fluency (combined for words and pseudo-words) and spelling is further examined in a scatter plot in Fig. 5.2. Interestingly, the relation between the two skills appears to be exponential rather than linear: the lower left section of the graph presents children with varying degrees of grapheme knowledge, but their reading fluency is still very low. Only for children who were able to transcribe about 100 or more of the dictated phonemes correctly into graphemes, reading fluency shows a systematic increase. Thus, it seems that a certain level of familiarity with grapheme-phoneme translation needs to be acquired through spelling before an impact on reading fluency becomes evident. With regard to accuracy, Azzam (1993) showed that to acquire literacy, alphabetic mechanisms are required for accurate reading while orthographic strategies are crucial for competent spelling. In this sense, accurate reading seems to precede orthographic spelling which seems to precede competence in reading fluency among children acquiring the Arabic orthographic system.

5.2.4.1 Prevalence of Reading and Spelling Disorders

In order to gain adequate cut-off scores for our *2-years-behind* criterion, the literacy tests were given to a control group of first graders who produced mean scores of 8 for reading and 84 for spelling, respectively. Based on these cut-off scores, 90 third

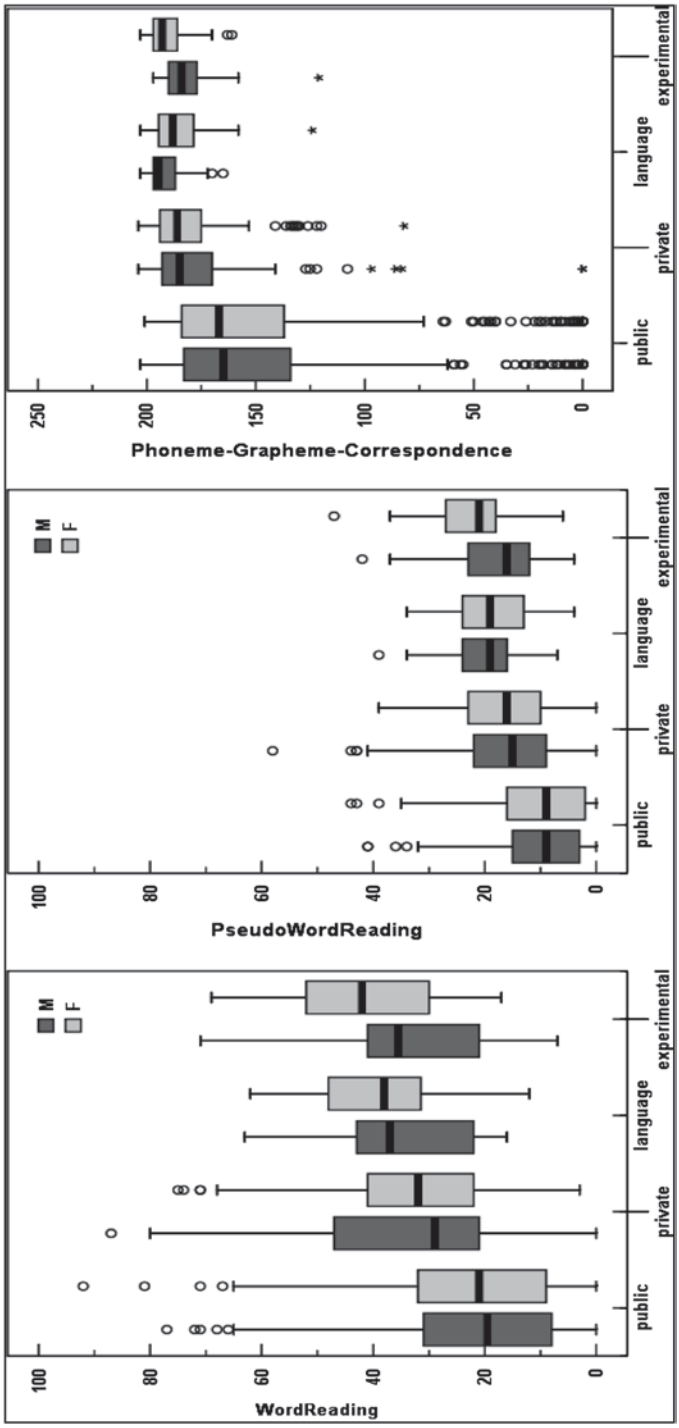

Fig. 5.1 Box plots of word reading, non-word reading, and spelling in different school types separately for boys and girls. "M" stands for male, while "F" stands for female

Table 5.1 Pearson correlation matrix for the whole cohort

	IQ	Word reading	Pseudo-word reading	Reading
Word reading	0.18			
Pseudo-word reading	0.18	0.87		
Reading (combined)	0.19	0.98	0.95	
Spelling	0.23	0.67	0.63	0.67

All correlations are significant on the 0.001 level

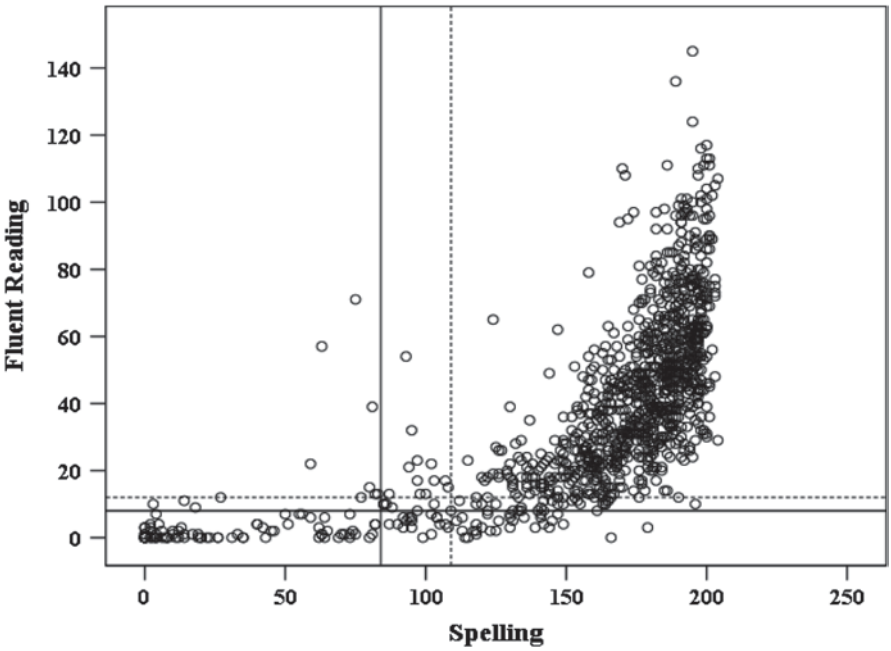

Fig. 5.2 Plotting of fluent reading against spelling. Cut-off scores are represented by reference lines (*full line*: percentile 16, *dotted line*: percentile 25)

graders (8.1%) were identified as severely poor readers and/or spellers. Interestingly, no significant gender difference was found: among the severely poor readers/spellers, 51 were boys and 39 were girls ($P=0.21$). Almost all severely reading/spelling impaired children attended public schools, only three cases were identified in private schools and not a single case of reading and/or spelling disability was identified in either Experimental or Language schools.

In order to calculate the prevalence of cases where reading and spelling skills show a marked dissociation, a more lenient selection criterion was defined, following Moll and Landerl's (2009) analysis for German-speaking children: all children who scored below the 16th percentile in either reading fluency or spelling were classified as poor readers/spellers. Children who scored above the 25th percentile

were labeled as good readers or good spellers. These cut-off scores are presented in Fig. 5.2 as reference lines. Based on these selection criteria, we calculated the prevalence of three groups: good readers-poor spellers, good spellers-poor readers, and poor readers-poor spellers. As evident from Fig. 5.2, only few children with clear dissociations between reading and spelling skills could be identified. Only 1.1% of the full sample was identified as good readers-poor spellers, and only 0.9% of the sample was categorized as poor readers-good spellers. The prevalence of children who perform poorly in reading as well as spelling was clearly higher at 12.7%. The low prevalence of children with isolated problems in reading or spelling is also evident from the finding that out of 150 children with poor reading skills, only 6.7% showed good spelling skills, and out of 152 children with poor spelling skills, only 7.9% had intact reading skills.

5.2.5 Discussion

The current study explored the prevalence of fluent reading and spelling disorders in a large sample of Arabic-speaking third graders. The assessment of reading speed is standard in orthographies with higher grapheme-phoneme consistency (transparent orthographies) as in these orthographies reading accuracy is high even in poor and dyslexic readers (Klicpera and Schabmann 1993; Landerl 2001; Wimmer 1993; Wimmer et al. 1998). Therefore, in more consistent orthographies, speed rather than accuracy is the appropriate diagnostic measure (Moll and Landerl 2009). We also wanted to know whether recent findings of marked dissociations between fluent reading and spelling development in German (Moll and Landerl 2009) and in French (Fayol et al. 2009) could be replicated for Arabic. The main findings of our study were as follows: (a) there is a strong association between the development of fluent reading and spelling in the vowelized Arabic script, (b) a certain amount of grapheme knowledge seems to be necessary in order to develop reading fluency, so, unexpectedly, the development of adequate spelling skills is very likely to precede fluent reading and at the same time enhances it, and (c) between 8 and 15% of Arabic-speaking third graders exhibit specific reading and/or spelling disorders, but isolated disorders in reading or spelling are rare.

5.2.5.1 Prevalence of Disorders in Reading and Spelling in Arabi*c*

While most studies have defined dyslexia based on a reading level of bottom 16th percentile or one standard deviation below the mean with an IQ within the normal range (e.g. Lam et al. 2008; Lindergren et al. 1985; Rama 2000), in other studies (e.g. Gomez 2004) dyslexic children were diagnosed based on teachers' or parents' subjective reports. Based on the *2 years—behind grade level* (Farrag et al. 1988) as acriterion for a marked developmental delay, 8.1% of our sample were identified as children with reading and/or spelling disorders. This

incidence rate is within the range of 5 to 12 % reported for European languages. Cross-national comparisons showed an estimated incidence to be around 10 % in Italy, the U.S. (Lindergren et al. 1985) and Finland (Lyytinen et al. 2004). While prevalence of dyslexia ranges between 3 and 10 % in India, (Rama 2000), it was estimated to be around 10–12 % among Chinese school children (Lam et al. 2008). The only epidemiological study conducted in Malaysia reported 7 % of children with dyslexia (Gomez 2004).

Interestingly, we did not observe any systematic gender differences, either in the full sample analysis or with respect to prevalence rates of dyslexia. Such balanced gender ratios have also been shown for English (Shaywitz 1998) and Chinese (Lam et al. 2008). On the other hand, several epidemiological studies have found dyslexia to be 2–4 times more common in boys than in girls (Rutter et al. 2004) and it seems that this was probably not due to the tendency on the part of parents and teachers to refer more boys to clinics (Jorm 1983). However, Shaywitz and Shaywitz (2001) showed that when actual reading scores, and not teacher ratings, were used to identify children, there were no significant differences in the prevalence of dyslexia between boys and girls.

We observed systematic differences between the four school types, with children in public schools turning out to be underachievers in all literacy skills compared to the other types of school. Moreover, children with reading and spelling disorders were significantly more prevalent in public schools (12 %) than in private schools (1 %) while not a single case of dyslexia was identified in Language and Experimental schools. One plausible explanation for this difference may be that children in public schools typically have lower socioeconomic status (SES) compared to children in the other school types with a higher incidence of disabilities in reading and/or spelling. It has been reported that disabled readers or spellers are comparably rare amongst the highest social classes (Jorm 1983), in which home literacy environment (e.g., print exposure) is more favorable for the development of reading skills (Finucci 1985). Another possible explanation of the comparably good literacy skills in Language and Experimental schools may be that these children can profit from the early intensive bilingual education that is offered in these schools. Bournot-Trites and Tallowitz (2002) reported that children receiving bilingual teaching no longer show a lag behind monolinguals in their L1 literacy skills by grade 2 and 3, and this is due to the transferability of cognitive processes which contribute to the development of literacy skills between L1 and L2 (Cummins 1991). In line with this, Saiegh-Haddad and Geva (2010) conclude that transferability could be determined by (a) specific features of the linguistic and orthographic structure of the languages involved, (b) features of the learners, such as their linguistic proficiency, and the possibility of some proficiency threshold, and (c) contextual/instructional features such as explicit teaching and amount of exposure. Finally, it is worth noting that in our study, sample size was comparably small for Language and Experimental schools, so further research will be necessary to clarify the impact of bilingual education on the acquisition of literacy skills in L1 and L2.

5.2.6 Association between Reading and Spelling

Our results showed that reading and spelling in Arabic are correlated and accordingly are based on similar processes, and this in turn suggests more associations than dissociations between the two skills in Arabic. First, the association could be potentially explained by the fact that the development of both reading and spelling in the vowelized Arabic script are dependent on similar cognitive processes. Evidence showed that accurate reading in vowelized Arabic is predicted by a straightforward phonological awareness (Saiegh-Haddad and Geva 2008), as well as by memory, rapid naming and most strongly by GPC recoding knowledge (Saiegh-Haddad 2005). This latter finding aligns with previous research demonstrating a heavy reliance on GPC rules in reading in transparent European orthographies (Seymour et al. 2003). Similarly, early stages of spelling development require predominant reliance on phonological processes in consistent orthographies (e.g., Wimmer and Landerl 1997) and in Arabic (Taha & Saiegh-Haddad, ms.). This is illustrated by our results showing that learners of Arabic, namely vowelized Arabic, need first to read at a threshold level and only then does their fluent reading develop. In 1993, Azzam adopted Frith's model (1985, 1986) for Arabic and showed that spelling in Arabic accelerates both the alphabetic and the orthographic phase and that reading develops only later.

Another possible explanation for the early development of spelling compared to fluent reading could be attributed to the phonological distance in Arabic diglossia between the spoken and the literary/standard representations of Arabic language (Saiegh-Haddad 2003, 2004, 2005). In line with this it has been shown that fluent reading of pseudo-words by the end of the first grade is not directly predicted by phonological awareness but more by cognitive factors such as the speed of converting graphemes to phonemes (Saiegh-Haddad 2005) and morphological processing (Saiegh-Haddad and Geva 2008).

5.2.7 Are there Dissociations of Deficits in Reading and Spelling in Arabic?

As there were recent reports of a considerable proportion of children showing clear dissociations between reading and spelling skills in German (Moll and Landerl 2009) and French (Fayol et al. 2009), we aimed to investigate whether such isolated problems in reading or spelling could also be observed in our Arabic sample. Interestingly, such cases of poor readers-good spellers and good readers-poor spellers were very rare in our sample with prevalence rates of only 0.9 and 1.1 %. Thus, although there is some variability in the relation between reading and spelling in the full population, children who develop significant problems in literacy acquisition typically show serious deficits in both. This is an important finding with respect to intervention which should include both components, that is, reading as well as spelling.

5.3 Conclusion

The current analysis of an epidemiological sample of third graders acquiring the Arabic vowelized orthography in Egypt shows that a considerable proportion has developed serious deficits in reading and spelling. Epidemiological studies on Arabic are scarce, so this analysis provides important information for schools and health care systems to enable them to provide adequate support for affected children. This finding also points out the high relevance of research on the mechanisms underlying both typical and atypical reading and spelling development in Arabic.

It is important to note some limitations of the current research in Arabic. First, we used a reading measure that combined accuracy and speed into one score. Future studies might aim to design and administer measures that allow assessment of accuracy and fluency separately. Second, we used different materials for our reading and spelling tasks. Applying both, similar and different materials for reading and spelling will present a more differentiated view of the associations and dissociations between reading and spelling. Importantly, the role of diglossia in the relation between reading and spelling should be given more attention in order to adopt a broader sociolinguistic perspective for investigating reading and/or spelling deficits in Arabic orthography.

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