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How Can Orthographic Representations in Arabic Contribute to Phoneme Awareness Development?

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Abstract
The contribution of the orthographic representations to the development of phonemic awareness in Arabic was tested among 289 native Arab readers from the second, the fourth, and the sixth grade. Phonemic awareness was tested by using two phonemic segmentation tasks: words and pseudowords. The participants' words and pseudowords reading and spelling skills beside to orthographic knowledge were tested also. The results revealed that the accuracy levels of phoneme segmentation of words were higher than pseudowords for all ages. In addition, the results revealed that the pseudowords reading skills and the orthographic knowledge contributed significantly to the phoneme segmentations of words and pseudowords. The results were discussed in light of the assumption that in transparent orthographies, such like Arabic, the grain size of phoneme awareness development is contributed by capturing the correspondences between the phonology and the orthography and the orthographic representations development.

Keywords Phonological awareness · Orthographic knowledge · Arabic Language · Diglossia · Reading

Introduction

Reading and spelling acquisition were supposed to be contributed by the readers' phonological awareness skills (Landerl et al., 2019; Snowling, 2001; Torgesen et al., 1997; Vellutino et al., 2004). Phonological awareness is defined as the individual ability to realize the

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phonological structure, or the sound structure, of words (Anthony et al., 2007; Ziegler & Goswami, 2005). Different investigators postulate that intact development of the different levels of the individuals' phonological awareness increases the chances for intact acquisition of literacy skills (Anthony & Francis, 2005; Boets et al., 2006; Carrillo, 1994; Goswami et al., 2005; Landerl & Wimmer, 2008; Ziegler & Goswami, 2005).

The term "different levels of phonological awareness development" means that this skill develops from awareness to the large phonological components of the words (for example the syllables level of awareness) into the small phonological units, i.e., the phonemes (Anthony & Francis, 2005). First, children become aware to the whole phonological structure of spoken words, while through the linguistic development children make a progress toward awareness to the syllabic structure of words and later toward awareness to the basic phonemes that compose the words (the phonemic awareness level). Accordingly, phonemic awareness represents the deep level of awareness and describes the transition from large levels of phonological awareness into the "the grain size" levels (Anthony et al., 2007; Ziegler & Goswami, 2005). In addition, it was assumed that the phonological awareness development into the different levels can be distinguished by the task which is being performed and the size of the unit of sounds that is in the focus of the task, i.e. the large size or the grain size (Anthony & Francis, 2005; Ziegler & Goswami, 2005). For example, syllable segmentation tasks test the level of awareness for the large phonological units of words while phoneme segmentation tasks are intended to test the individual awareness to the grain size or the small units' level (Schuele et al., 2007).

Therefore, performing phonemic awareness tasks reflects a very progressive stage in the developmental course of the phonological awareness (Ziegler & Goswami, 2005). Such developmental course of reaching this "deep level" of phonological awareness seems to vary from one language to another due to the fact that linguistic and orthographic factors, which vary from language system to another, were found to have a significant role in enhancing the process of grasping the level of phoneme awareness (Anthony & Francis, 2005; Duncan, 2010; Goswami et al., 2005; McBride-Chang et al., 2004; Saiegh-Haddad, 2004; 2007; Tibi & Kirby, 2018). Consistently, different researchers exported that the development of the orthographic knowledge, which mainly expresses the development of the knowledge about the written components of words, was reported to affect the quality of the phonemic awareness development (Apel et al., 2019; Castles et al., 2003; Goswami, 1999; Lyytinen et al., 2006).

Different writing systems of different languages are considered as transparent orthographies where the orthography reflects the phonology of the words with high levels of correspondences. Other writing systems are considered as "low transparent orthographies" (Anthony et al., 2007; Lyytinen et al., 2006; Saiegh-Haddad & Geva, 2008; Spencer & Hanley, 2003). This contribution of the orthographic knowledge to the phonemic awareness skills was mainly evident in transparent than non-transparent orthographies due to the fact the consistent one-to-one grapheme-phoneme correspondences in transparent orthographies enable performing accurate phoneme segmentations by relying on the grapheme sequence of the stored orthographic patterns of words (Nayernia et al., 2019; Rakhlin et al., 2019; Goswami 1999). Such studies reported consistently that reaching the phoneme awareness levels in such transparent orthographies occur in the earlier stages of the reading acquisition because of the high-transparent relationships between the phonology and the orthography in these orthographies (DeJong & Van Der Leij, 2003; Lyytinen et al., 2006).

Accordingly, in transparent orthographies, such relationship between reading acquisition and phonological awareness is thought to be mutual; while phonological awareness efficacy affects the reading acquisition in early stages of acquisition, intact reading acquisition enables an intact exposure to print and in turn enhances reaching the grain levels of phoneme awareness (Castles & Coltheart, 2004; Hulme et al., 2005; Snowling, 2001). Therefore, different researchers reported about the direct impact of the orthographic knowledge on the developmental course of the phonological awareness. For example, Castles et al., (2003) found that adults exhibited higher accuracy levels on phoneme deletions when there were transparent correspondences between letters and sounds. In addition, it was found that elevated performance on phonological awareness tasks is associated with the use of orthographic information.

The Arabic orthography can be considered as a transparent in its vowelized form. Vowelization in Arabic are presented within the written pattern of the word as signs beyond the word letters and contributes to high levels of phoneme-grapheme transparency. This vowelized form of the written Arabic is used for reading instruction for early grades. By the time, and when the readers become more skilled (toward the end of the elementary school), vowelizations marks are omitted from textbooks and reading materials while the reading process become depends mainly on the orthographic knowledge of the readers. This type of non-vowelized orthography meets the consideration of non-transparent orthography (Taha, 2016).

From psycholinguistic point of view, Arabic language represents a pure case of diglossia, where two varieties of the languages are being used; the spoken and the Standard Arabic (see: Saiegh-Haddad, 2003, 2004; Taha 2013). The spoken Arabic is the daily life language which is normally acquired by native speakers of Arabic without any formal instruction. There are different spoken vernaculars which vary according to the different geographical regions. All the spoken vernaculars differ from the standard language which is usually used for formal communication and learning purposes and is usually acquired during the formal school years through intensive instructional process. The differences between the two linguistic contexts (The spoken and the standard Arabic) could be exhibited through different linguistic domains, the phonological, the morphological, and the conceptual domains. In light of the fact that the formal exposure to the standard Arabic usually begins when the individual starts to learn to read, it was supposed that this delay in the acquisition of the standard Arabic has a negative impact on the phonological awareness skills among native Arab readers (for further details see, Saiegh-Haddad, 2003 and 2004). This impact was reported as difficulties on processing several phonemes that exist only on the standard language but not the spoken one.

In light of the above-mentioned review, it can be assumed that the reading acquisition and orthographic knowledge of native Arab students enhance their phoneme awareness development. Accordingly, the main argument of the current study assumes that because of the transparent features of the written vowelized Arabic, which is the main case of orthography being used for teaching reading for beginner readers, the Arab students can benefit from this orthographic knowledge to grasp the phonemic structure of the words. Hence, the current study aims to investigate the developmental levels of phonemic awareness among native typical readers.

Yet, it is important to clarify that the large size of phonological awareness enhances reading acquisition in its early stages, whereas the development toward “grain size” of the

phonological awareness, i.e. the phonemic awareness, is found to be contributed mainly by the explicit phoneme-grapheme learning which is begins as an essential stage of learning to read (Anthony et al., 2007; Ziegler & Goswami, 2005). Therefore, familiarity with the orthographic sequence of letters of the written words contributes to the phoneme segmentation skills. Therefore, it could be postulated that, in Arabic, while children develop their knowledge about the sequence of the written graphemes which compose the orthographic patterns of the written words, they can easily understand the phonemic structure of such words. Such orthographic knowledge contributes to grasp the phonemic structure of words in more concrete manner. Therefore, phonemic segmentation of words with familiar orthographic patterns might be more accurate than the segmentation of the phonemes of words with non-familiar orthographic patterns. Even more, and due to the assumption that familiarity with letter sequence of the written word contributes to the segmentation process itself, it would be assumed that phoneme segmentation of words with familiar orthographic patterns might be performed more accurately than of words without orthographic familiarity. This effect might be expressed significantly within transparent orthographies, such like Arabic, where the letters represent the phonemes in consistent one-to-one correspondences. Therfore, the most important assumption is that developing orthographic representations contributes to the accuracy levels during performing phonemic segmentation tasks. Accordingly, it could be assumed that phonemic segmentation of real words, while there is a higher level of orthographic familiarity, will reveal into higher levels of accuracy compared to phonemic segmentation of words with low orthographic-familiarity levels such like pseudowords.

Two phoneme segmentation tasks were used in current study (pseudo and real words segmentation tasks). As it was above-mentioned, it has been assumed that high levels of accuracy will be recorded for both tasks in light of the fact that the phonological skills in transparent orthographies are contributed from the transparent relationships between the orthography and the phonology. However, and due to the assumption that orthographic representations contribute to the phoneme awareness level, it has been assumed that in view of the fact that orthographic representations are relevant for the real words but not for pseudowords, this makes the phonemic segmentation for real words easier than pseudowords.

In addition, orthographic knowledge is assumed to correlate with phoneme awareness and to explain significantly a large part of the variance in the performance of phoneme awareness tasks.

Method

Participants

Two hundred and eighty-nine readers (140 boys and 149 girls) with typical reading development were recruited from three age groups (2nd, 4th and 6th grades). For each participant, emotional, sensory, and neurodevelopmental disorders were excluded. For the second grade, 95 participants were selected (47 boys and 48 girls), with age mean of 8.26 ± 0.32, while for the fourth grade 95 participants were selected (51 boys and 44 girls), with age mean of 9.71 ± 0.21. Eventually, for the sixth grade 99 participants were selected (45 boys and 54 girls), with age mean of 11.61 ± 0.22. Parents' consents were obtained for each participant

before conducting the experiment. In addition, all the background data for each participant were stored in highly secured files.

The selection of the readers was implemented by using the school reading fluency scores that were reported by Arabic language teachers. It is important to mention that for each student, there is a school score that reflects his/her performance in reading fluency as it was measured according to the school fluency tests. Due to the fact that the data collection was conducted in the second semester of the school year, the first semester reading fluency scores were used. In light of the fact that there is a uniform objective indicator for examining reading fluency for all students in the schools, and in the absence of a standardized fluency tests, the above-mentioned method can be considered as a valid alternative one for the participants selection. Readers were defined as having difficulty in reading if their reading fluency scores ranged below the 16 percentile of the reading fluency scores, such readers were excluded. The selected readers with typical reading development were those of reading fluency scores that ranged between the 50 to the 75 percentiles.

Procedure

Each participant was tested individually in quiet place in the school, which was devoted for the research purposes. The data collection was implemented by students from a teachers' college for education who were trained carefully how to use the tasks and to implement all the stages of the study. All participants were speakers of the northern Palestinian vernacular of Arabic. The phoneme awareness skills were tested by using phoneme segmentation for real words task and another task for using phoneme segmentation for pseudo words. Both tasks were fully matched according to word length, phonological and syllabic structure (see task description). In addition, each participant was tested by pseudo and real words reading tasks to assess the reading and decoding accuracies. Using the reading tasks was to enable the testing of how the developments of reading skills contribute to the phoneme awareness skills. Reading development and mainly the explicit phoneme-grapheme learning, which is begins as an essential stage of learning to read, was reported to contribute to the phonemic awareness skills read (Anthony et al., 2007; Ziegler & Goswami, 2005). In addition, the orthographic knowledge and spelling was tested by using the following tasks: orthographic decision tasks, pseudo words and real words spelling tasks.

Tasks

Phoneme Segmentation Tasks

a) Full phoneme segmentation of words. This task consisted of 20 Standard Arabic words that ranged in length from 4 to 5 phonemes and 1 to 2 syllables. Participants were asked to segment each word into all its internal phonemes ($\alpha = 0.92$). Correct response was considered when the participant made a full true segmentation for all the phonemes of the word. The total accuracy level was computed as the sum of the correct responses for each participant. The selected words were those with high-level of frequency and familiarity according to judges ranks. This ranking procedure was implemented in aim to select the words for the task and to ensure that all the participants, in all age groups, are

familiar with the orthographic patterns of the presented words. Accordingly, three Arabic language teachers ranked the familiarity of the words in aim to ensure this familiarity to the readers. Each teacher was asked to rank each word by using a five-levels scale of orthographic word familiarity. Words that gained a familiarity rating score average above 3.5 were selected as familiar words and were included in the task. This process was the main one which was implemented for selecting the items of the real word in all the tasks in the current study.

b) Full phoneme segmentation of pseudo words. This task consists of 20 pseudo words that were composed with full matching with the above-mentioned selected real words according to the morphological patterns and length. Therefore, the pseudowords length ranged from 4 to 5 phonemes and 1 to 2 syllables. Participants were asked to segment each pseudoword to its separated phonemes ($\alpha = 0.93$). Correct response was considered when the participant made a full true segmentation for all the phonemes of the pseudoword. The total accuracy level was computed as the sum of the correct responses for each participant.

Reading tasks each participant was asked to read aloud a list of real words and another one of pseudowords. The description of the items in each list is presented as following.

a. a) Vowelized isolated real words: The task consisted of 30 words ($\alpha = 0.87$). The words which were used in this task targeted five different aspects of Arabic phonology and morphology. Each category consists of six words. A total of 30 words were presented within this task as following categories: (a) words with diglossic phonemes: words containing standard Arabic phonemes that are not within the spoken vernacular of the participants. (b) words with emphatic phonemes: words containing velarized phonemes which differ from non-velarized phonemes in one secondary phonetic feature (velarization) but share with it all three main phonetic features (voicing, place of articulation, and manner of articulation), both velarized and non-velarized phoneme pairs exist in Arabic and they are represented in the Arabic orthography using different letters. (c) Words with a diglossic syllabic structure. Words that have Standard syllabic structures which are not frequent in the spoken vernacular of the participants. (d) morphologically transparent regular words. Words that have a transparent morphological structure (no homophonic letters) and a regular mapping between their sounds and reading. (e) Morphological transparent irregular words: words that have a transparent morphological pattern. Reading these words requires the use of morphological cues. The letter length of the vowelized words ranged from 3 to 6 letters (mean $= 4.13 \pm 0.89$), while the syllabic length ranged from 1 to 4 (mean $= 2.5 \pm 1.13$).

b. b) Pseudowords reading task: The task consisted of 30 pseudo words ($\alpha = 0.89$). As in the real words reading tasks, this task was composed with keeping full matching with the stimulus in the real words reading task. Accordingly, this task was composed also by targeting five different aspects of Arabic phonology and morphology. Each category consists of six pseudowords. A total of 30 pseudowords were presented within this task as following categories: (a) pseudowords with diglossic phonemes: pseudowords containing standard Arabic phonemes that are not within the spoken vernacular of the participants. (b) pseudowords with emphatic phonemes: pseudowords containing velarized phonemes which differ from non-velarized phonemes in one secondary phonetic

feature (velarization) but share with it all three main phonetic features (voicing, place of articulation, and manner of articulation), both velarized and non-velarized phoneme pairs exist in Arabic and they are represented in the Arabic orthography using different letters. (c) pseudowords with a diglossic syllabic structure. Pseudowords that have a standard syllabic structure which are not frequent in the spoken vernacular of the participants. (d) morphologically transparent regular pseudowords. Pseudowords that have a transparent morphological structure (no homophonic letters) and a regular mapping between their sounds and reading. (e) Morphological transparent irregular pseudowords: pseudowords that have a transparent morphological pattern. Reading these pseudowords requires the use of morphological cues. The letter length of the vowelized pseudowords ranged from 3 to 6 letters (mean = 4.27 ± 0.9), while the syllabic length ranged from 1 to 4 (mean = 2.5 ± 1.13).

Spelling tasks two spelling tasks were used, real and pseudowords spelling tasks. In each task, each participant heard the item from the examiner and was asked to write it down. The description of the items in each spelling list is presented as following.

c. a. Real words Spelling Task: The task consisted of 30 words (α = 0.88). Each word was embedded within a short context and was read out loudly to the participant three times before s/he was asked to write it down. The words which were used in this task targeted five different aspects of Arabic phonology and morphology: (a) words with diglossic phonemes: words containing Standard Arabic phonemes that are not within the spoken vernacular of the participants; (b) words with emphatic phonemes: words containing velarized phonemes which differ from non-velarized phonemes in one secondary phonetic feature (velarization) but share with it all three main phonetic features (voicing, place of articulation, and manner of articulation), both velarized and non-velarized phoneme pairs exist in Arabic and they are represented in the Arabic orthography using different letters; (c) words with a diglossic syllabic structure. Words that have Standard syllabic structures that are not frequent in the spoken vernacular of the participants (e.g., CVCC); (d) morphologically transparent regular words. Words that have a transparent morphological structure (no homophonic letters) and a regular mapping between their sounds and spelling; (e) Morphological transparent irregular words: words that have a transparent morphological pattern. The letter length of the vowelized words ranged from 2 to 6 letters (mean = 4.23 ± 1.16), while the syllabic length ranged from 1 to 4 (mean = 2.53 ± 1.22).

d. b. Pseudowords Spelling Task: This task was used for as an indicator for the phoneme-grapheme encoding skills and the sub lexical process in spelling of new words. The task was developed by keeping a full matching with the real words spelling task. Accordingly, the task consisted of 30 pseudowords (α = 0.9). The words used in this task targeted six different aspects of Arabic phonology and morphology: (a) pseudowords with diglossic phonemes: pseudowords containing Standard Arabic phonemes that are not within the spoken vernacular of the participants; (b) pseudowords with emphatic phonemes: words containing velarized phonemes which differ from non-velarized phonemes in one secondary phonetic feature (velarization) but share with it all three main phonetic features (voicing, place of articulation, and manner of articulation), both velarized and non-velarized phoneme pairs exist in Arabic and they are represented in the

Arabic orthography using different letters; (c) pseudowords with a diglossic syllabic structure. Pseudowords that have Standard syllabic structures that are not frequent in the spoken vernacular of the participants (e.g., CVCC); (d) morphologically transparent regular words. Pseudowords that have a transparent morphological structure (no homophonic letters) and a regular mapping between their sounds and spelling; (e) Morphological transparent irregular pseudowords: words that have a transparent morphological pattern. The letter length of the vowelized words ranged from 3 to 6 letters (mean = 4.2 ± 0.99), while the syllabic length ranged from 1 to 4 (mean = 2.37 ± 1.03).

Any significant differences were found between the spelling and the reading tasks regarding the letter and syllabic lengths.

Orthographic Knowledge

Orthographic decision task: This task was designed for testing the orthographic knowledge. The task consists of 10 items (α = 0.7). Each participant was asked to choose the correct orthographic pattern of a written word from three suggested homophone patterns. Each item contained three homophonic targets (one is the correct orthographic pattern while the other are pseudohomophones), for example: <عضفـض ، عضفـد ، عضفـض >.

Results

For testing the effect of the orthographic familiarity of the items on the performances on the phonemic awareness performances, *the* 2 × 3 ANOVA was performed on accuracy using word condition (phoneme segmentation of words vs. pseudowords) and group of age (second, fourth and sixth). The results revealed a significant effect of the segmentation condition (words versus pseudowords) [F (1, 286) = 14.77, p < .001], while the average of words segmentation was significantly higher than the pseudowords segmentation (see Table 1 for means and SDs). In addition, a significant effect of grade was found [F (2, 286 = 3.78, p = .024] due to the higher accuracy levels for the older groups compared to the youngest groups. However, non-significant interaction of the segmentation condition by grade was found [F (2, 286) = 2.21, p = .11] keeping the situation of words superiority effect versus the pseudoword related performances (see Table 1 for means and SDs).

Beside to the analysis of variance that was performed, and for investigating the contribution of the orthographic knowledge variable to the performance on the words and pseudowords segmentation tasks, a stepwise regression was implemented for exploring the contribution of the reading performances in the different tasks (words and pseudowords) in addition to the contribution of the spelling performances and the orthographic knowledge (the performance in the orthographic decision task) to the performances in the phoneme awareness tasks.

Phoneme awareness of words. The results of the linear regression analysis revealed a significant contribution of the following predictors: the pseudowords reading ($R^2 = 0.48$), the performance in the orthographic decision ($R^2 = 0.09$), and the performance in pseudowords spelling task ($R^2 = 0.012$) (See Table 2 for the R^2 values and the F values considering the significant changes in the R^2 as result of the contribution of the different variables).

Table 1 Means and SDs for the performances in the different tasks

Grade		%Reading Pseudowords	%Reading Words	%words spelling	%Pseudowords Spelling	%Word phonemic segmentation 1	%Phonemic segmentation of pseudowords	%Orthographic decision
2nd	M	66.53	73.30	73.99	64.44	58.27	52.60	60.94
	SD	25.34	21.31	19.72	23.63	33.19	38.11	22.15
4th	M	74.25	81.53	81.56	71.19	63.28	61.82	66.63
	SD	19.91	15.53	15.68	19.78	30.85	32.50	22.15
6th	M	75.40	86.21	89.51	82.00	69.00	66.37	83.47
	SD	20.30	12.62	10.80	15.29	27.78	27.45	18.84

Table 2 R^2 and the F values considering the significant changes in the R^2 regarding the contribution of the different variables to the performance in the words phonemic awareness

Variables	R^2	R^2 change	F value
Reading Psuedowords	0.48	0.48	267.9***
Orthographic decision	0.57	0.09	195.13***
Pseudowords spelling	0.58	0.012	137.07***

*** = $p < .001$

Table 3 R^2 and the F values considering the significant changes in the R^2 regarding the contribution of the different variables to the performance in the pseudowords phonemic awareness

Variables	R^2	R^2 change	F value
Reading Psuedowords	0.44	0.449	233.75***
Orthographic decision	0.522	0.073	156.13***
Pseudowords spelling	0.53	0.014	110.7***

*** = $p < .001$

Phoneme awareness of pseudowords. The results of the linear regression analysis revealed a significant contribution of the following predictors: the pseudowords reading ($R^2 = 0.44$), the performance in the orthographic decision ($R^2 = 0.073$), and the performance in pseudowords spelling task ($R^2 = 0.014$) (See Table 3 for the R^2 values and the F values considering the significant changes in the R^2 as result of the contribution of the different variables).

Discussion

The main assumption of the current study argues that phonemic awareness represents a level of deep conscious of the phonological structure of words (Anthony et al., 2007; Ziegler & Goswami, 2005). Therefore, phonemic awareness develops as a result of reaching the level of understanding the relationship between the orthography and the phonology of words (Anthony & Francis, 2005; Duncan, 2010; Goswami et al., 2005; McBride-Chang et al., 2004). Accordingly, transparent rather than non-transparent relationships between the phonology and the orthography are supposed to have a different impact on the development of such awareness (Anthony & Francis, 2005; Goswami, 1999; Lyytinen et al., 2006; Nayernia et al., 2019; Rakhlin et al., 2019). The results from the current study support this assumption. The phonemic segmentation for familiar words was performed in more accurate manner compared to non-familiar patterns (pseudowords). This finding was consistent through all ages and supports the assumption that orthographic familiarity of the segmented words enhances the process of phoneme segmentation. The role of orthographic representations on enhancing phoneme segmentation can be explained as following:

Cognitively, familiar words are with higher chances to be mentally represented by orthographic representations, while this is not the case for pseudowords. It should be noted that in both tasks of phonemic segmentation there is a reliance on the processes of working memory for the purpose of performing the tasks (Oakhill & Kyle, 2000; Stage & Wagner, 1992). The involvement of working memory in the processes of phonemic segmentation is part of the process of the phonological processing. Therefore, the load on the working memory processes when performing the tasks will be reduced in the existence of orthographic representations which allow to monitor the process of the segmentation. Accordingly, since the orthographic representations exist in the case of real words, this enables monitoring the process of extracting the phonemes according to the order of the letters in the word. This

process reduces the load on working memory processes. Such orthographic representations do not exist in the case of the pseudowords and therefore the phonemic segmentation process will overload the working memory processes as compared to real words condition. This postulation is compatible with previous suggested one which proposed that learning to read and write in an alphabetical system allows the emergence of phonemic awareness and finely tuned phonological representations, as well as of orthographic representations. This could improve the quality, strength, and precision of lexical representations, and hence offer better support for the temporary encoding of memory items (Demoulin & Kolinsky, 2016). Accordingly, this could be the main reason why phonemic segmentation for words was cognitively less demanding than pseudowords.

For the current case of transparent orthography of Arabic, the orthographic representation enables the participant to rely on the sequence of the graphemes (letters and the vowelization signs) to extract the phonemes in sequential manner because of the dominant one-to-one phoneme-grapheme correspondences in the written Arabic. These transparent correspondences enable the use of the grapheme sequence to extract the phonemes in more accurate manner compared to cases of non-transparent correspondences (Goswami, 1999).

In light of the above-mentioned postulation where phoneme-segmentation of words benefits from the orthographic representations of such words, unlike pseudowords, the results showed that for older groups, and as result of their expanding orthographic representations, the accuracy levels for performing the phonemic segmentation for words become higher than those were recorded for the younger groups.

The regression analysis supports this latter explanation. Reading pseudowords and orthographic knowledge were the main significant predictors for the phonemic awareness performances in both tasks of phoneme segmentation. It makes sense that reading pseudowords explains will the performances in phonemic awareness since reading pseudowords depends highly on phonological decoding in according to the grapheme sequences. Accordingly, such task reflects the process of segmentation during the decoding process.

Therefore, as there are efficient phonological decoding processes, the ability to grasp the phonological structure of words will turn better. Following from that, the ability of phoneme segmentation could be strongly affected by the ability to use the knowledge about the orthographic patterns, as a cognitive strategy, for the purpose of "disassemble" the phonemes by relying on the sequence of the graphemes which compose the orthographic pattern of the word (Anthony et al., 2007; Lyytinen et al., 2006; Saiegh-Haddad & Geva, 2008; Spencer & Hanley, 2003).

As a result, for words which already have been represented as familiar orthographic patterns, the ability to perform phoneme segmentation by extracting the phoneme sequence during relying on their stored orthographic representations was found to be easier than pseudowords. For real words, there is no need to implement a composition of the orthographic representation in light of the fact that such representations are already exist in the orthographic mental lexicon. This situation makes the ability to disassemble words into phonemes less-demanding task compared to pseudowords.

From clinical and instructional implications points of view, the current research findings shed light on the cognitive basis of phoneme awareness development among native Arab readers. The current results demonstrate that the "grain" levels of phonological awareness are correlated with grasping the alphabetic code in Arabic and the development of orthographic representations of written words. Accordingly, clinical implications can be raised

from the current results, specifically for the field of the clinical assessment of phonological processing skills among reading disabled readers. Phonemic awareness development of reading disabled readers might be delayed as a result of non-sufficient development of orthographic representations of words because of the poor exposure to print.

One of the main limitations of the current study is related to the fact that words condition was compared just to pseudowords one, while the main assumption was that orthographic familiarity affects phonemic segmentations performances. Therefore, better comparisons can be revealed if were conducted between the segmentation of words with higher levels of orthographic familiarity compared to words with low levels of familiarity and pseudowords.

In addition, investigating the impact of the quality of exposure to print and reading skills on the performances of such tasks might be more informative when comparing skilled versus disabled readers. Even-more, it will be useful to investigate phonemic awareness skills among kindergarten children compared to first graders in aim to show that in case of lack of orthographic knowledge, performing phonemic awareness tasks would be difficult in a distinguished manner. Covering the above-mentioned limitations needs future research.

Declarations

Compliance with Ethical Standards The authors of the current manuscript declare that all parents of the participants in the current study gave their informed consent in writing prior to the inclusion of their children in the study. In addition, the authors declare that there are no conflicts of interest that could have direct or potential influence or impart bias on the work. The current study and all its ethical standards were approved by the research and ethical committee.

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