

Typology of Visual Dyslexia Errors in Arabic

A Single Case Study

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Abstract

This study aims to describe the errors made by children from 3rd-grade of primary school presenting visual dyslexia in the Arabic language. We applied several tests to evaluate performance in school and phonological skills in a single case study of a child with visual dyslexia. The case of the pupil Z-A presents a wide range of deficits in reading and writing. His difficulties are characterized predominantly by visual errors in all positions of the target words. His errors result in substitutions, omissions, additions, fewer errors in migrations and vowel substitutions. Some errors have affected the morphological aspect of the word, whereas in some Z.A's responses, he kept the root and omitted the suffixes of the words, as we noted difficulties in identifying letters in the test of "matching identical letters" with difference in position in the word or difference in diacritical mark, therefore, we noted a lexical effects such as the frequency of words and orthographic neighborhood effect. We suggest that Z-A has both subtypes of visual dyslexia, one impairment in the input of the orthographic visual analysis system, and the second at a later stage, outputs of the orthographic visual analysis system.

Keywords:

Visual dyslexia - Arabic language - Visual errors - Lexical effects - Letter identification disorders.

أخطاء عسر القراءة البصري باللغة العربية: دراسة حالة

الملخص

تهدف هذه الدراسة إلى وصف الأخطاء التي يرتكبها الطفل في الصف الثالث الابتدائي يعاني عسر القراءة البصري باللغة العربية. قامت الباحثة بتطبيق العديد من الاختبارات التي أعدها فريق علم أمراض اللغة بمركز البحث العلمي والتقني لتطوير اللغة العربية لتقييم الأداء الأكاديمي والمهارات الصوتية لحالة تعاني من عسر القراءة البصري.

تعاني الحالة ع - ز من اضطراب في القراءة والكتابة. وتتميز صعوباته بشكل أساسي بأخطاء بصرية في جميع مواضع الكلمات المستهدفة، تتميز أخطائه باستبدالات وحذف وإضافات وأخطاء أقل في عمليات الترحيل واستبدال أحرف العلة. أثرت بعض الأخطاء على الجانب المورفولوجي للكلمة، بينما في بعض إجابات عبد القادر احتفظ بالجزء اللواحق. كما بينت نتائج البحث صعوبات في تحديد هوية الحرف في كل من اختبار مطابقة الأحرف مع اختلاف في الموضع داخل الكلمة أو اختلاف في علامة التشكيل. إضافة لهذا، أظهرت نتائج الدراسة تأثيراً معجمياً مثل تكرار الكلمات وتأثير الجوار الإملائي. واقترحنا أن ز، ع يعاني من اضطراب في مستوى مدخلات نظام التحليل الهجائي البصري، واضطراب في مرحلة لاحقة، مخرجات نظام التحليل الهجائي البصري.

الكلمات المفتاحية:

عسر القراءة البصري - اللغة العربية - الأخطاء البصرية - التأثيرات المعجمية - اضطراب تحديد هوية الحروف.

Les erreurs de dyslexie visuelle en arabe: Une seule étude de cas

Résumé

Cette étude vise à décrire les erreurs commises par un enfant de 3^e primaire présentant une dyslexie visuelle en langue arabe. Nous avons appliqué plusieurs tests pour évaluer les performances scolaires et les compétences phonologiques. L'élève Z-A présente un large éventail de déficits en lecture et en écriture. Ses difficultés se caractérisent principalement par des erreurs visuelles dans toutes les positions des mots cibles. Ses erreurs entraînent des substitutions, des omissions, des ajouts et moins d'erreurs dans les migrations et les substitutions de voyelles. Certaines erreurs ont affecté l'aspect morphologique du mot, alors que dans certaines réponses d'abd-el-kader, il a conservé la racine et omis les suffixes. Comme nous avons noté des difficultés à identifier les lettres dans le test de correspondance des lettres identiques avec une différence de position dans le mot, ou une différence de signe diacritique, nous avons noté un effet lexical tel que la fréquence des mots et l'effet de voisinage orthographique. Nous suggérons que Z-A a les deux sous-types de dyslexie visuelle, une déficience dans l'entrée du système d'analyse visuelle orthographique et la seconde à un stade ultérieur, des sorties du système d'analyse visuelle orthographique.

Mots clés:

Dyslexie visuelle - Langue arabe - Erreurs visuelles - Effets lexicaux - Troubles de l'identification des lettres.

Introduction

The developmental and academic learning difficulties are among the main school issues that have taken a lot of examination into what establishes a significant hindrance to scholarly accomplishment and achievement. Among the most pervasive learning troubles in the school climate, we find that dyslexia is quite possibly the main contemporary educational problems. This is shown by a significant percentage of primary pupils suffering from difficulties in learning to read and write. Also, the absence of screening and symptomatic instruments in Algerian school forestall the privilege analyze and the detection of this issue which leads to confusion with other learning difficulties or other disorders, subsequently leading to repeated academic failure which is one of the problems that can lead to disastrous consequences for students and society.

The education survey conducted in Yemen in 2004 indicated that one of the most important causes of school failure, which reaches 43% in elementary schools is the presence of reading and writing difficulties (Majeed and Aref, 2005). These difficulties are among the main scholarly challenges that youngsters face in primary school, affecting the rest of the other school subjects. What makes it more difficult to deal with these children is the fact that these difficulties do not appear in the first years of schooling, however, show up from the third or fourth grade and above.

We distinguish two types of developmental dyslexia: central and peripheral, the first type is the most common in schools, while the second is rare, there fore the least studied by researchers, especially those related to the Arabic language.

In this research, we will address this rare type of dyslexia, and we will describe and analyze the type of errors that affect peripheral dyslexia in Arabic language, very exactly visual dyslexia in a case study of third grade fundamentals.

Problem:

From that point, one ponders about what are the mistakes submitted in visual dyslexia in Arabic speakers?

Are the patterns of errors in Arabic the same as in foreign languages?

Hypotheses:

On the basis of the questions raised, we assume

- ◆ The presence of errors affecting the property of the Arabic language.
- ◆ And that there is a distinction between errors committed in the Arabic language and foreign languages.

Objectives:

The purpose of this study is to describe the mistakes made by a third grade child with visual dyslexia in the Arabic language.

Importance of the study:

The importance of this study derives from its actual subject, it addresses a rare type of dyslexia as well, and the minority that exists in visual dyslexia in the Arabic language contributes and enriches this type of research.

Limits of the study:

This research was limited to a case study we diagnosed at Moussa Farhi Primary School in Bachdjarrah Algiers-Algerian the beginning of the 2019/2020 school year.

Terminology:

Visual Dyslexia is a reading difficulty resulting from visual processing disorders (cognitive/neurological causes). Some of the specific manifestations attributed to this type of dyslexics according to Saroj D. Sutaria (Specific Learning Disabilities: Nature and Needs, 1985), are difficulties in visual discrimination; slow rate of perception; difficulties in visual sequencing; visual memory problems; deficits in visual analysis and synthesis; omissions, additions and substitutions and loss of space during reading.

visual errors are erroneous non-lateralized productions that share at least 50% of the letters of the target word and most often produce a new word that is visually very similar.

The lexical effect is a phenomenon in which a lexical variable influences the perception of the stimulus.

Letter identification includes the ability to name letters, their characteristics and the recognition of all letters with their case difference and position in the word.

1. Theoretical background

1.1. state of the art

Several studies have contributed to the development of the reading process model from studies of acquired dyslexia, to detect the location of the deficit in the components of the reading process, and to subsequently extract the type of dyslexia. This is the way two types of developmental dyslexia have been distinguished; peripheral dyslexia and central dyslexia.

In addition to central dyslexia, many studies have reported cases of peripheral dyslexia, among which we cite Friedmann and Nachman's studies of neglect dyslexia (Friedmann & Nachman-Katz, 2004), letter-by-letter dyslexia (Hinshlwood, 1917.), attentional dyslexia (Valdois, Gérard Vanauld & Dugas, 1995) and visual dyslexia. However, research on visual dyslexia is rare, especially in Semitic languages. In this paper, we reported a patient in whom all the hallmarks of visual dyslexia were observed in the Arabic language. We discuss the pattern of errors in his reading.

Marshall and Newcombe 1973 and Newcombe et Marshall 1981 have described a form of peripheral dyslexia. Patients produce non-lateralized visual errors that share at least 50% of letters with the target word, and most often produce a new word (for example "was" read "saw"), this type of dyslexia is called visual dyslexia.

Visual dyslexia is characterized by visual errors, including substitutions, omissions, and additions. According to Ellis and Young's study (1996), the visual dyslexia is caused by a disorder at the level of the visual analysis system, in particular, the letter identification function.

Various researchers presented cases of visual dyslexia, in different languages, either acquired or developed. These include Lambon Ralph and Ellis (1997), who presented an English-language case A-B with acquired visual dyslexia who misread more than 40% of the isolated words. More than 90% of reading errors can be classified as visual errors, The analysis of which factors did or did not affect AB's reading accuracy seemed to reveal effects of age of acquisition, frequency, and imageability but not distinctiveness, regularity, or letter length. While Cuetos and Ellis (1999) presented a case study of acquired visual dyslexia in Spanish language SC who misread 55% of isolated words, his reading errors

were influenced by the imageability and frequency of words. Furthermore, Valdois, Gerard, Vanault, and Dugas (1995) also identified two cases of developmental visual dyslexia in the French language, and similar results were noted in their two patients. On the other hand, in Semitic languages we do not find any study on visual dyslexia, except Friedmann, Michal Biran, and AviahGvion, 2012 who reported two Hebrew-speaking individuals with acquired visual dyslexia who made predominantly visual errors in reading, in all positions of the target words. Nonetheless, their visual errors are not similar, one showed lexical effects with a strong tendency to produce verbal responses with letter substitution errors, and the other did not show lexical effects such as frequency and orthographic neighborhood effects and produced nonverbal responses, and made omissions errors, additions, position errors of letters and migrations between words. Another study of Friedmann and Haddad Manar (2014) focused on the Arabic language, showed visual errors of the substitutions, omissions, additions, migrations of letters type within words, and between words in 6 cases of acquired visual dyslexia and noted that all these patients do not make phonological errors.

For our part, we would like to understand what the types of errors in Arabic are in developmental visual dyslexia. To answer this problem we give a small overview of the characteristics of the graphic system of the Arabic language.

1.2. The graphical nature of the Arab system

The Arabic language is a Semitic one, which is read from right to left, and is characterized by a cursive script whose graphic letters are ligated together (either with those preceding it, or the one that succeeds it or both) (e.g. letter *b* / باء: ties to the letter above it, resulting in the graphic **ب**, if it ties to the letter that follows it, we will obtain the graphic **بـ**, and in both directions we will get the graphic **بـ**, aside from a couple of graphemes and two long vowels that never ligate with the following grapheme as in the example of the letter /ra/ ر, and the long vowel /و. / Kouloughli (1994).

Consequently, Arabic letters have up to four forms according to their positions in the word (initial - median - final - unbound isolate); nevertheless, some graphics take more than four forms, namely the letter /ta/ /ت/ which can take up to six forms (ت, تا, تـ, تـ, تـ, تـ), These different presentations of forms of the same

letter are called allography.

1.1 Diacritical dots

Many letters have the same form but differ from their identities. These are indicated by dots accompanying the letter and are called diacritical dots

1.3. The phonic system of Arabic

1.2 Diacritical signs

The Arabic spelling only notes consonants and long vowels, while short vowels are optional; they consist of three small signs, whose place is above or below the letters (ـَ , ـُ , ـِ), They represent the three short sounds (*a, u, i*). This is in contrast to some other languages that require writing vowels and consonant letters. When the words are taken in an indeterminate sense, we add the “tanwin”, this peculiarity is indicated in writing by doubling of a diacritic sign, (ـً / *an /*, ـٍ / *un /*, ـٍ / *in /*), and in the oral by adding the sound “n”, which causes difficulties in the writing and dictation of Arabic words.

1.3 Duplicate consonants

All the consonants of the Arabic language can be geminated. Gemination plays (an important role) a key role in morphology. For this, it is essential to distinguish between a simple sound and a geminate sound. To geminate a sound does not mean to articulate the sound twice, but rather to reinforce its articulation

1.4 The letters *dād- ḍāḍ* الضاد - الظاء

There is some confusion among learner readers between the two Arabic letters [*dād- ḍāḍ*] الضاد / الظاء which leads to difficulty in their written production and speaking example: /*d*elun^ض/*ḍ*elun^ظ/

1.5 Emphasis consonants

An emphasis consonant is a type of consonants specific to Semitic languages, with a particular articulation called “emphasis”. Emphasis can manifest itself in a uvularized or pharyngealized.

1.6 The so-called sun and moon letters:

The determinative article “el/ال” is placed at the beginning of a word and pronounced in the event of contact with the So-called moon letters ([*elqamaru*] = القمر → the moon). In contrast, it is not pronounced in contact with So-called

sun letters, thus we articulate the sun letter duplication ([ššamsu]=لشمس → *the sun*).

The sun letters or sounds that absorb the /l/ of the definite article are as follows: ت، ث، د، ذ، ر، س، ش، ص، ض، ط، ظ، ل، ن

Taa', thaa', daal, dhaal, raa', zaay, siin, shiin, Saad, Daad, Taa', Zaa', laam, nuun

“Moon letters” do not absorb the /l/ of the definite article. The moon letters are: ء، ب، ج، ح، خ، غ، ع، ف، ق، ك، م، ه، و، ي

hamza, baa', jiim, Haa', xaa', 'ayn, ghayn, faa', qaaf, kaaf, miim, haa', waaw, yaa'

1.7 The taa' marbuuta

The writing of taa' marbuuta is one of the difficulties of spelling in the Arabic language. We usually pronounce the open vowel /fatha/sound without pronouncing the letter “taa’”. One consistent feature of *taa' marbuuta* is that it is always preceded by the vowel /a/ sound. This leads the child to error, so he omits the letter *taa'* and just keeps the consonant with its open vowel.

Another difficulty for words spelled in Arabic language is the existence of multiple shapes of letters and some words are irregular in their match between writing and pronunciation and various forms of *Hamzah*

1.4. The written system of the Arabic language

1.8 The difference between the written and pronounced words

Despite the transparency of the Arabic language, it does not deprive itself of any irregularities in words. This is a manifestation of deletion of some of the spoken letters from writing (e.g: هذا [ha:Da]>this, الرَّحْمَن [ḍrrahma: n]>*merciful*, السموات ḍssamawa:t]>*Heavens*), (these are some words in Arabic that phonetically contain a long vowel that is not graphically noted), or increase some letters in writing without pronouncing them in example: مائة [mi'atun] >*hundred*, we note the addition of the long open vowel /'alif el medd/ after the consonant /m/, but we do not pronounce it orally- example [ḥafidhū]حفظوا) > *save*, in the conjugation of the verbs of the second and third persons of the plural, we systematically add an open long vowel/'alif/ at the end of the word.

Multiplicity in drawing letter (al-hamzah)

The /hamza/ is phonetically the glottal occlusive, and graphically it is often

written on supports according to the grammatical rules.

At the beginning of word, /*el hamza*/ is always written on a '*alif* support. If its vowel is a /*a* / or /*u*/ it is written above the '*alif*, if it is a /*i* / it is written below the support '*alif*.

However, in the middle of the word, it follows some of the following rules:

- It is written on the '*alif* support when it is preceded by /*a*/ vowel and its vowel is /*a*/, when it is preceded by /*soukkoun*/ and its vowel is /*a*/, or it's preceded by /*a*/ vowel and its vowel is /*soukkoun*/

- It is written on a /*ya* ' support if it is preceded or followed by a /*i*/ or /*ii*/ vowel, or preceded by /*soukkoun*/ and a consonant /*ya* '/, when preceded by /*u*/ vowel and his vowel is an /*i*/, when preceded by /*a*/ vowel and his vowel is an /*i*/, if it was preceded by /*i*/ vowel and his vowel is an /*a*/, or preceded by /*i*/ vowel and his vowel is *soukkoun*, finally, when preceded by /*i*/ vowel, and his vowel is /*u*/

- It is written on a /*waw*/ support if it is preceded or followed by a /*u*/ or /*uu*/ vowel, preceded by /*a*/ vowel and his vowel is /*u*/, if it was preceded by /*u*/ and his vowel is *soukkoun*, or preceded by /*u*/ vowel and his vowel is *a* and finally preceded by /*u*/ vowel and his vowel *issoukkoun*.

Procedures

1.1. Methodology:

To begin this research we used the descriptive and analytical approach, by which we describe and analyze the various errors committed by the case study.

1.2. The Case study:

Z.A. is a young boy of 9 years and 5 months enrolled in the 3rd year of primary school. He is right-handed; he does not present any pathological antecedent. The development of motor skills and oral language was perfectly normal. He has normal hearing acuity. He wears corrective glasses. No disorder was reported in kindergarten; it was at the age of 6 when he entered the first year of primary school, that massive difficulties in school learning arose. His reading level, estimated by his teacher, is incredibly low. At the cognitive level, Z.A.'s intellectual efficiency, assessed on the Raven scale (Ibrahim Mostapha Hammad, 2008), places him in the range of children of his age.

Z.A. was also subjected to visual-spatial, visuo-constructive and sensorim-

otor tests. His performance in bell testing (50^e centile; [28]) with a linear and organized strategy, which excludes a problem of hemineglect. The assessment of visuospatial and visuo-constructive functions did not indicate a dyspraxic disorder, however, there was poor performance (25^ecentile; 3).

1.3. Materials:

The aims of the psycholinguistic assessment of Z.A. were to determine the stage of development of his reading skills and to identify his specific reading difficulties. The dyslexia test was developed by the Language Disorder, Diagnosis and Rehabilitation team of the Scientific and Technical Research Center for the Development of the Arabic Language. The test is based on the phonic and graphical structure of the Arabic language, from which we used the grammatical rules, we extracted the frequency of words from children's written texts. We interpreted the patient's results from a theoretical model of reading development, Then we compared the data from A-Z with a group of 165 normal readers of 3rd grade primary.

The test contains several tests consisting of

1.3.1. Letter identification test: The test intends to ascertain the integrity of information on letter identity, it is inspired by the Boston test (BDAE, Goodglass, Kaplan, Barresi, 1972., Mazeau and Orgogozo, 1982).

This test consists of a set of cards, each card contains 20 target alphabets at the top, and six letters below, among which the letter is identical to the target letter. The group of letters below can take the same form, a different form, or a difference in the vowel of the letter. The patient must identify this character from the characters shown to him.

1.3.2. Word identification Test: The purpose of this test is to ensure the integrity of information about word identities and to analyze the visual features of the word.

This test consists of a set of cards. Each card contains 61 target word from three at seven letters at the top, and a set of words from three at seven letters at the bottom. These words take the same general form and differ between them either by their vowels or in the position of the letters within the word, or by changing the letter in the word while keeping the general form of the target word. The

patient must identify the word corresponding to the target word.

1.3.3. Phonological Awareness Test: The purpose of this test is to identify the process of access to the phonological pathway.

This test includes 16 panels containing a group of images, in each panel we find an image at the top and represents the target, and four images below, one of which begins with the same letter of the stimulus image at the top. It is up to the patient to define it.

1.3.4. Reading test: The objective of the test is to determine if there is a phonological and lexical disorder and to evaluate the effectiveness of procedural reading processes, it contains three lists of words; frequent, infrequent and pseudo-words.

Each list contains 21 words and pseudo-words in vocalized Arabic of transparent size 72. The patient must read each list aloud, in a second with precision while respecting the vowel.

1.3.5. Text reading test: This is based on Pierre Lefavrais' Alouette test.

It is a text without a linguistic context and which has an extra linguistic context, so that the subject cannot predict the words of the text.

The purpose of this test is to extract the age of reading by the number of errors made and the time taken to do so.

The text consists of 210 words containing infrequent words, some of which are difficult to read. In addition, it contains paragraphs that are heterogeneous in terms of print size. After one minute, the patient surrounds the word reached by reading it on the scoring sheet, also, the procedure is repeated until the fifth minute, we note the errors recorded by the patient.

1.3.6. Written to dictation: The test consists of three lists of 20 words (frequent, infrequent, pseudo-words) of different lengths (from 3 to 7 letters) with different spelling rules.

We tell the child each word of the three lists and ask him to write them down. If he hesitates to write this word within 10 seconds, we move on to the next word.

The purpose of this test is to identify the subject's ability to control the spelling rules of the Arabic language and to discover the type of errors that can occur.

1.3.7. Oral spelling test: The test contains two lists of frequent and infrequent words; each list contains 16 words of different lengths.

The purpose of this test is to examine the child's ability to comply with Arabic spelling rules and to determine the extent to which the examiner maintains sequential auditory memory

2. Procedure

We first brought got the authorization from the academy EST to be able to conduct our research properly. We recorded the oral responses of the child witnesses and that of the patient A.Z. using a Dictaphone.

In the second step, we extracted the mental age from Z. A. to ensure that he did not have an intellectual disability.

2.1. Statistical analysis:

Z.A's performance in the above-mentioned tests was compared to the standards of the chronological age control group, which includes 165 third year primary school pupils with an average age of 9 years and 6 months.

We used Crawford's one-tailed t-test and chi-square to test the significance of the observed differences. As we used a significant level and percentile to find out whether or not there is a pathology, and a correlation between spelling orally and in writing. Then we transcribed the responses of the patient in order to analyze his errors.

3. Results:

3.1. Identification process

3.1.a. Letter identification test

We recorded low performance in the identification tests of letters and words that were below the 10th percentile and this performance in both tests to identification one standard deviation lower than the mean for children of the same age as shown in Table 1 below, which indicates a pathology at this level.

Z.A. had a good performance in the task of naming letters with their different positions in the word (108/108), we did not find a deficit in the identification of the letters written in a list of 95 letters at different positions (95/95). We have noted a good performance in the naming of various vocalized letters and their identification (140/140). However, his performance is poor in matching similar

letters. The type of errors we found in Z.A. was visual errors (نُ ← نُ، ت ← ت), We noticed 3 types of errors in the “matching of Similar letters” test:

1. When there is the same letter with difference in accent marks;
2. When a letter is presented against its orthographic neighbors;
3. When there is a difference in the position (form) of the letter.

3.1.b. Word Identification Test

On the other hand, the majority of Z.A’s errors were concentrated on words whose difference is the diacritical sign (6/21)

(e.g., مَغْطَسٌ ← مَغَطْسٌ /mirṭasun/ > /marṭasun/, ظَهْرٌ ← ظُهُرٌ /dohrun/ > /ḍahrun/), than in letter substitutions (14/20) (e.g., عَصَفَ ← نَصَفَ, أَحْضَرَ ← أَخْضَرَ /'ahḍara/), or much less in the position of the letters (19/20) (مُتَخَلِّفَةٌ ← مُتَخَلِّفَةٌ).

3.2. Phonological awareness

In the test of phonological awareness, we did not observe low performance in Z.A., his score being at the 10th percentile level. It means the absence of difficulty at this level. In this way, the significance test (Crawford & Howell[1998]) of difference between individual’s score and control sample in the phonological awareness is (t(165) = -1,556 p= 0.06), which indicates the no significance of the results.

Table 1: Comparison of Z.A mean to the normative sample in the letter and word identification test

test	Z.A. 's score	Significantlevel	Centile 10≥	Z score
Letter identification	6/20	7.02	6.5	-1.44
Word identification	39/61	10.03	10	-1.11
phonologicalawareness	11	12.01	11	-1.55

3.3. Reading assessment

3.3.a. Reading test:

We reported about reading isolated words a good performance in reading frequent words which does not differ significantly from the expected scores (t(165)= 0.518 p= 0.30) compared to reading infrequent words (t(165) = -2.842 p= 0.003) and pseudo-words (t(165)= -2.84 p= 0.003) whose performance is significantly lower than the standard (lower in centile 10) for both tests.

We run a point-biserial correlation to determine the relationship between reading in high frequent and low frequent word. There was a negative correlation between reading and frequency word, which was statistically significant at level 0.01 ($r_{pb} = -.902$, $n = 39$, $p = .000$). Thus, we have revealed in the AZ results the absence of a length effect; this was calculated by point-biserial correlation which resulted as $r_{pb} = -0.15$, $p = .90$, and this indicates that length did not affect AZ's reading.

Another point to be noted was the effect of orthographic neighbourhood size. We have seen a difference between reading words with many orthographic neighbours and words without neighbours. A point-biserial correlation found a positive correlation between reading both types of words, which was statistically significant at the 0.05 level ($r_{pb} = .334$, $n = 39$, $p = .037$).

3.3.b. Text reading test

In the reading text test, we noted a low performance as shown in the table below ($t(163) = -2.208$, $p = 0.015$). Z.A identified 112 words out of 149 words, the reading time is 6 min and 7 Sc. Z.A. made 68 errors, the number of words read correctly is 44 words. Thus give a result of an accuracy index 39.82 which is lower than the 10th percentile, which explains the reading disorder in Z.A.

We noted that half of the letters of the erroneous responses were present in the target word, and were characterized much more by long vowel additions, omissions of consonants and long vowels and rarely by migrations. In addition, we have pointed out errors in the word scheme; AZ has a tendency to transform the word towards its root (e.g. مناطق ← منطقة /*manāṭiq*/ → /*manqita*/.), which induces morphological errors.

Table 2: Comparative performance of Z.A.'s reading assessment to those of the control group of the same age.

Reading	Z.A.'s performance	control group
	<i>Reading text</i>	
<i>Number of errors</i>	68*	27.84 (22.71)
<i>Number of words read</i>	112 ^{ns}	134.28 (26.28)

<i>precision index</i>	39.29 ^{ns}	118.69 (80.45)
<i>Speed index</i>	35.97*	78.92 (17.65)
	<i>Isolate words</i>	
<i>Frequent words</i>	17/20 ^{ns} 89.47%	(3.83)15
<i>Infrequent words</i>	0** 0%	13.87 (4.87)
<i>Pseudo-words</i>	0** 0%	13.94 (5.21)

ns: not significant ; * $p < 0,05$; ** $p < 0,01$

However, there is no pathological time in Z.A.'s reading test. Z.A did not proceed in his reading to spell the word letter by letter. Rather, the pace of reading was normal.

Adding to these scores, we noted a significant difference between the three types of words in A.Z ($\chi^2 = 50.25$ $p = 0.000$). A.Z's performance was poor compared to the control group in the low frequency and non-words reading ($t(165) = -2.83$ $p = 0.0025$), but we didn't reveal a significant difference in high frequency words when comparing it to the control group ($t(165) = 0.51$ $p = 0.30$)

We carried a detailed examination of the type of error for the text and single word reading task. From there, we extracted errors of substitution, omission, migration, and addition. However, we noted few migration errors and vowel substitution. The table below summarizes the errors made by Z.A. in the reading task.

Table 3: examples of visual errors made by Z.A. in reading test

Word target	Graphemic transcription	Phonemic transcription	translation
		<i>substitution</i>	
النقل → النقع	ANQf → ANQL	ʔannaqf'u → ʔannaqlu	dust → transport
النخل → النحل	ANXL → AN HL	ʔannaxlu → ʔannaħlu	palms → bee
تمجر → تمجر	TMXR → TMJR	tamxuru → tumajjiru	wake → nonword
سبا → سبع	SBʔ → SBf	sabaʔ → sabf	saba → lion
طمست → دمست	fMST → DMST	fomisat → dumisat	obscure → braise (non frequent)
		<i>addition</i>	
نهييم → نهيلكم	NHM → NHLKM	Nahi:mu → nahi:lakum	miserly → nonword

تواضع → توضع	TDḤ→TWDḤ	tuḍaʿu→tuwa:duʿu	Be placed→nonword
طالب → طاب	ṭB→ṭLB	ṭa:ba→ṭa:lib	appealto→student
اليعرف → اليعر	ALYḤR→ALYḤRF	ʔalyaʿru→ʔalyaʿrifu	sheep→nonword
الألوان → اللون	ALLWN→ALALWN	ʔallawnu→ʔalalwa:nu	color→colors
		omission	
الراسيات → رسية	RRSYT→RSY	ʔarra:siya:tu→rasiyatu	mountains→nonword
رحلته → رحلة	RHLTH→RHL	riħlatuhu→riħla	Histravel→travel
كامل → كل	KML→KL	Ka:milun→kul	entire→all
الجبال → الجبل	ALJBL→ALJBL	ʔaljiba:lu→ʔaljabalu	mountains→themountain
الفاخرة → الفاخرات	ALFXRT→ALFXRT	ʔalfa:xira:tu→ʔalfaxiratu	(deluxe→deluxe(singular
		migration	
وردة → رودة	RWD→WRD	rawdatun→wardatun	nonword→flower
محفظة → مفحظة	MFHD→MHFD	mifħadatun→miħfadatun	nonword→notecase
		Vowelerrors	
ظنن → ظن	DḤN→DḤN	daʿana→daʿna	depart→nonword
ذهب → ذهب	ḍHB→ḍHB	ḍahabun→ḍahaba	gold→go to

As we notice in the example in the table 3, Z.A’s errors are characterized by visual errors that represent half of the target word. Some errors have affected the morphological aspect of the word, where in some Abd-el-Kader’s responses he kept the root and omitted the suffixes as in the example in the table above (رحلته/RHLTH/ [riħlatuhu] →رحلة/RHL/ [riħla]), as well as the phonological aspect of the word which is found in the phonetic neighborhood of the letters (طمست/ṭMST / [ṭomisat] →دمست/DMST / [dumisat] obscure→braise(non-frequent)) or simply the visual aspect of the word that includes orthographic neighborhood letter (النخل/ANXL//[ʔannaxlu]→النحل/ANḤL/ [ʔannaħlu] palms→bee).

3.4. Spelling process

3.4.a. oral spelling test

As summarized in Table4, Z.A performed poorly the oral spelling test: frequent words and infrequent words. He scored 2% for frequent words and 0% in infrequent words. As we noted, these results were below the 10th centile and significant level that is why we conclude that there is an oral spelling disorder. However, we did not note any significant difference between high frequent words oral spelling and low frequent words oral spelling ($\chi^2=2.13$, $dll=1$ $p=0.14$). Significance test on difference between AZ’s score and control sample in

the high frequent word oral spelling test was not significant ($t(165) = -1.36$ $p = 0.08$), it is only significant in the low frequent word oral spelling test ($t(165) = -1.80$ $p = 0.03$).

3.4.b. Written to dictation

In the written dictation we noted that AZ’s performance was poor compared to the control group; the significant difference is located in the two type words atlow frequency ($t(164) = -1.70$ $p = 0.004$) and non-words ($t(164) = -1.59$ $p = 0.03$), but we don’t perceive this meaning in the high frequency words ($t(164) = -1.43$ $p = 0.07$), as we found a significant difference between the three types of words ($\chi^2(Hf/Lf) = 16.36$ $dll = 1$ $p = 0.003$), ($\chi^2(Hf/Nw) = 22.52$ $dll = 1$ $p = 0.012$), ($\chi^2(Lf/Nw) = 14.24$, $dll = 1$, $p = 0.006$).

Table 4: Comparison of Z.A. mean to the normative sample in the oral and written spelling test

Test	Z.A.'s score	Significant level	Centile ≥ 10	Z score	M	SD
Oral Spelling						
<i>frequent word</i>	2	3.86	2	-1.36	8.95	5.10
<i>Infrequent word</i>	0	5.91	2.6	-1.80	8.58	4.75
Writtenspelling						
<i>frequent word</i>	2	4.12	1	-1.43	8.97	4.85
<i>Infrequent word</i>	0	3.12	2	-1.70	7.51	4.39
<i>nonword</i>	3	6.37	3	-1.59	12	5.63

However, we do not detect any length effect ($\chi^2 = 3.56$ $dll = 1$ $p = 0.133$) which means no achievement in the graphical buffer level.

The written spelling mistakes of the target words were analyzed to determine the type of error, from which we detected three types of errors; phonological, orthographic, and morphological. We summarize these types of errors in the table-6- that follows

Table 5: Some examples of types of dictation errors in Z.A.

NBRE	Word target	Phonemic transcription	The written response	Phonological errors	Orthographic errors	Morphological errors

1	silence=صمتٌ	ṣamtun SMT	سمتن SMTN	ṣ>s	doubling of a diacritic sign to consonant n	
2	فتاة=	fata:tun FTT	فتة FTT	omission of the long vowel		
	girl					
3	مئزر=	miʔzarun	ملازرن		Substitute ya' / support to alif support/ doubling of a diacritic sign to consonant n	
	Apron	MʔZR	MLʔZRN			
4	فارحين Joyful	Fa:riḏhi :na FRHN	فَرِحًا FRH			derivativeword
5	خرجوا They came out	:Xaraju XRJ	جرح و JRJW		Cuttingerror	
6	الذي which	:ʔallaḏi Lḏ	اللَّذان LḏN			Derivatesingular to dual
7	مواصلات	Muwa:Ṣala:t	موسلة	Substitute Ṣ emphatic to s		Derivate plural to singular
	transport	MWṢLT	MWSL			
8	مستشفى hospital	:Mustaṣfa MSTṢF	مستشفي MSTṢF		Substitute the	
9	أرض land	ʔarḏun ʔRḏ	أرصن ʔRṢ		Substitute ḏ to ṣ/ doubling of a diacritic sign to consonant n	
10	خر Fell down	Xarra XRR	جر JR	Omission of the gemination	Substitute X /to J	

II	ذخيرات	<i>ḍaxi :ra :tun</i> <i>ḍXRT</i>	دجرتن <i>DJRTN</i>	<i>omission</i> <i>of the long</i> <i>vowel</i>	<i>Substitute D</i> <i>to d/Substitute</i> <i>x to j/</i>	
	<i>Ammunition</i>				<i>doubling of a</i> <i>diacritic sign</i> <i>to consonant n</i>	

As we note in the table above, the errors are varied, and most of the errors are substitution errors. We note visual errors as well as in the examples “5- 8- 9- 10 - 11”. We see confusion between phonemes with similar orthography, whereas the child finds no difficulty in naming, identifying or designating the phoneme such as “خ/x/>ج/j/, ذ/D/>د/d/, ض/ḍ/>ص/ṣ/...”

4. Discussion:

This study reports a child in Grade 3 with developmental visual dyslexia in Arabic language. The most common type of error in reading, whether frequent, infrequent or pseudo-words is marked by visual errors. These errors were characterized by migration, omission, addition, substitution or even vowel errors in the reading task. Most of the deletion errors were long vowel omissions.

In Z.A results, we uncovered difficulties in letter identification, which as we would see, prompted exceptionally notice able errors in letter substitution in the test of written and spelling of single words, this led us to meditate on the subtype of visual dyslexia which is the identity of letters and lead to disorders in visual analysis. This goes without saying with Friedman’s study on the case of KD who suffered from letter identity visual dyslexia, and who had difficulties with letter coding. It’s a visual analysis input disorder.

We have seen in AZ’s visual errors a kind of orthographic neighboring phoneme confusion whose diacritical point is different, either in the task of identification or reading or even writing under dictation task (نحلة, to حبل, نحلة to جبل) (تمجر to تمخر). We can consider that the orthographic neighborhood of words is one of the specificities of the Arabic language because of its abundance (in this language) in it, Therefore, that we observe it much more in the test of the identification of words, which has generated difficulties to pay attention to (the difference that is inbetween) the difference between words, especially when the difference is located at the diacritical sign or point. Studies in this sense have been marked in the Hebrew language that showed the effect of orthographic neighborhood in visual dyslexia (Naaman Friedmann, Michal Biran, AviahGvion, 2011). At the

same time, we found a sort of diacritical sign dissipation that makes the difference between one word and another, Abd-el-Kader paid little attention to the diacritical sign, and focused on the consonant frame. Nevertheless, this form of error does not support Azzam's report, which noted confusions among a few diacritical signs between the /u/ vowel and the consonant /w/ "و", among /i/ vowel "ي" and /a/ vowel "ا". and is matched in its results with the tanwin confusion and the "n" sound.

However, we did not observe any semantic or phonological disorder in AZ, which is confirmed by the study of Crutch and Warrington (2007) who made visual errors in reading and did not have a semantic impairment.

In contrast to Friedmann's study of Hebrew visual dyslexia in the two cases KD and SF, AZ shows, in addition to his disorder at the level of abstract letter identification, lexical effects (frequency effect, and orthographic neighborhood effect) that indicate difficulties to input to the orthographic input lexicon.

5. Conclusion

To conclude, the case study of Arabic visual dyslexia, presented here, demonstrates the pattern of errors that characterizes this type of dyslexia, which is different from other types of dyslexia.

AZ had a partial deficit in the identification of letters in orthographic proximity of which the point and diacritical signs are the difference. In addition, the non-detection of semantic and phonological signs, thus no visual impairment.

His difficulties are characterized predominantly by visual errors in all positions of the target words, and his errors result in substitutions, omissions, additions, and fewer errors in migrations and vowel substitutions. Some errors have affected the morphological aspect of the word, whereas, in some Abd-el-Kader's responses, he kept the root and omitted the suffixes. Furthermore, we noted difficulties in identifying letters in the test of matching identical letters with difference in position in the word or difference in diacritical mark, so, we noted a lexical effect such as the frequency of words and orthographic neighborhood effect. We suggest that Z-A has both subtypes of visual dyslexia, one impairment in the Input of the orthographic visual analysis system, and the second at a later stage, outputs of the orthographic visual analysis system.

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