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Factors Affecting Arabic Handwriting of a Sample of Adult Egyptian Twins

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Abstract

Introduction: Both of heredity and the environment may play a crucial role in development of a person's handwriting. This study aimed to investigate the degree of similarity in Arabic handwriting of twins and features of Arabic handwriting in relation to some environmental factors.
Methods: The study included 40 pairs of adult Egyptian twins (20 identical and 20 fraternal pairs). The study investigated the effects of genetic factor as well as two environmental factors (primary language of education and drawing practice) on Arabic handwriting of the included subjects.
Results: There was no significant difference between identical and fraternal twins in frequency of similar pairs in the characteristics of Arabic handwriting. Subjects whose primary language of education was Arabic language were found to have better legibility of Arabic handwriting and lesser frequency of spelling mistakes. Also, they showed more frequent use of punctuation marks. On the other hand, handwriting of subjects whose primary language of education was English language showed greater frequency of keeping regular word spacing. Subjects who were practicing drawing were found to keep regular right and left margins, regular spacing between lines and good legibility of handwriting.
Conclusions: Both of primary language of education and drawing practice was found to affect Arabic handwriting while the effect of genetic factor couldn't be evidenced.

Key words Arabic, Handwriting, twins, factors, environmental.

Introduction

Both of heredity and the environment may play a crucial role in development of a person's handwriting (Saini and Kapoor, 2015). Twins represent a special situation since they are sharing genetic construct as well as environmental factors that may affect handwriting. Thus, studying the degree of similarity of handwriting of a pair of twins is critical to verify the reliability of handwriting identification (Mohammed and Shamsuddin, 2011).

Previous studies showed a controversy about similarity in handwriting of twins (Dziedzic et al., 2007 and Saini & Kapoor, 2015). Srihari and his associates, (2008) found the error rate in distinguishing monozygotic twins using automatic handwriting analysis is about twice that of fraternal twins and the error rate for fraternal twins is more than twice that of non-twins.

Harralson, (2013) reported case study of a 14 – year old – adolescent male who died from a fatal gunshot to the head and his brother (mirror identical twin) was charged with manslaughter. The defense contended that the deceased brother committed suicide as suicide note and notebook containing entries that were considered as suicidal ideation were found in the room where the death occurred. These documents were sent to forensic document examiner.

Handwriting exemplars; letters to family members written by twin brothers; were obtained from their parents. Forensic document examiner couldn't rely upon individual characteristics because the writing was inconsistent and was shared by both twin brothers. Finally, identification of handwriting of the twin brothers was determined by their handedness, since one of them was right handed and the other was left handed (Harralson, 2013).

Although many studies have addressed identification of English handwriting, the studies of Arabic handwriting identification have been much more limited (Al-Maadeed, 2012). Therefore, this study aimed to investigate the degree of similarity in Arabic handwriting of twins and features of Arabic handwriting in relation to some environmental factors. This may help to identify the writer based on

examination of features of handwriting that are related to certain factors

Subjects and Methods

The approval of the local ethical committee was obtained before conduction of the study. The aim and benefits of the study were explained to participants before collection of samples of handwriting. Subject's agreement to give samples of his/her handwriting was considered as an implied consent for participation of the study. All samples were anonymous, and confidentiality of all data was ensured to all participants.

The study included 40 pairs of apparently healthy twins (20 identical pairs and 20 fraternal pairs), their ages ranged from 18 to 45 year old. Subjects with health problems that affect handwriting process (such as neurological, psychological or muscle and joint diseases) were excluded from this study.

Each pair of twins was verified to have similar environmental conditions (i.e. socioeconomic status and schooling). The following data were collected for each pair of twin:

- Type of twins (identical / fraternal)
- Handedness
- Gender
- Age
- Primary language of education
- Occupation
- If the subject practice drawing/ not (e.g., as a hobby, or a part of study or work).

Each one of the participating subjects was asked to write the same text in Arabic language four times on four separate sheets of paper (two blank and two lined sheets) in the same session. Subjects were asked to write on the blank sheets first then on the lined one, using similar pens (0.7 mm). A clipboard was used to support paper during writing and it was unified for all subjects. All samples of handwriting were obtained in the daylight. Each pair of twins was dictated the Arabic text simultaneously.

The samples of handwriting of each participant (4 sheets of paper) were kept anonymous in a file that was given a serial number from 1 to 20. The symbols A and B were given to the twins in each pair (i.e. 1A and 1B, 2A and 2B …etc). There were 2 separate sets; one for identical twins and the other for fraternal twins.

All samples were scanned and their digital images were imported into CorelDraw™, a computer graphics application (version 6.00.176) which enables magnification and examination of samples. All samples (original and scanned versions) were examined manually by two examiners. Each examiner investigated all samples twice.

Comparison of samples of handwriting in this study was based on the following features:

Class characteristics: Comparison of class characteristics in this study was based on the following;

- Right and left margins
- Spaces between lines
- Basic style of Arabic handwriting: Naskh (نسخ), Ruqʿah (رقعة) or combined hybrid style (مزيج من النسخ والرقعة).
- Legibility of handwriting: It was classified into good, fair and poor according to commitment to standards and rules of Arabic handwriting
- Spelling mistakes.
- Using punctuation marks
- Word spacing

Individual characteristics: The following individual features were selected for comparison of handwriting because these are the most inclusive features that can give definitive results;

- Characteristic forms of individual letters
- Connections between letters. (وقيع الله ، ٢٠٠٣)

The study investigated the effects of genetic factor as well as two environmental factors (primary language of education and drawing practice) on Arabic handwriting of the included subjects. Also, the study investigated the differences in the characteristics of Arabic handwriting between both genders.

The collected data was coded and tabulated in an Excel sheet and software IBM SPSS statistics version 19 was used for statistical analysis. Frequency and percentage were used as descriptive statistics since all studied variables were categorical. Chi square test was used to compare frequencies of the studied variables between groups. All reported P values were two-sided (P> 0.05: non-significant, P< 0.05: significant).

Results

Table 1 shows characteristics of the included pairs of twins in both groups (identical and fraternal twins). Each group included 20 pairs of twins.

There was no significant difference between identical and fraternal twins in frequency of similar pairs in the characteristics of Arabic handwriting (Table 2). None of studied pair of twins were identical in their Arabic handwriting. Figures (1-3) show examples of the samples of handwriting of the included pairs of twins.

Table 3 shows comparison of characteristics of Arabic handwriting of the included subjects according to their primary language of education. Subjects whose primary language of education was Arabic language showed significant increase in the degree of legibility of Arabic handwriting (50%, 20 subjects have good handwriting vs. 7.5%, 3 subjects in the other group, P value: < 0.001) and significant decrease in the frequency of spelling mistakes (22.5%, 9 subjects vs. 55%, 22 subjects in the other group, P value: < 0.003). Also, they showed more frequent use of punctuation marks (87.5%, 35 subjects vs. 65%, 26 subjects in the other group).

On the other hand, handwriting of subjects whose primary language of education was English language showed significant increase in the frequency of keeping regular word spacing (67.5%, 27 subjects

vs. 25%, 10 subjects). There was no significant difference in the other characteristics. Figure 4 shows samples of handwriting of two subjects with different primary language of education

Table 4 shows comparison of characteristics of Arabic handwriting of the included subjects according to drawing practice. Handwriting of subjects who were practicing drawing showed significant increases in the frequencies of regular right and left margins (40%, 14 subjects vs. 25%, 12 subjects, P value < 0.001), regular spacing between lines (75%, 15 subjects vs. 25%, 15 subjects, P value < 0.001), and good handwriting (70%, 14 subjects have good handwriting vs. 15%, 9 subjects, P value < 0.001). Figure 5 shows sample of handwriting of a subject who was practicing drawing.

Table 5 shows comparison of characteristics of Arabic handwriting between male and female subjects. Female subjects showed greater frequency of keeping regular spacing between lines (42.3%, 22 subjects vs. 28.5%, 8 subjects), good handwriting (36.5%, 19 subjects vs. 14.3%, 4 subjects) and using punctuation marks (80.7%, 42 subjects vs. 67.8%, 19 subjects). On the other hand, male subjects showed greater frequency of keeping regular right and left margins (39.3%, 12 subjects vs. 26.9%, 14 subjects), poor handwriting (53.6%, 15 subjects vs. 30.8%, 16 subjects), spelling mistakes (50%, 14 subjects vs. 32.6%, 17 subjects) and regular word spacing (53.5%, 15 subjects vs. 42.4%, 22 subjects). However, none of these differences was statistically significant. Figure 6 shows samples of handwriting of male and female subjects.

Table (1): Distribution of the characteristics of the studied pairs of twins in identical fraternal groups:

Groups / Characteristics		Identical group (20 pairs)	Fraternal group (20 pairs)
Gender	Male	6 (30%)	3 (15%)
	Female	14 (70%)	11 (55%)
	Opposite sex	-	6 (30%)
Handedness	Right	18 (90%)	18 (90%)
	Left	0	0
	Heterogeneous	2 (10%)	2 (10%)
Occupation	Student	11 (55%)	11(55%)
	Graduated	9 (45%)	9 (45%)
Primary language of education	Arabic	10 (50%)	10 (50%)
	English	10 (50%)	10 (50%)
Drawing practice	Yes	4 (20%)	6 (30%)
	No	16 (80%)	14 (70%)

Table (2): Chi square test comparing frequency of similar pairs in the characteristics of Arabic handwriting between identical and fraternal groups

Groups / Characteristics of handwriting	Identical group (N: 20 pairs)		Fraternal group (N: 20 pairs)		X^2	P value
	N	%	N	%		
Right & left margins	15	75	13	65	0.476	0.490
Spacing between lines	17	85	13	65	2.133	0.144
Basic style of Arabic handwriting	16	80	13	65	1.129	0.479
Accuracy of spelling	18	90	13	65	3.584	0.058
Using punctuation marks	18	90	15	75	1.558	0.212
Legibility of handwriting	15	75	13	65	0.476	0.490
Word spacing	14	70	15	75	0.125	0.724
Letters' forms	0	0	0	0	NA	NA
Connections between letters	0	0	0	0	NA	NA

N: number, %: percentage, NA: not applicable.

Table (3): Chi square test comparing characteristics of Arabic handwriting of the studied subjects according to primary language of education

Primary language of Education / Characteristics of handwriting		Arabic		English		X^2	P-value
		N	%	N	%		
Keeping regular right & left margins	Yes	16	40	10	25	2.05	0.152
	No	24	60	30	75		
Spacing between Lines	Yes	15	37.5	15	37.5	< 0.001	1
	No	25	62.5	25	62.5		
Basic style of Arabic handwriting	Naskh	9	22.5	15	37.5	2.97	0.227
	Ruqʿah	5	12.5	2	5		
	Combined	26	65	23	57.5		
Legibility of handwriting	Good	20	50	3	7.5	18.63	< 0.001*
	Fair	11	27.5	15	37.5		
	Poor	9	22.5	22	55		
Spelling mistakes	Yes	9	22.5	22	55	8.9	0.003*
	No	31	77.5	18	45		
Using Punctuation marks	Yes	35	87.5	26	65	5.59	0.018
	No	5	12.5	14	35		
Regular word Spacing	Yes	10	25	27	67.5	14.53	< 0.001*
	No	30	75	13	35		

***N:** number,**%:** percentage, ***:** significant P value after Bonferroni correction*

Table (4): Chi square test comparing characteristics of Arabic handwriting of the included subjects according to drawing practice:

Drawing practice / Characteristics of handwriting		Yes (N: 20)		No (N: 60)		X^2	P
		N	%	N	%		
Keeping regular right & left margins	Yes	14	40	12	25	17.09	< 0.001*
	No	6	60	48	75		
Spacing between lines	Yes	15	75	15	25	16	< 0.001*
	No	5	25	45	75		
Basic style of Arabic handwriting	Naskh	7	35	17	28.3	0.44	0.803
	Ruqʿah	2	10	5	8.3		
	Combined	11	55	38	63.4		
Legibility of handwriting	Good	14	70	9	15	22.75	< 0.001*
	Fair	4	20	22	36.7		
	Poor	2	10	29	48.3		
Spelling mistakes	Yes	5	25	26	43.3	2.12	0.145
	No	15	75	34	56.7		
Using punctuation marks	Yes	17	85	44	73.3	1.13	0.288
	No	3	15	16	26.7		
Regular word spacing	Yes	12	60	25	41.7	2.03	0.154
	No	8	40	35	58.3		

***N:** number, **%:** percentage, ***:** significant P value after Bonferroni correction.*

Table (5): Chi square test comparing characteristics of Arabic handwriting between both genders:

Characteristics of handwriting	Gender	Females (N: 52)		Males (N: 28)		X^2	P
		N	%	N	%		
Keeping regular right & left margins	Yes	14	26.9	12	39.3	2.11	0.147
	No	38	73.1	16	60.7		
Spacing Between Lines	Yes	22	42.3	8	28.5	1.47	0.226
	No	30	57.7	20	71.5		
Basic style of Arabic handwriting	Naskh	17	32.7	7	25	2.41	0.3
	Ruqʿah	6	11.5	1	3.6		
	Combined	29	55.8	20	71.4		
Legibility of handwriting	Good	19	36.5	4	14.3	5.58	0.062
	Fair	17	32.7	9	32.1		
	Poor	16	30.8	15	53.6		
Spelling mistakes	Yes	17	32.6	14	50	2.3	0.13
	No	35	67.4	14	50		
Using punctuation marks	Yes	42	80.7	19	67.8	1.68	0.195
	No	10	19.3	9	32.2		
Regular word spacing	Yes	22	42.4	15	53.5	0.93	0.335
	No	30	57.6	13	46.5		

N: number,%: percentage,

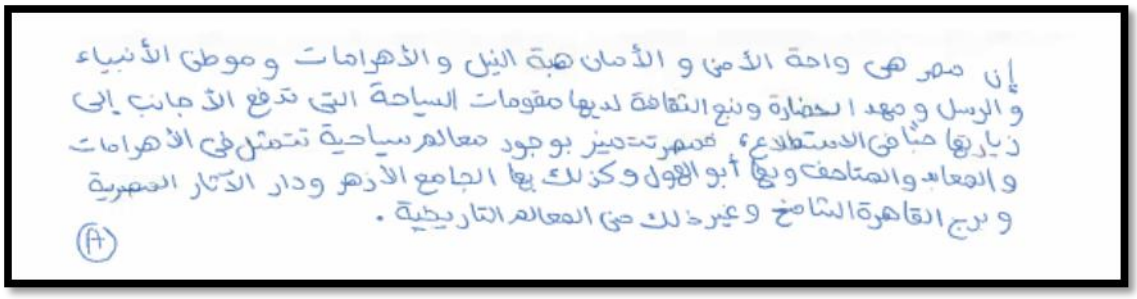

Fig 1a

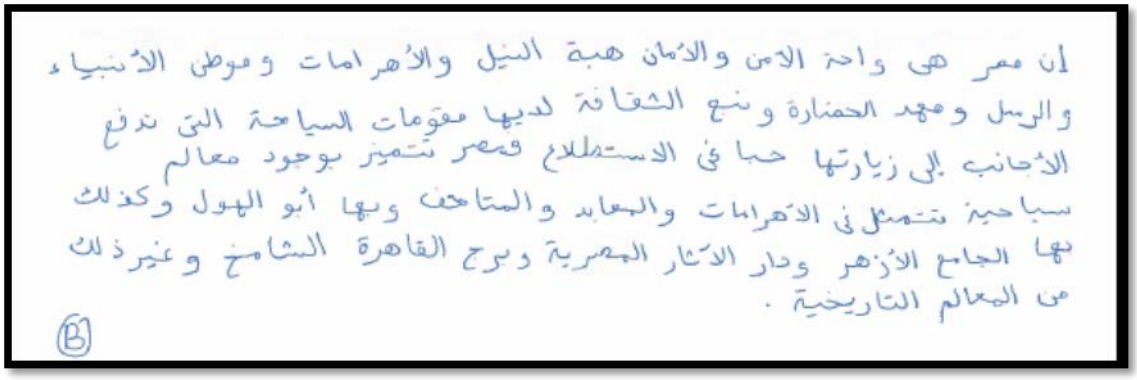

Fig 1b

Fig1: Samples of handwriting of identical pair of twins. They are similar in class characteristics as both of them keeping right and left margins, using Naskh style, with fair legibility of handwriting and using punctuation marks infrequently.

The individual characteristics are unique for each one; the letter forms (e.g., م،ه) and connections between letters (e.g., the connection of the letter ى with the preceding letter).

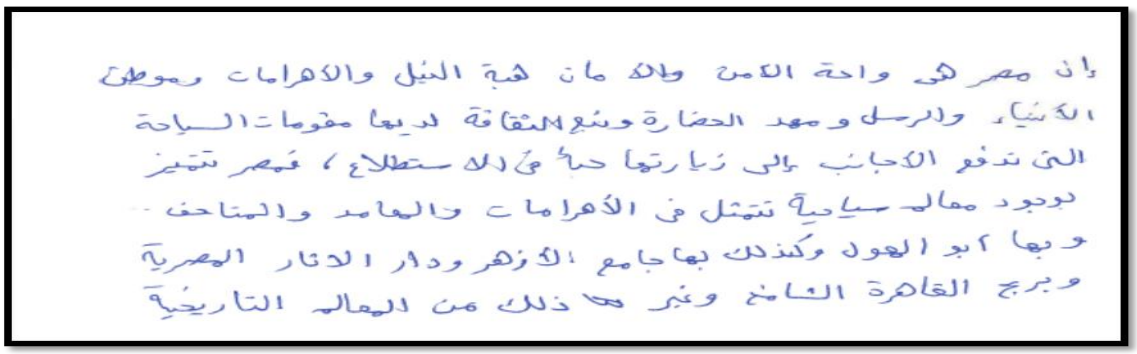

Fig2a

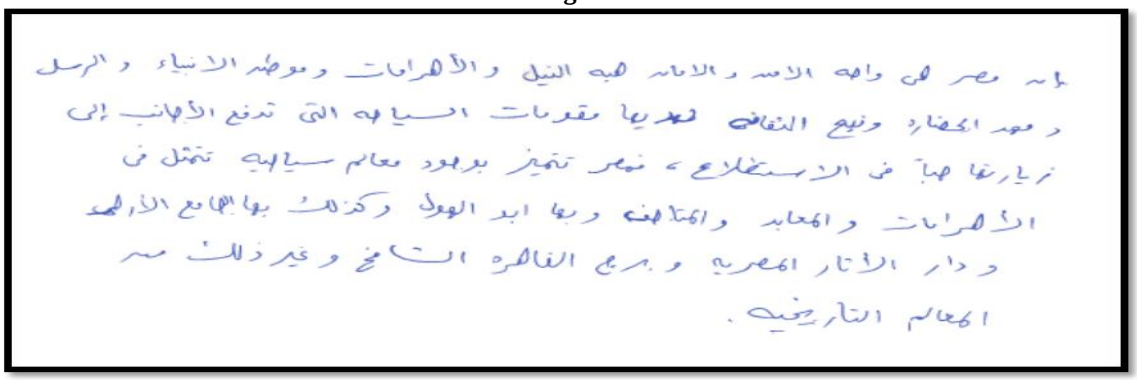

Fig2b

Fig2: Samples of handwriting of identical pair of twins. Class characteristics are different;
- In Fig 2a: keeping regular right and left margins, using the combined hybrid style and legibility of handwriting is poor.
- In Fig 2b: right and left margins are irregular but keeping regular spacing between lines, using Ruqʿah style, legibility of handwriting is fair and with more frequent use of punctuation marks.

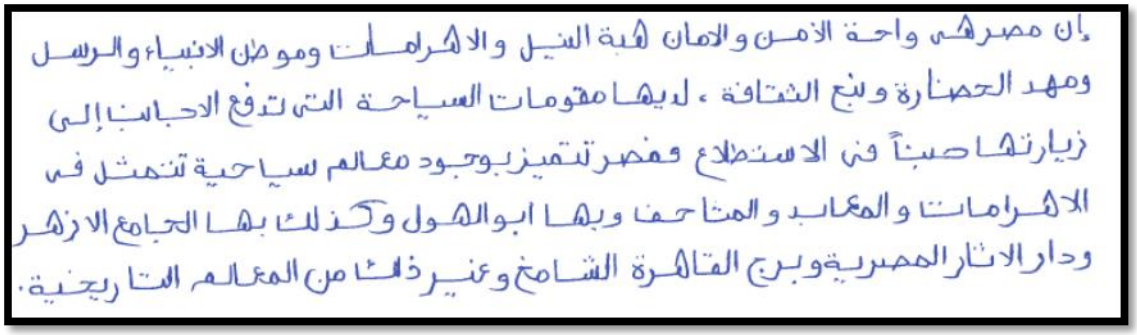

Fig3a

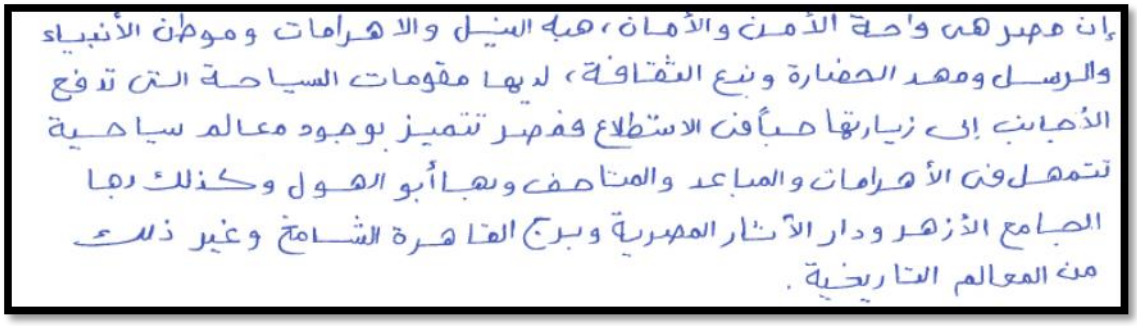

Fig3b

Fig3: Samples of handwriting of fraternal pair of twins.They are similar in class characteristics as both of them keeping regular right and left margins and regular spacing between lines, using the Naskh style, with good legibility of handwriting and using punctuation marks.
- The letter forms (e.g., ه، ع، ل) and connections between letters (e.g., the connection of the letter ى with the preceding letter) are different.

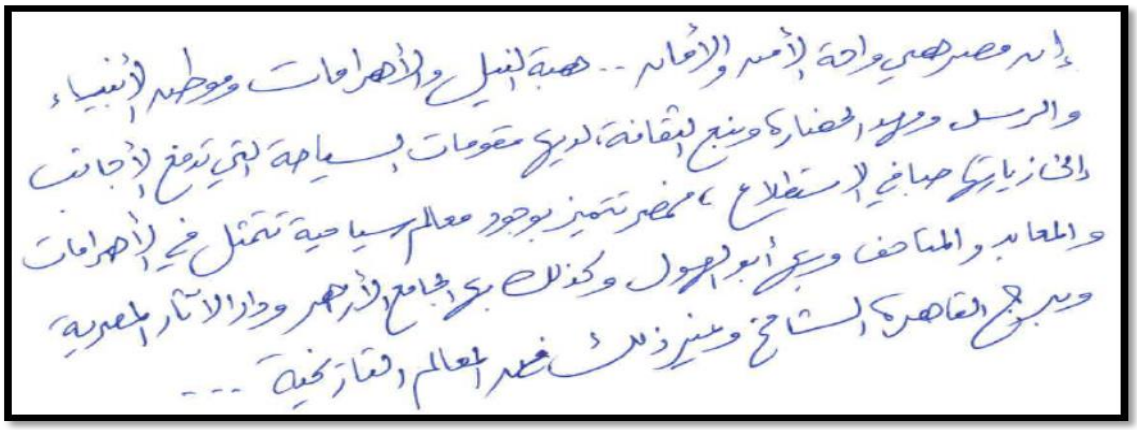

Fig4a

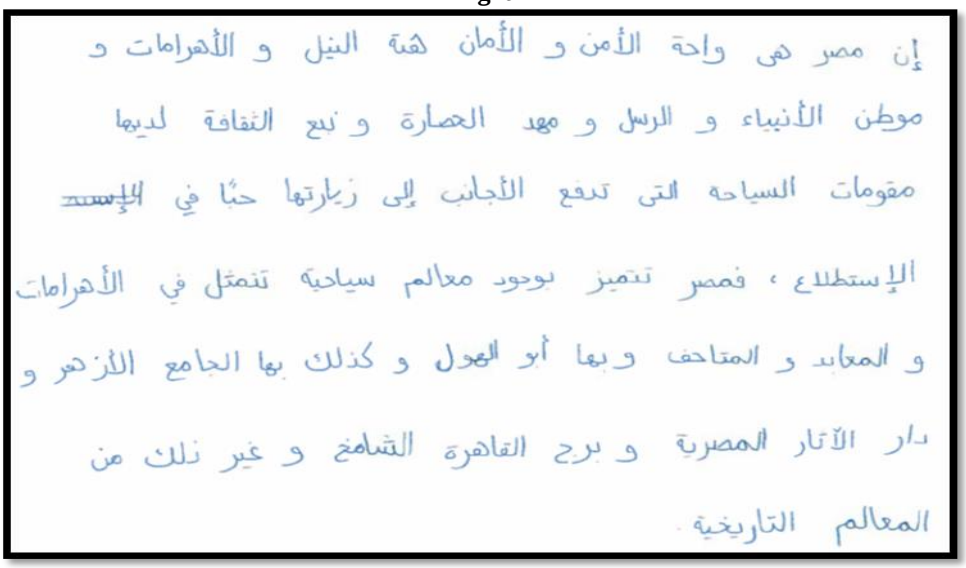

Fig4b

Fig4: Samples of handwriting of two subjects with different primary language of education (Arabic language in 4a and English language in 4b).

- In Fig4a; the subject used Ruqʿah style, legibility of handwriting was good and punctuation marks were more frequent.

- In Fig4b; the subject was keeping regular and wider word spacing, used Naskh style and legibility of handwriting was fair.

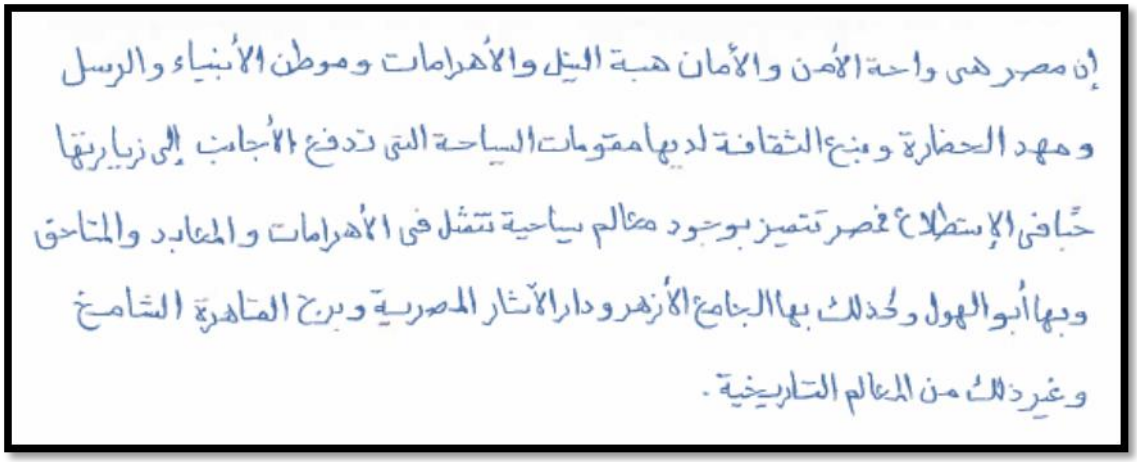

Fig5: Sample of handwriting of a subject who was practicing drawing: he/she is keeping right and left margins and regular spacing between lines. The legibility of handwriting is good

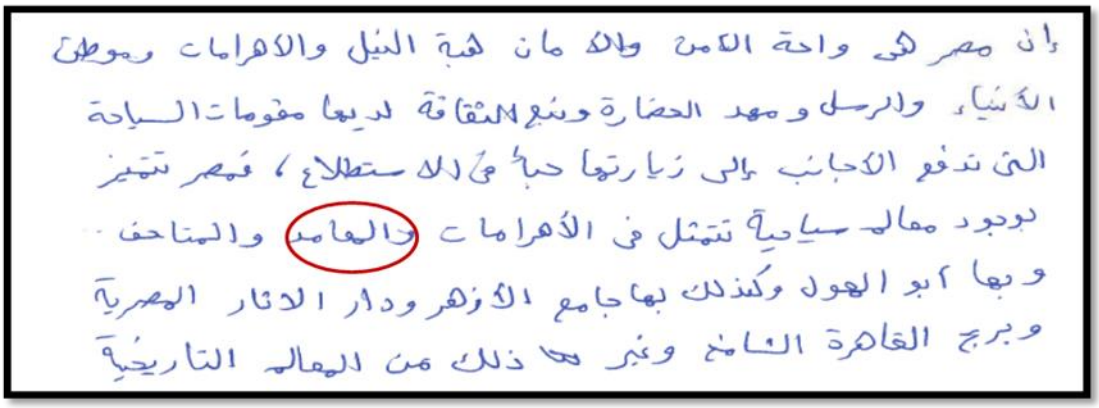

Fig6a

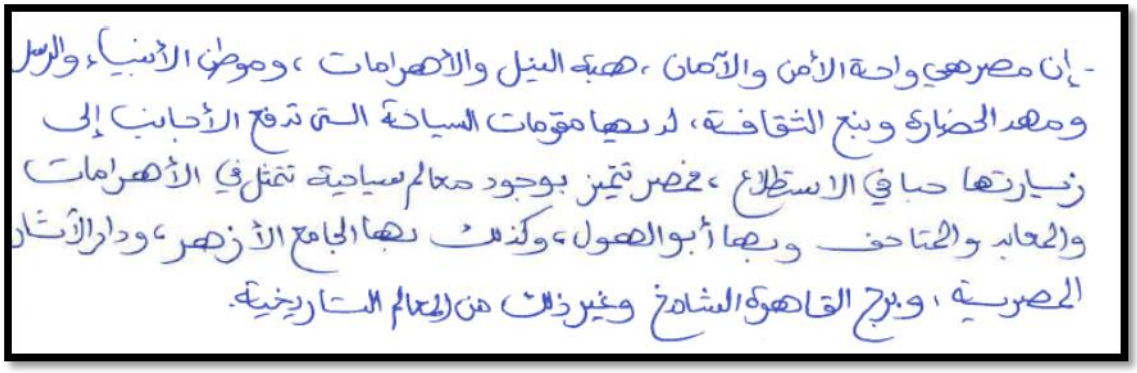

Fig6b

Fig6: Samples of Arabic handwriting of two subjects with different genders (Fig 6a for a male subject while Fig 6b for a female subject).

In Fig 6a, the writer was keeping right and left margins and regular word spacing. The legibility of handwriting is poor and there is a spelling mistake (red circle)

In Fig 6b, the handwriting of a female subject showed regular spacing between lines, good legibility and more frequent use of punctuation marks.

Discussion

This study found none significant difference between fraternal and identical twins in the frequency of similar pairs in the studied characteristics of Arabic handwriting. Also, none of included pairs of twins had identical handwriting since the studied individual characteristics of handwriting (letters' forms and connections between letters) were unique for each subject.

Similar findings were reported by Dziedzic and his associates as they found non-significant difference in the frequency of similarities of handwriting between identical and fraternal twins (Dziedzic et al., 2007). Also, Mohammed and Shamsuddin, (2012) examined handwriting of identical twins and found none of them wrote exactly alike. Boot, (1998) found none of the studied twins were identical in their handwriting although of marked degree of similarity in the handwriting of some cases. There was no evidence suggesting higher degree of similarity in handwriting of identical twins than that of fraternal twins.

These findings are consistent with previous studies that have evidenced individuality of handwriting (Dziedzic et al., 2007; Mohammed and Shamsuddin, 2011). This has been explained by the tendency of the person who learns to write a given style or system of handwriting to deviate from it to integrate their individual characteristics to produce their individual writing style (Vos et al., 2000).

In contrast, Srihari et al., (2008) found greater degree of similarity in handwriting of identical twins than that of fraternal twins. This was explained by greater similarity in genetic constitution of identical twins that may influence handwriting as it is a neuromuscular activity coordinated by the nervous system. In addition to the shared environment, the siblings and twins tend to imitate each other (Saini and Kapoor, 2015).

The current study investigated primary language of education and drawing practice as environmental factors that may affect Arabic handwriting. Subjects whose primary language of education was Arabic language were found to have better legibility of Arabic handwriting and lesser frequency of spelling mistakes. Subjects whose primary language of education was English language showed greater frequency of regular word spacing

These features belong to class characteristics of handwriting that are influenced by the style that is taught and acquired during the earlier stages of childhood (Graham et al., 1998).

Several studies reported the impact of bilingual education on the first language as it may result in attrition of the first language and its replacement by the second language (Montrul, 2005; Dmitri, 2008 and Unganer, 2014). Previous study in Saudi Arabia was conducted to explore the impact of English on the Arabic language in children studying in bilingual schools. This study found children suffering problems in learning Arabic language related to linguistic disability, both in oral expression and writing (El Harethy, 2008).

Replacement of first language by secondary language in bilingual education system will be reflected on the writing style and its characteristics because teachings of the motor preliminaries of handwriting (such as regularity and neatness) vary from culture to culture. In addition, the introduction of cultural biases such as slant, left to right transport, counter clockwise rotations, posture and grasp) will affect handwriting (Saini and Kapoor, 2015). Culture also plays a crucial role in influencing the cognitive development of a child which will affect development of handwriting (Saini and Kapoor, 2017).

Previous studies reported the uniqueness in handwriting characteristics peculiar to the ethnic origin of the writers (Cheng et al., 2005 and Saini, 2016). This was explained by the common cultural and environmental traits in the population group that lead to a certain degree of similarity in their cognition and learning behaviors (Saini, 2016).

This may explain the findings of the current study since the observed characteristics of Arabic handwriting of subjects whose primary language of education was English may be due to their deficiencies of Arabic language skills. This was evidenced by their lack of use of punctuation marks that can be attributed to their deficient knowledge of the rules of Arabic handwriting.

By examination of the handwriting of subjects whose primary language of education was English, there was elongation in some strokes leading to an increase in the number of lines and failure to keep margins regular. Also, they found to have tendency to the angular way in writing which consequently leads to slowness during writing (this was evidenced by increased pen pressure) that may cause legibility of handwriting to range from fair to poor; since previous studies reported an association between slow handwriting and poor quality (Tseng and Chow, 2000). Slow handwriting of those subjects leading to more control on writing instrument. This may explain subjects' ability to keep regular word size and regular word spacing.

Regarding the basic style of Arabic handwriting, a combination of Naskh and Ruqʿah was the most common style in both groups, followed by Naskh style. Infrequent use of Ruqʿah in handwriting of the included subjects may be due to lack of training on its use since Arabic calligraphy (الخط العربى) had no longer been learned in primary schools in Egypt for several decades.

Similar findings were reported for cursive style as some schools dismissing teaching it because the Common Core Standards no longer oblige elementary students to learn cursive (Slape, 2012).

This study found subjects who were practicing drawing keeping regular margins and regular spacing between lines and their handwriting of good quality. These finding are consistent with the reported common observation that most people with drawing skills exhibit good handwriting (Bonoti et al., 2005). This was explained by the strong similarities between drawing and handwriting as both of them requires fine motor hand movements. So drawing develops the basic graphic and movement skills needed for handwriting (Ainsworth et al., 2011).

The present study investigated the characteristics of Arabic handwriting of both genders and found none significant difference between them.

In contrast, several studies reported differences in handwriting according to the writer's gender. Hamid and Loewenthal, (1996) found 'delicacy and decorativeness' as a major discriminating factor between writings of males and females. Al Haddad et al., (2009) examined a collection of Arabic signatures and they identified significant differences between male and female in some of the examined features such as number of strokes, number of dots, height and length. In addition, females were found to write more legibly than men (Schneider et al., 2006).

Furthermore, some studies have shown that gender can be predicted from handwriting with varying degrees of success. The average rate of correct identification of gender in these studies was around 70% (Alkahtani and Platt, 2011).

Previous study on 282 individuals provided handwriting samples in both Arabic and English has shown that handwriting by males and females tend to exhibit distinctive characteristics, even across different languages and cultures (Ibrahim et al., 2014).

Typically, the psychologists suggest that females are characterized by neat, even, well-organized, rounded, small and symmetrical writing. On the other hand, males are characterized by hurried, uneven, messy, spiky and sloping writings (Burr, 2002). These differences in handwriting of males and females were attributed to differences in motor coordination or the different types of hormones they produce. This was reported by Beech and Mackintosh, (2005) who showed how prenatal sex hormones can affect female handwriting performance.

Conclusions

Both of primary language of education and drawing practice were found to affect Arabic handwriting. There was non-significant difference in the frequency of similarities of handwriting between identical and fraternal twins.

Recommendations

The effects of bilingual education system on the Arabic handwriting should be investigated. Further studies of

characteristics of Arabic handwriting in different cultures and communities are recommended to investigate other environmental factors that may affect it.

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الملخص العربى

العوامل المؤثرة على الكتابة اليدوية العربية لعينة من التوائم المصريين البالغين

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المقدمة:تلعب كل من الوراثة والبيئة دورا حاسما في تطور الكتابة اليدوية للشخص. وقد هدفت هذه الدراسة إلى دراسة درجة التشابه في الكتابة اليدوية العربية للتوائم وخصائص الكتابة اليدوية العربية بالنسبة لبعض العوامل البيئية.

طريقة البحث: شملت الدراسة ٤٠ زوجًا من التوائم المصريين البالغين (٢٠ زوجًا متطابقًا و ٢٠ زوجًا شقيقًا). حققت الدراسة في تأثير العامل الوراثي بالإضافة إلى عاملين بيئيين (اللغة الأساسية في التعليم وممارسة الرسم) على الكتابة اليدوية العربية للمشاركين بالدراسة.

النتائج: ولم توجد أي فروق ذات دلالة إحصائية بين التوائم الأخوية والمتطابقة فى معدلات تكرارالأزواج المتشابهة في خصائص الكتابة اليدوية العربية.

وقد وجد أن للأفراد الذين كانت اللغة العربية هي اللغة الأساسية في تعليمهم درجة أعلى من جودة الخط، وأخطاء إملائية أقل. كما أبدوا استخداما أكثر تكرارا لعلامات الترقيم. وعلى الجانب الآخر، ظهر الحفاظ على مسافات منتظمة بين الكلمات بشكل أكثر تواترا فى الكتابة اليدوية للأفراد الذين كانت اللغة الانجليزية هي اللغة الأساسية في تعليمهم.

وقد وجد أن الأفراد الذين يمارسون الرسم يحافظون على وجود هوامش منتظمة جهتى اليمين واليسار، وتباعد منتظم بين السطور ومستوى الكتابة اليدوية لديهم جيد.

الاستنتاجات: وجد أن كلا من اللغة الأساسية في التعليم وممارسة الرسم يؤثرعلى الكتابة اليدوية العربية بينما لم يتمكن من إثبات تأثير العامل الوراثي

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