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The Ability of Forensic Handwriting Examiners to Judge the Quality of Signature Simulations in an Unfamiliar Writing System

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This article addresses the question of whether forensic handwriting examiners (FHEs) can successfully apply forgery detection analysis to recognize forgeries in foreign signatures with which they are not familiar. Two FHEs who were fluent speakers and writers of Arabic and 2 who were unfamiliar with the Arabic language and script analyzed 100 freehand simulations of 2 Arabic signatures. They gave separate ranks to the accuracy with which each of elements of line quality, form, and proportion were simulated by each simulator. No significant differences were found between the assessments of the 2 teams of FHEs for each element. More research on other scripts, languages, and elements would be desirable to generalize the results.

Introduction

This study investigated the ability of forensic handwriting examiners (FHEs) to recognize forgeries of signatures in foreign scripts with which they were not familiar, a topic that has not previously been studied statistically. A number of reports and observations, largely unpublished, suggest that the techniques of forensic handwriting examination can be applied successfully to scripts the examiner has never read or written. These scripts have included noncursive scripts such as Chinese (Hanna 1989; Huber and Headrick 1999) and Eskimo (Huber and Headrick 1999), abstract symbols (Leung and others 1993; Huber and Headrick 1999), abstract designed signatures (Hensel Khan and Dizon 1973; Huber and Headrick 1999), and even painting and drawing (Miller 1995; Huber and Headrick 1999). Hensel, Khan, and Dizon (1973) present examples of simulated and genuine signatures in Filipino, Ethiopic, Bengali, Urdu, and Arabic scripts, which readers who are illiterate in these scripts can easily distinguish. There seem to be no accounts of failure by FHEs to identify forgeries in unfamiliar scripts, but the subject is not extensively explored in the literature. Such descriptive reports constitute useful and respectable evidence in the field of forensic handwriting examination; much of the knowledge of the field is based on subjective evidence from the work of many professionals, and it has held up well over time. However, in recent years, court rulings have occasionally called for scientific testing of the assumptions underlying types of expert testimony that are based on this type of evidence (*Daubert v. Merrell Dow Pharmaceuticals*, 509 U.S. 579 [1993]). This has given rise to an interest in testing such assumptions in controlled statistical studies; the present research is intended to contribute to that goal.

This study compared the judgments of Arabic-literate and Arabic-illiterate FHEs of the accuracy of attempted freehand simulations of Arabic signatures. Signatures were chosen as the models to be simulated because they are involved in most forgeries. Arabic was selected because it is quite different from Roman script and is familiar to the researcher. Both Arabic and Roman scripts are linear, cursive scripts that derive from the Middle East; but the letters are completely different. Individuals who are unfamiliar with either script cannot easily guess where the boundaries between the letters are, since both scripts are differently shaped before and after other letters. Arabic script is written from right to left, while Roman script is written from left to right. Thus, Arabic letters tend to slant forward toward the left, and the writing tends to be aligned upward toward the left. Roman script, by contrast, tends

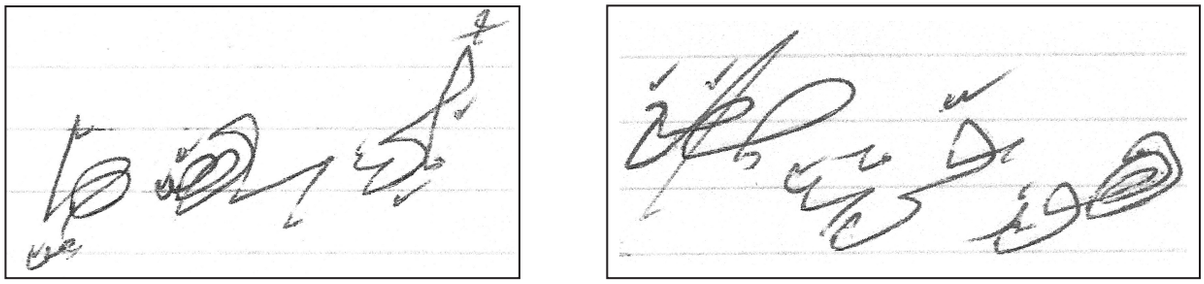

Figure 1 The 2 Arabic signatures that are targets of simulation

to slant forward toward the right, and the writing tends to be aligned upward toward the right.

Methods and Materials

This study involved 2 certified, experienced FHEs who were fluent speakers and writers of Arabic and 2 similarly qualified non-Arabic speaking and writing FHEs who were unfamiliar with the Arabic language and script. Each team of 2 FHEs ranked 100 simulations of 2 Arabic signatures for accuracy of simulation using 3 broad elements: line quality, form, and proportion. The rankings were then compared statistically to determine whether the judgments of the 2 pairs of FHEs were significantly different.

The 2 signatures used as models are shown in Figure 1. Each contained 3 separate writing units, corresponding to words. The signatures were designed to elicit a wide variety of simulation errors, as established in previous research. Also, a maximum number of different Arabic letters in different word environments were included.

The definitions of the 3 broad elements in this study follow. Form includes the general shapes of letters, the shapes of connecting strokes between letters, the treatment of dots, tendencies toward angular or toward curved strokes, and the shapes of initial and terminal strokes. Form is widely regarded as an element that is likely to be noticed, even by amateurs, and likely to be simulated accurately in Roman cursive script and even in abstract symbols. Line quality refers to rhythmic alternations of pen pressure and to the tapering of the line at the beginning and ending of writing, which are typical of mature, confident, and rapid writing that has become habitual. Carefully drawn forgeries typically show a wavering, uncertain line with many hesitations or pen lifts where the simulator has paused to compare his production with the original; they also tend to have abrupt beginnings and endings of the writing line. In contrast to form, line quality is generally agreed to be the most difficult element of Roman cursive to simulate accurately and is often suggested to be the most useful indicator of forgery for the FHE (Osborn 1939; Harris 1958; Harrison 1958; Hilton 1993; Huber and Headrick 1999).

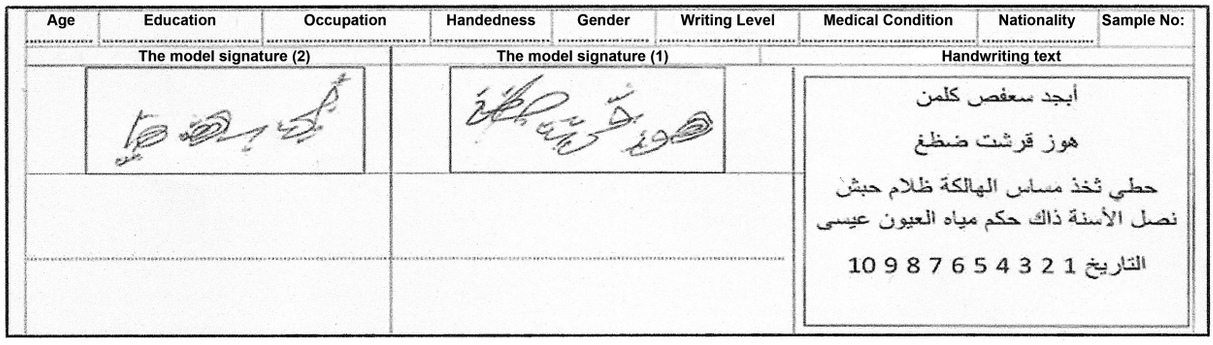

Figure 2 Freehand simulation form

Table 1. Mean Ranks for Each Team of FHEs for Line Quality, Form, and Proportion

FDH	Element	N	Mean Rank
Arabic	Line Quality	100	101.17
Non-Arabic		100	99.83
Arabic	Form	100	103.41
Non-Arabic		100	97.60
Arabic	Proportion	100	101.78
Non-Arabic		100	99.22
Arabic FDH	Total	100	103.70
Non-Arabic		100	97.30

Table 2. Significance Measurements of the Differences in Mean Ranks of the 2 Groups of FHEs

FDH	Element	Mean Rank	P value (x^2)*
Arabic	Line Quality	101.17	0.862
Non-Arabic		99.83	
Arabic	Form	103.41	0.450
Non-Arabic		97.60	
Arabic	Proportion	101.78	0.752
Non-Arabic		99.22	
Arabic FDH	Total	103.70	0.433
Non-Arabic		97.30	

5% confidence rate

The 3rd main broad handwriting element is proportion. The proportion element includes sub-elements such as size, spacing, baseline, and slant. The FHEs were asked to give their total assessment to the proportion element, taking in consideration these proportional sub-elements in simulated signatures. The relative difficulty of freehand simulation of form, line quality, and proportion in Arabic signatures has been studied; and the results stated that form is significantly better simulated than proportion, and proportion significantly better simulated than line quality (Al-Musa Alkahtani and Platt 2009)

The simulations of Arabic signatures used in this research were produced by 100 Arabic-speaking and -writing men and women. Each participant was given a half-hour to study and practice simulating 2 model signatures and then produced freehand simulations of each signature in designed form (Figure 2). The 4 certified FHEs who ranked the simulations each had 4 years or more of experience in identifying forgeries. Each FHE assigned an overall accuracy rank to the element of proportion, form, and line quality for each participant. That rank summarized the accuracy of all the simulations of that element made by the participant. For example, the quality of the simulations of every instance of proportion in 1 participant's simulations was averaged or summarized to give that participant's final rank for proportion. The judging was carried out according to standard forensic handwriting examination methods, involving painstakingly small measurements as well as more subjective observations.

The FHEs were allowed as much time as needed to complete their ranking. They used 4 ranks (1 through 4).

This is how the rankings would be worded in ranking the similarity of "element X" in a simulation to "element X" in the model signature.

- Rank 1: Extremely different. Element X in this participant's simulated signatures is extremely different from element X in the model signature.
- Rank 2: Quite different. Element X in this participant's simulated signatures is significantly different from element X in the model signature.
- Rank 3: Similar. Element X in this participant's simulated signatures is quite similar to element X in the model signature.
- Rank 4: Identical. Element X in this participant's simulated signatures is identical or almost identical to element X in the model signature.

After all the ranks were assigned, the ranks of the 2 Arabic-literate FHEs were averaged; and those of the 2 Arabic-illiterate FHEs were also averaged. The data were then placed in a file for analysis by the SPSS 13.00 statistical analysis software program. The Mann-Whitney test was used to measure the significance of the differences between the mean ranks of each team of FHEs. A significance level of 0.05 was used.

Results and Discussion

Table 1 shows the Mann-Whitney mean ranks for each team of FHEs for each element of line quality, form, and proportion; and Table 2 lists the significance values (χ^2) for each element. As can be seen in Table 1, the differences in the mean ranks were all very close. Table 2 shows that none of the differences reached significance at the 0.05 level, or even at the 0. 01 level.

The highest mean rank agreement was achieved in line quality, while the lowest occurred with form.

These results suggest that Arabic-illiterate FHEs are able to apply the methods of forensic handwriting examination to Arabic signatures as accurately as Arabic-literate FHEs. This corresponds with the view found in the literature that forensic handwriting examination can be carried out successfully in languages and scripts with which the FHE is not familiar. Thus, a statistical study fails to disconfirm a view based on observation and experience.

Conclusions

This study supports the view that questioned handwriting examination techniques can be applied successfully to scripts and languages with which the FHE is not familiar. It is the 1st study to apply statistical tests of significance to data bearing on this topic. The non-significances obtained by statistical test results do not eliminate completely the importance of familiarity with the writing system of suspect writing in some cases, particularly in situations of limited standard materials which are very important in the comparison, or in the event of small amount of evidence; e.g., short written entry, or the lack of distinctive handwriting characteristics.

To strengthen these results, additional research is needed on other scripts and languages, and on other elements in order to generalize the findings.

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