



Questioned Documents Section - 2013

J10 Statistical Basis to Determine Probabilities of Occurrence of Handwriting Characteristics

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After attending this presentation, attendees will be informed of preliminary results of computerized assessment of specific handwriting characteristics and their frequency in a general population database.

This presentation will impact the forensic science community by providing an example of frequency determination of handwriting analysis that may be applicable to other kinds of pattern analyses that are observer dependent with subjective conclusions.

This research proposes to supplement the existing research conducted in the publication, *A Statistical Examination of Selected Handwriting Characteristics*.¹ That research involved the statistical analysis of specific handwriting characteristics for the “th” combination. This and other previous studies focused on the “th” combination because of its frequency of use in the English language, as well as its role in the most commonly used English word, “the.” Based on a survey by www.AskOxford.com, the next most common English words are “of” and “and.” The current study will seek to examine handwritten characteristics of the selected word “and” in both its hand printed and handwritten (cursive) form, as well as occurrences of the symbol for “and” (e.g., ampersand). The intent of this research is to determine the feasibility of studying aspects of the selected word, and quantify observed characteristics into statistically useful information.

When Forensic Document Examiners (FDE) render conclusions based on their comparison and examination of handwritten items, they tend to assign probative values to specific handwriting characteristics and their combinations. Their judgments are usually based entirely on the examiners experience and power of recall. Statistical data concerning frequency of occurrence of characteristics and their combinations offer promise for providing a quantitative basis for forensic document examiner conclusions. If the frequency of occurrence of combinations of particular handwriting characteristics is available, then the probability of the observed characteristics can be determined. Such objective information would not only support the examiner’s conclusions, but would provide additional scientific credence in courtroom testimony.

In the present research, a computer-executable “truthing” tool was developed to more easily allow the consulting FDEs to evaluate each instance of the written word “and,” then select specific characteristics observed from drop-down menus. The “truthing” tool works in conjunction with images of handwriting and hand printing specimens in a database consisting of supervised handwritten and hand printed specimens from over 1,500 individuals representative of the United States population. Examples of observable characteristics are whether the “a” staff is: (1) retraced; (2) looped; (3) a single line; or, (4) no fixed pattern. These characteristics and their most frequent combinations will then be used to determine their frequencies in the database. Since the number of combinations can be very large, a probabilistic graphical model is used to calculate the probability of any given combination will be determined. The probabilistic models are then used to infer the desired probabilities. The number of characteristics is necessarily limited in order to establish preliminary frequency characteristics without requiring an overwhelming amount of labor-intensive effort from the consulting forensic document examiners. The resulting methods will be incorporated into a software system to aid the forensic document examiner. The database and selected characteristics can be expanded for future research projects that may focus on additional characteristics of the word “and” or other words and their selected characteristics.

Reference:

¹ Muehlberger, R.J., et. al., *Journal of Forensic Science*, 1976
Handwriting, Frequency, Computer