



## LANDMARK STUDIES IN FORENSIC DOCUMENT EXAMINATION

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The following major studies in Forensic Document Examination have been summarized and appear in chronological order. The summaries are not exhaustive or all-inclusive of every detail, but were compiled from various sources to serve as an overview and general summary of noteworthy critical articles that forensic document examiners should be familiar with.

For further information, any interested forensic document examiner is encouraged to perform additional research on these or any other articles in connection with studies of forensic document examination and/or forensic sciences. Additions to the summaries listed here are always welcome.

### Studies on the handwriting of twins:

There are at least three studies published in forensic journals about the handwriting of twins. One in 1960 involved 50 sets of identical twins, one in 1980 involved 58 sets of identical twins, and one in 1998 involved 95 sets of twins. All of the studies came to the same conclusion: with a sufficient amount of handwriting samples, it was always possible to distinguish the handwriting of identical and fraternal twins.

[Beacom, M. S. A study of handwritings by twins and other persons of multiple births,](#) Journal of Forensic Sciences (1960) 5:121-1 31

[Gamble, D. The Handwriting of Identical Twins,](#) *Canadian Society of Forensic Science Journal*, Vol. 13, No. 1 (1980)

[Boot, D. An investigation into the degree of similarity in the handwriting of identical and fraternal twins in New Zealand,](#) Journal of the American Society of Questioned Document Examiners, Vol. 1, Number 2 (1998).

More on Twins: Additional studies have been done outside of the forensic field regarding the handwriting of twins:

[Newman, H., Freeman, F.N., Holzinger, K. Twins: A Study of Heredity and Environment,](#) Chicago: University of Chicago Press, 1937.



## Studies Involving Abilities to Differentiate Handwriting:

There are several studies that address the abilities of forensic document examiners to differentiate handwriting. Dr. Kam's studies assess these abilities of FDEs when compared with lay persons, Dr. Found's studies assess the abilities of FDEs when compared to laypersons to distinguish between genuine signatures and simulation, Dr. Srihari's study discusses the results of utilizing computer software to analyze handwriting, and Durina's study assesses the abilities of FDEs to correctly attribute authorship to writers trained at the same school using the same copybook style.

[Kam, M. Wetstein, J. & Conn. R. \(1994\) Proficiency of Professional Document Examiners in Writer Identification, Journal of Forensic Sciences, 9\(1\), 05-14](#)

[Kam, M. Fielding, G. & Conn., R. \(1997\) Writer Identification by Professional Document Examiners, Journal of Forensic Sciences, 42\(5\), 778-786.](#)

[Kam, M., Fielding, G. and Conn, R. \(1998\) The Effect of Monetary Incentives on Document Examination by Nonprofessionals, Journal of Forensic Sciences, 43\(5\): 1000-1004.](#)

[Kam, M., Gummadidala, K. Fielding, G. & Conn, R. \(2001\) Signature Authentication by Forensic Document Examiners, Journal of Forensic Sciences, 46\(4\), 884-888.](#)

[Kam, M. & Lin, E. \(2003\) Writer Identification Using Hand-Printed and Non-Hand Printed Questioned Documents, Journal of Forensic Sciences, 48\(6\), 1391-1395.](#)

[Sita, J., Found, B. & Rogers, D. \(2002\) Forensic Handwriting Examiner's Expertise for Signature Comparison, Journal of Forensic Sciences, 47\(5\), 1117-1124.](#)

[Srihari, Sargur; Sung-Hyuk, Cha, Arora, Hina; Lee, Sangjk, Individuality of Handwriting, Journal of Forensic Sciences, July 2002, Vol. 47, No. 4. CEDAR \(Center of Excellence of Document Analysis and Recognition\) at State University of New York, Buffalo.](#)

[Srihari, S. Author's Response to Commentary by Saks, Journal of Forensic Sciences, 48\(4\), 919-920.](#)

[Durina, M. E. and Caligiuri, M. Ph.D. The Determination of Authorship from a Homogenous Group of Writers, Journal of the American Society of Questioned Document Examiners, Inc., Vol. 12, Number 2, December 2009](#)

Summaries:

Beacom, M. S. **A study of handwritings by twins and other persons of multiple births**, *Journal of Forensic Sciences* (1960) 5:121-131. This article reports the results from a study of the handwriting of 50 different pairs of fraternal and identical twins. Comparisons of the writings revealed differences in letter forms, connections, letter sizes, pressure, slant, spacing and alignments, even among identical twins who received the same upbringing and education.

Gamble, D. **The Handwriting of Identical Twins**, *Canadian Society of Forensic Science Journal*, Vol. 13, No. 1 (1980). This paper examines the handwriting of identical twins to determine whether their handwriting displays uniformity or if the writing of each twin is distinctive and identifiable. The following handwriting characteristics were used in comparing the handwriting on each of 58 pairs of twins: 1. General appearance or: "pictorial effect";

2. size of writing
3. writing slope
4. writing speed
5. writing quality
6. letter proportions
7. individual letter forms

The study "confirmed that even though the handwriting of some of these twins had the same general appearance and some similar letter forms, there remained a sufficient number of differences for the experienced examiner to distinguish between the writings of each of the twins in a set and, as a result, the basis of handwriting identification is still valid." The author further concludes: "This research has strengthened the science of handwriting identification by demonstrating that no matter how similar two persons may write, who have similar genetic backgrounds and developing environments, adequate handwriting samples will always contain sufficient material by which their individuality may be established."

Boot, D. **An investigation into the degree of similarity in the handwriting of identical and fraternal twins in New Zealand**, *Journal of the American Society of Questioned Document Examiners*, Vol. 1, Number 2 (1998). The author reports that a document examination case involving the handwriting of identical twins showed a striking degree of similarity in their handwriting. Following this observation, research was undertaken to gauge the degree of handwriting similarity in a larger sample of identical and fraternal twins' handwriting. Handwriting samples and questionnaires allowed the investigation of factors such as genetically linked similarity, schooling, and handedness. The results showed that none of the twins wrote exactly alike, however, in some cases there was a marked degree of similarity. No evidence was found to suggest that identical twins write with more similarity than fraternal twins. While the effect of genetic factors on handwriting could not be truly judged, the study did highlight the need for care and thoroughness in any examination of handwriting

Newman, H., Freeman, F.N., Holzinger, K. **Twins: A Study of Heredity and Environment**, Chicago: University of Chicago Press, 1937. Excerpts also published in the Journal of the American Medical Association, 1938; 110(10):764. In this book handwriting individuality among twins is discussed in Chapter VI entitled “Resemblance in Handwriting of Identical and Fraternal Twins Reared Together”. Studies done by the authors and an additional study done by Francis Galton are reported on as follows: “In both cases the feature of handwriting which was studied was its general appearance – its individuality, the sum total of characteristics which enable us to identify the handwriting of an individual amid all the variations which occur from time to time, and to distinguish it from that of other individuals. We might, perhaps, expect identical twins to resemble each other especially in this characteristic in somewhat the same way as they resemble each other in facial appearance, and to a great degree than in speed or quality. But such is not the case.” It is important to note that this book is used in the field of educational psychology. It is not a book authored by or targeted for forensic document examiners, yet it still supports the validity of individuality in handwriting.

Kam, M. Wetstein, J. & Conn. R. (1994) **Proficiency of Professional Document Examiners in Writer Identification**, *Journal of Forensic Sciences*, 9(1), 05-14

This was the Kam pilot study. Seven FDEs from the FBI and 10 laypersons (control group) participated in study.

- Mean number of incorrect Identifications was 0.14825% for FDEs compared to 8.0% for lay persons
- Incorrect Eliminations were 0.45857% for FDEs compared with 16.7% for laypersons.
- Laypersons were about 56 times more likely to wrongly associate handwriting than FDEs.
- Lay persons were about 36 times more likely to wrongly differentiate handwriting than FDEs.

Kam, M. Fielding, G. & Conn., R. (1997) **Writer Identification by Professional Document Examiners**, *Journal of Forensic Sciences*, 42(5), 778-786. Large scale handwriting study included 105 FDEs and 41 laypersons (as control group).

Results:

- Correct ID: 87.9% for FDEs compared with 87.7% for laypersons.
- False ID: 6.5% for FDEs compared with 38.3% for laypersons

Kam, M., Fielding, G. and Conn, R. (1998) **The Effect of Monetary Incentives on Document Examination by Nonprofessionals**, *Journal of Forensic Sciences*, 43(5): 1000-1004. Monetary Incentives study - This study found variable monetary incentives for participants in study make no difference in layperson performance.

Kam, M., Gummadidala, K. Fielding, G. & Conn, R. (2001) **Signature Authentication by Forensic Document Examiners**, *Journal of Forensic Sciences*, 46(4), 884-888. Study included 69 FDEs and 50 laypersons.

- Calling genuine signatures correctly: FDEs 85.89% compared to laypersons 70%
- Calling genuine signatures incorrectly (as simulated) FDEs 7.05% compared to laypersons 26.1% Laypersons were about 3 ½ times more likely to call a good signature bad than FDEs
- Calling a non-genuine signature correctly FDEs: 65.06% compared to laypersons 92.0%
- Calling a genuine signature incorrectly (as a simulation): FDEs: 0.49% compared to laypersons: 6.47%. Laypersons were about 13 times more likely to call a bad signature good than FDEs

Kam, M. & Lin, E. (2003) **Writer Identification Using Hand-Printed and Non-Hand Printed Questioned Documents**, Journal of Forensic Sciences, 48(6), 1391-1395. This was a re-analysis of the Kam 1997 study, separating out hand printing. 90 FDEs and 34 laypersons participated. With regard to only hand printed documents;

- Correct ID: FDEs scored 88.5% compared to laypersons 93.85%
- False ID: FDEs scored 9.3% compared to laypersons: 40.455
- Laypersons were about 4.35 times more likely to wrongly identify hand printing than FDEs.

On Non-hand printed documents (with cursive and mixed cursive/hand printing)

- Correct ID: FDEs 87.9% compared to laypersons 97.7%
- False ID: FDEs: 6.5% compared to laypersons 38.3%
- Laypersons about 7 times more likely to wrongly identify non-hand printing than FDEs.

Sita, J., Found, B. & Rogers, D. (2002) **Forensic Handwriting Examiner's Expertise for Signature Comparison**, Journal of Forensic Sciences, 47(5), 1117-1124, Signature Study from LaTrobe University, Australia, 2001 17 FDEs (from Australia & New Zealand) and 13 laypersons (control) examined 150 signatures to determine if genuine or simulation

- FDEs: Correct 54.8%, Inconclusive 41.8%, Incorrect: 3.4%
- Laypersons: Correct: 57.4% Inconclusive: 23.6. % Incorrect: 19.3%
- Laypersons were about 5.6 times more likely to make a mistake than FDEs.

Srihari, Sargur; Sung-Hyuk, Cha, Arora, Hina; Lee, Sangjk, **Individuality of Handwriting**, Journal of Forensic Sciences, July 2002, Vol. 47, No. 4. CEDAR (Center of Excellence of Document Analysis and Recognition) at State University of New York, Buffalo. This research study involved collected handwriting exemplars form 1,500 writers from 5 states. Srihari used the CEDAR computer program to automatically extract two categories of handwriting features:

- Conventional features (used by FDEs) – Only a few of the handwriting features used by FDEs were used, such as slant, spacing, and character formation.
- Computer features: These included Macro-features, such as darkness interior and exterior contours, and Micro-features, such as character structures.

Using quantified digitized data of both conventional and computer features, the CEDAR computer program correctly identified handwriting with its writer at a 95% confidence level. Dr. Srihari concluded that this level could rise to 100% with more features used by FDEs.

Srihari, S. **Author's Response to Commentary by Saks**, Journal of Forensic Sciences, 48(4), 919-920. This response is a rebuttal to criticisms raised by M. Saks in his Commentary on Srihari's Individuality of handwriting research (See Journal of Forensic Sciences, July 2003, Vol.48, No 4.) In this response, Srihari addresses criticisms by Saks of Srihari's research (see above: Individuality of Handwriting") regarding: diversity of samples; extrapolation of results from a limited sample to a general population, size of the writing sample used by Srihari; number of intra-writer samples; the type of writing used in the study, and the issue of human ability when compared to the computer program.

Durina, M. E. and Caligiuri, M. Ph.D. **The Determination of Authorship from a Homogenous Group of Writers**, Journal of the American Society of Questioned Document Examiners, Inc., Vol. 12, Number 2, December 2009. A research project was conducted in which samples were obtained from 52 adult writers who grew up in the same neighborhood, were taught the same copybook style, at the same Catholic elementary school, by the same teachers, approximately 4 decades earlier. The specimen writings were subsequently examined by 49 FDEs throughout the world.

- The FDEs rendered conclusions of authorship with an overall accuracy rate of 98%.
- Factors that contributed to the error rate included the length of the questioned document and the geographic location of the FDEs.
- Results of the study offer evidence to support that there is a high degree of inter-writer variation among writers even in populations where the driving forces for variation were low.
- The research addresses criticisms (by Saks) that earlier studies on the individuality of handwriting (by Srihari) did not include populations from homogeneous writing communities and relied on computer analysis of handwriting rather than human examiners