



Signature Distortion in Multi-generation Photocopy: A Review

Yadav A^{1*}, Singh Rkr², Tarannum A³ and Sachdeva MP⁴

¹Department of Anthropology, Delhi University, India

²CEO, Sherlock Institute of Forensic Science (SIFS), India

³Senior Scientific Officer, Sherlock Institute of Forensic Science (SIFS), India

⁴Department of Anthropology, Delhi University, India

Review Article

Volume 7 Issue 2

Received Date: April 08, 2022

Published Date: May 20, 2022

DOI: 10.23880/ijfsc-16000262

***Corresponding author:** Amrita Yadav, M. Sc. Forensic Science, Department of Anthropology, Delhi University, India, Email: amritayadav482@gmail.com

Abstract

The photocopies are often used as secondary evidence in a particular situation where the original copies of a document got damaged or lost in any way. Photocopied documents can never reproduce the exact copy of the original document. It cannot be denied that with every generation the overall quality of the photocopied document keeps on degrading. However, there is no equivalent substitute for conducting an analysis of line quality features as best as in the "original" document. The absence of features that must have been observed in the original document does not rule out the possibility of copying. This paper presents a review of how the author's dealt with various line quality features in subsequent generations of the photocopied document and what are various types of difficulties faced while examining and analyzing the multi-generation photocopied document which can further help the Forensic Document examiner in the evaluation and analysis of multi-generation photocopied samples.

Keywords: Signature distortion; Photocopied document; Multi-Generation; Line quality

Introduction

Document is not only a loose sheet of paper, it is used particularly in professional, legal, commercial, banking work, business purpose and personal affairs of most people and play an important role in the court of law [1]. A reproduction of a document made on paper by an office or commercial system is known as a photocopy [2]. Original and Photocopied Documents can be easily differentiated as handwritten documents are unique and photocopiers do not make a copy of the same size as original ones, usually, there is an increase of about 1% in dimensions of the letters [3]. When subjected to multi-generation photocopy the dimensions keep on increasing with each generation often resulting in degradation of the line quality. Further, it becomes difficult and challenging for the Forensic Questioned Document Examiner to opine on the authenticity

of a document. However, positive aspects of photocopied document examination are that certain handwriting characteristics such as letter formation, letter comparison, unusual letter formation, word and letter spacing, slant, embellishments, diacritic placements, t-crossing positions or i-dots are possible to examine & understand detail up to second-generation photocopy [4]. Apart from writing, other marks like staple holes, stains, tear marks, folds in the paper, creases on paper, marks formed by dust or damage etc. can also be produced on the photocopied document which creates difficulty in the examination.

Review Literature

Holland [5] discussed how photocopiers were produced and how various processes and machine features can be used to characterize and classify photocopiers. As a result, he

concluded that certain models and brands of copiers can be determined from physical class characteristics. Copy quality, paper quality and size, and bulk supply method will all help classification of make and model.

Morton [6] study was conducted on Office copiers, where it was found that it was widely used starting in the early 1970s. Forensic Document Examiners had a lot of challenges with their products. The general consensus was that a copy should not be used to form a definitive judgement about handwriting identification or elimination. Office copiers have substantially improved in the intervening years, and forensic document examiners have become more conversant with their limitations. Further, Forensic Document Examiners examined the reproductions generated on 7 plain paper office copiers, using a combination of 6 writing instruments and 4 paper stocks, and recommended that it is possible to form a definite opinion based on the photocopied document with great caution.

Totty [7] discussed different techniques available for different problems and solutions regarding the investigations. These techniques include trained and informed visual and low power microscope examination of the documents used by the forensic scientists. The author also discussed techniques that were rarely used by the forensic document examiner in document examination i.e. energy dispersive spectrometry (using a scanning electron microscope) and infra-red spectroscopy. Also mentioned about the detailed analysis of paper fibers.

Totty [8] mentioned the problems faced by the document examiner while identifying and classifying the photocopiers. When comparing the photocopiers, defect marks help in identifying the copies on an individual's office copy machine. The most preferable method of identification was elimination as it eliminates the large numbers of machines before the detailed examination. Toner differentiations were an effective method of achieving this elimination. Further, author discussed physical and chemical properties of different types of toner and how they can be utilized for toner discrimination. The chemical composition of bulk toners' was outlined together with chemical techniques assessment, pyrolysis mass spectrometry, energy-dispersive x-ray analysis, and infrared spectroscopy which have been applied to the toner analysis removed from copy paper. The different toners' physical properties on a paper were associated with their composition and method used to fuse toners into papers. When examined under low power microscopy, colour, texture, and surface appearance were observed. The author further suggested that each technique's effectiveness should be evaluated and a chronological approach to toner analysis needs to be done.

Dawson and Lindblom [9] conducted a comparative study on photocopied and original signatures set to evaluate line quality. They assessed photocopies for presence of tremor, pause, patching, pen raises, blunt initial strokes, terminal strokes, and sudden change of direction. Authors compared results with corresponding original signatures. They successfully determined which line quality features were more difficult to identify, which simulation sign was hidden and what defects were introduced by photocopying process. Conclusively, they mentioned that the line quality features can be determined in average quality photocopies. In a few cases, the morphology of the ink line was an issue with ink gooping and striation patterns misinterpreted as hesitations, pen lifts, and patches on photocopies. The authors strongly recommended a thorough assessment and evaluation of any non-original document.

Found and Rogers [10] conducted a study, where they tested accuracy rate of 15 examiner opinions on the genuineness of questioned photocopied signatures. All 15 examiners received same set of original signature samples from 1 person and 80 questioned photocopied signatures set including simulated and genuine signatures. Fifteen (15) Forensic Document Examiner provided opinions for each 80 questioned photocopied signatures which resulted in twelve (1200) opinion units for the group. In all these opinions there were only 240 opinion units for genuine signatures and 960 (nine hundred sixty) opinion units for simulation signatures. The error rate for grouped examiners' opinions was 0.9% providing strong evidence that forensic document experts can make more accurate observations regarding authorship of non-original handwriting.

Saini and Singh [11] studied handwriting characteristics from non-original documents. After conducting an in-depth study, the authors concluded that Forensic Document Examiner can examine the photocopied documents. Although the bad qualities of photocopied documents do create some problems in establishing some of the important handwriting characteristics. The authors mentioned that the examination of every character's features has not been interpreted or detected very precisely. Pen lifts, pen patching, and pen skipping were a few of the features which were commonly misinterpreted. At the same time traced features cannot be reproduced in photocopies documents. Hence, every individual photocopy must be evaluated upon its merit considering the image quality and resolution difference.

Saroa and Saini [12] examined 62 photocopied samples and classified them into 2, 4, and 8 groups on basis of toner type, toner fusion and toner splattering effect respectively. Photocopies from photocopiers of same make and using same type of toner were classified together. Upon analysis,

they found different kinds of trash marks on 49 samples. When all the physical features were considered together, they found that 52 out of 62 black photocopy samples were distinguished completely. Hence, consideration of all physical features together is most suitable for high discrimination.

Saroa and Saini [13] examined 100 black and 20 coloured samples of the altered photocopies for the determination of alterations. Olympus SZX7 Stereomicroscope was used to examine printed, typed, handwritten and signature portions of black, as well as colour, photocopied samples. The author also scrutinized the mentioned samples till 3rd generation for different physical characteristics. Different features like strokes quality, difference in strokes brightness, background printing discontinuity, toner extra deposition, spacing & alignment difference, etc. have been observed, which clearly indicate alterations present in photocopied documents. Alterations have been observed in black and colour samples (37% and 40% respectively) when all characteristics were collectively considered. When the multi-generation of document was examined, authors found it's difficult to detection of the alterations.

Gupta [4] discussed the problems and challenges encountered by forensic document examiners while examining photocopied documents. After the study, the author observed that even a good quality copier cannot record all the writing characteristics exactly. Forensic Document Examiner faces issues while observing the watermarks, sequence of crossing strokes, pen pressure, pen lift, line quality, and pen patching in the photocopied document. The author further mentioned the systematic approach for conducting the photocopied document examination in order to give opinion for their best knowledge in the court along with a better understanding of the limitations in the field of forensic documents field. Conclusively, the author also mentioned that forensic document examiners prefer to give an opinion regarding authorship of a written document on the original document.

Jasuja, et al. [14] conducted a study to observe the effects of subsequent generation photocopying on the collected signature samples. The authors conducted the study with an aim to provide data to the Forensic Document Examiners to enhance their scope of examination which has certain limitations due to the loss of several handwriting features in the multi-generation photocopying process. The study confirms the findings of the earlier researchers that the evaluation of the line quality from the first-generation photocopy does not pose major problems and Forensic Document Examiners can frame the opinion upon the authorship of the handwriting. The study further reveals that a few other line quality features can also be detected from the 2nd & 3rd generation's photocopies but beyond that, the

quality of the document produced results in degradation and distortion of the features. The authors observed and reported the features like thinning in line, widening in line, tooth edges, ragged edges, cluster formation, merging of ink, and breaks in line in the subsequent generation of photocopies. Conclusively, the authors mentioned that the presence and absence of the feature help the Forensic Document Examiner to indicate whether the document being examined is a higher generation reproduction copy, or not.

Found, et al. [15] aimed to compare the accuracy of Forensic Document Examiner's opinion on 260 original questioned signatures samples and photocopied signature samples. In this study, 6 Forensic Document Examiners of New Zealand Police participated, which includes two trials. Every trial was made as per the standard procedure of comparing known signatures group with questioned signatures group where writer was known to experimenters but not to forensic document experts. In the two trials, one trial contains the original specimen and questioned signature whereas in another trial comprises photocopies of same signature questioned and specimen signatures. Upon analysis, the authorship for original or photocopied signatures was established without any error and even there was no case where Forensic Document Examiner has reserved the opinion between a photocopy and its original. The authors mentioned that 2.3% of the opinion related to the original signatures differed in a way from the photocopy. The correct opinion rate concerning process of production of original and photocopied, simulated, questioned signatures combined was 99.7%. Conclusively, it was said that the forensic document examiners were able to compare complex signatures with same accuracy when using either originals or photocopies.

Mishra, et al. [16] presented a study on the problems encountered by Forensic document examiners as to why, when, and how to express an opinion on different aspects of questioned documents when the only photocopier was submitted for examination and analysis. Authors presented a detailed and elaborative review and evaluation of the issues and different solutions expressed by different authorities on a subject upon their own experience. In this paper, a case study has also been presented with an aim to emphasize Forensic Document Examiners need to express an opinion on photocopies submitted for the examination.

Jasuja, et al. [17] conducted a study in which the authors have attempted to study and evaluate the reproduction process effect on different line quality features like initial & terminal strokes of letters; peculiar characteristics associated with the writing instrument such as ink gooping & striation marks; features associated with the writer such as pen lifts, tremor, retouching, guideline, movement impulse, etc. in 5th

generations of photocopier reproductions. In their study, the authors have created 4500 reproductions from 100 original signature samples from 9 different photocopiers of different makes & models. Conclusively, the authors mentioned that few features like initial & terminal strokes could be detected in photocopies till the 5th generation, although the reproductions after the 3rd generation showed thickening of the strokes and consequential degradation of the line quality. The authors also mentioned that beyond the 2nd generation there were certain features that were misinterpreted as other features also. Author believes that the information provided by this study will be helpful to the Forensic Document Examiner while conducting the forensic examination of signatures from multi-generation photocopies.

Conclusion

The review analysis reveals that multi-generation photocopies do pose problems in the identification and evaluation which further leads to difficulty for the forensic document examiner to give a definite opinion from the photocopies submitted for the examination. It can be said that the identification of various line quality features from the first generation of photocopy (i.e. directly reproduced from the original document) does not pose major problems in analysis. Upon further study, few line quality features were found which can also be evaluated from the second and third generation of a photocopy but beyond the third generation, line quality features are often misinterpreted due to degradation and distortion in line quality features beyond the third generation of photocopy which leads to a problem in the analysis and evaluation. In order to address the future problems of photocopied document examination, there is significant space for improvement in modern scientific technologies for their use in a more effective manner.

Acknowledgement

First and Foremost, praises and thanks to God, the Almighty, for his showers of blessings throughout my research work to complete the research successfully. Research work is accomplished by relentless efforts & proper support and guidance.

I would like to express my deep and sincere gratitude to my research supervisor Dr. M.P Sachdeva (HoD), Department of Anthropology, Delhi University for giving me the opportunity to do research and providing invaluable guidance throughout this research. His vision, sincerity, and motivation have deeply inspired me. Further, I will extend my gratitude to Dr. Ranjeet Kumar Singh, CEO of Sherlock Institute of Forensic Science (SIFS) India for his help, guidance, and valuable suggestions given time to time for the execution of my work. He has taught me the methodology

to carry out the research and so present the research work as clearly as possible. It was a great privilege and honour to work and study under his guidance.

I also express my profound gratitude and regards to Ms. Afreen Tarannum, Senior Scientific Officer of Sherlock Institute of Forensic Science (SIFS) India for her guidance, monitoring, constant encouragement, and suggestions for this dissertation made me complete my work with ease. I would like to give my special thanks to my parents for their love, care, and concern for educating and preparing me for my future. Also, a special thanks to my friends for the keen interest shown to complete this research successfully.

References

1. Bisesi MS, Kelly JS, Lindblom BS (2006) Scientific Examination of Questioned Documents. CRC Taylor & Francis Group.
2. Ordway H (1991) Scientific Examination of Questioned Documents. Elsevier.
3. Ellen D (2006) Scientific Examination of Documents: Methods and Techniques. CRC/Taylor & Francis.
4. Reeta RG (2020) Challenges in Forensic Examination of Photocopied Document. IP International Journal of Forensic Medicine and Toxicological Sciences 3(1): 12-14.
5. Holland NW (1984) Photocopy Classification and Identification. Journal of the Forensic Science Society 24(1): 23-41.
6. Morton SE (1989) A Look at Newer Photocopiers. Journal of Forensic Sciences, JFSCA 34(2): 461-467.
7. Totty RN (1990) Analysis and Differentiation of Photocopy Toners. Forensic science review 2(1): 1-23.
8. Totty RN (1990) The Examination of Photocopy Documents. Forensic Science International 46(1-2): 121-126.
9. Dawson GA, Lindblom BS (1998) An Evaluation of Line Quality in Photocopied Signatures. Science & Justice 38(3): 189-194.
10. Found B, Rogers DK (2005) Investigating Forensic Document Examiners' Skill Relating to Opinions on Photocopied Signatures. Science & Justice 45(4): 199-206.
11. Saini K, Singh A (2008) The Evaluation of Handwriting Features in Photocopied Signatures. The Internet Journal

- of Forensic Science 4(1): 1-7.
12. Saroa JS, Saini K (2013) Physical Examination of Photocopied Documents. Problems of Forensic Sciences 94: 485-501
 13. Saroa JS, Saini K (2016) Determination of the Authenticity of Photocopied Documents. Problems of Forensic Sciences 108: 623-631.
 14. Jasuja OP, Mishra S, Ji D (2018) Introduction of Unique Artefacts in Handwriting Line due to Multi-Generation Photocopying and their Influence on Forensic Handwriting Analysis. Adli Bilimler Dergisi / Turkish Journal of Forensic Sciences 17(4): 7-16.
 15. Bryan F, Rogers D, Herkt A (2018) Comparison of Document Examiners' Opinions on Original and Photocopied Signatures. Journal of Forensic Document Examination 28: 27-34.
 16. Mishra SK, Sharma P, Singh M, Jasuja OP (2019) What Forensic Information Does a Photocopier Reproduction Convey – Is It Suitable and Sufficient to Lead an Expert to a Definite Conclusion?. Problems of Forensic Sciences 117: 19-36.
 17. Jasuja OP, Mishra S, Singh M (2019) Forensic Evaluation of Line Quality Features Occuring in Multi-Generational Photocopied Handwriting. Adli Bilimler Dergisi / Turkish Journal of Forensic Sciences 18(2): 7-19.

