



Research Article

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Discrimination of Tremors in Illiterate and Fraud Handwritings



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Abstract

Tremor is an unintentional, rhythmic muscle movement involving to and fro movements (oscillations) of one or more parts of the body. It is defined as unusual departure of line from its intended course resulting in disturbances in performance of fine motor skills. Such tremors and the consequent degradation of fine motor skills have significant implications for the field of forensic document examination. Document examiners frequently encounter the challenges of determining the authenticity of the documents containing tremors. There is broad range of possible causes of tremor in handwriting including the writers suffering from illiterate or having some health issues or due to illiteracy and many more. The main objective of this study is to highlight some specific characteristics differentiating the tremors seen in the handwriting of illiterate and fraud writers. A total of 80 handwriting samples were collected from the writers belonging to two different categories: illiterate and fraud. The samples so collected were examined for presence of tremors in each alphabet and numeral of all the 80 samples. The tremors were identified and recorded with respect to their occurrence at specific parts of the letters such as Upper, Middle and Lower part and also at the same time with respect to their occurrence in specific type of strokes such as Straight, Curved and Loops wherever applicable. The results were then evaluated and interpreted statistically.

Keywords: Forensic; Document; Tremor; Handwriting; Illiteracy; Fraud; Forgery

Introduction

Impairment of motor functions in human is considered as the common symptom of neuromuscular imbalance and can cause loss of competency in everyday activities [1]. Degradation in handwriting resulting from such motor dysfunction is often the first sign of a problem that needs further investigation [2]. Tremors are defined as unconscious, rhythmic to and fro muscle movement of one or more parts of the body [3]. Tremor in handwriting is unusual departure of line from its intended course resulting in disturbances in performance of fine motor skills. Such tremors and the consequent degradation of fine motor skills have significant implications for the field of forensic document examination [4]. Document examiners frequently encounter the challenges of determining the authenticity of the documents containing tremors [5]. States that one of the most challenging problems faced by document examiner is determining the cause of tremor in writing. Some important factors to consider include where the tremor occurs, the extent to which the pen deviates from its normal path, and the writer's condition when the document was allegedly written.

There is broad range of possible causes of tremor in handwriting. Tremors in handwriting are classified as genuine tremors due to age [6] ill health [7] illiteracy, under the influence of drugs [8,9]. ethanol intoxication or by combination of these unconscious activities. Apart from this there is another potent cause of handwriting tremor i.e. due to forgery. This type of tremor is observed when one tries to copy other person's writing. The act of slowly drawing the lines, instead of writing them, causes corrugation of writing line. Therefore, in forensic scenario the experts often face the critical question regarding the nature and cause of handwriting tremor [10]. They have to answer whether the tremor seen in handwriting is due to the genuine deterioration of the motor skills of the writer or owing to any form of conducted a study for addressing the difficulty in differentiating between shaky handwriting and handwriting which is jerky, twisted, or inhibited. The study discussed about the effective parameters for distinguishing various motor disorders as well as what might occur due to smoking, caffeine ingestion, and alcohol.

The results of the study would serve as a guideline for the practitioners of the profession to differentiate between genuine tremors due to illiteracy and tremors seen in forged writings by examining the inherent characteristics of strokes. This will play a vital role in exonerating innocents who are falsely implicated because of tremors and are misidentified as forgers [3,11]. States that the hallmarks of basic illiteracy are hesitation and a kind of tremor characterized by a general irregularity of the line that is due to a lack of skill and a mental uncertainty as to design and form, and to a general muscular clumsiness from unfamiliarity with the writing process [12-19].

Materials and Methods

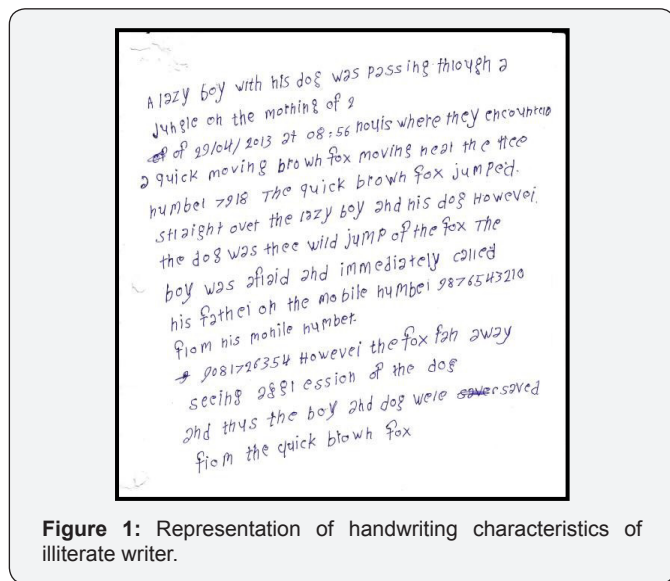


Figure 1: Representation of handwriting characteristics of illiterate writer.

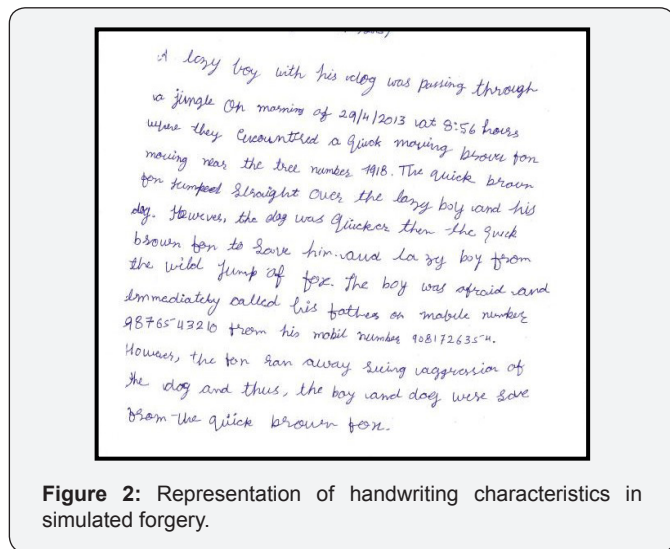


Figure 2: Representation of handwriting characteristics in simulated forgery.

The present study aimed at providing description about the nature of tremor occurring in illiterate and fraud writers. A total of 80 subjects who volunteered and signed the informed consent to participate were selected for the present study belonging to the group of illiterate and fraud writers. A standard text was prepared in simple English language consisting of all 26 English

alphabets and all numerals, with due care to ensure that each alphabet and numerical occurs minimum twice in the prepared standard sample text for intra writer comparison. For samples of illiteracy, handwritings were collected from 40 writers above the age of 60 years with different sex & religion and with no other physical illnesses reported. For forgery samples, handwritings were collected from 40 writers asking them to copy the standard text exactly identically as far as possible. The text was either verbally dictated or given to the writers to copy as per their demand or convenience. Every writer was asked to write the given text in their natural handwriting on plain A4 size paper with a ball pen (Figures 1 & 2).

The samples so collected were examined for presence of tremors in each alphabet and numeral of all the 80 samples. The tremors were identified and recorded with respect to their occurrence at specific parts of the letters such as Upper, Middle and Lower part and also at the same time with respect to their occurrence in specific type of strokes such as Straight, Curved and Loops wherever applicable (Figure 3). The examination was carried out manually using hand magnifier, stereomicroscope and through the help of Video Spectral Comparator (VSC) - 6000/HS. The photography of specific observations was all taken with the help of VSC-6000/HS. Each observation was compared with intra-class samples and inters-class samples to determine specificity in features. The observations in forms of UPPER, MIDDLE, LOWER, STRAIGHT, CURVE & LOOP for each alphabet/letter and numerals were recorded in Excel sheets and the observed data was then evaluated and interpreted statistically using appropriate tools.

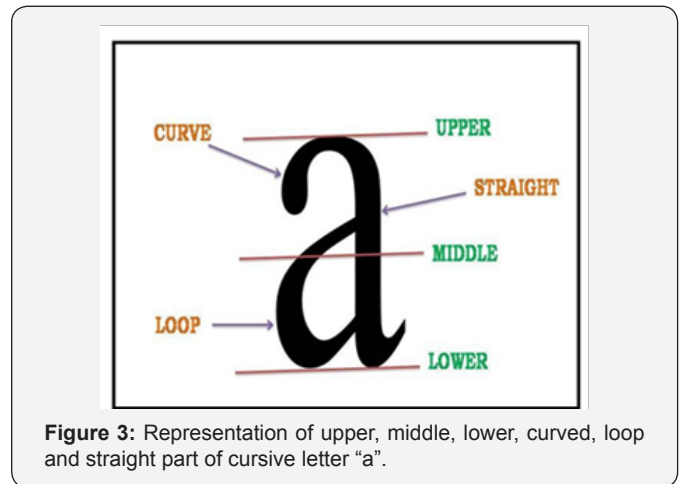


Figure 3: Representation of upper, middle, lower, curved, loop and straight part of cursive letter "a".

Results and Discussions

After analysis of the data it was observed that the handwriting samples of illiterate writers reflected 85.69% tremor in upper region, 87.22% tremor in middle and 73.4% tremor in lower region of the characters and numerals (Figure 4). While the handwriting samples of fraud writers showed only 58.26% tremor in the upper region, 48.54% tremor in middle region and 58.47% tremor in the lower region of the characters

and numerals (Figure 5). The handwriting samples of illiterate writers reflected 56.39% tremor in straight part, 27.99% tremor in loop and 40.63% tremor in curved part of the characters and numerals (Figure 6). While the handwriting samples of fraud writers showed only 45.83% tremor in the straight part, 21.88% tremor in loop and 45.21% tremor in the curved part of the characters and numerals (Figure 7).

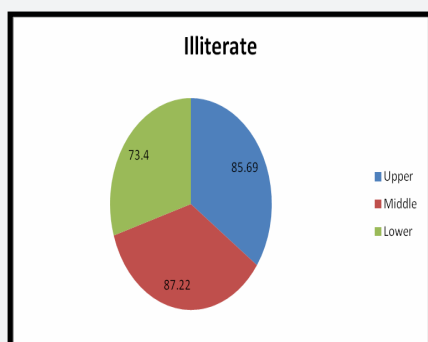


Figure 4: Percentage of occurrence of tremor in upper, middle and lower portion of characters in the handwriting samples of illiterate writers (N=40).

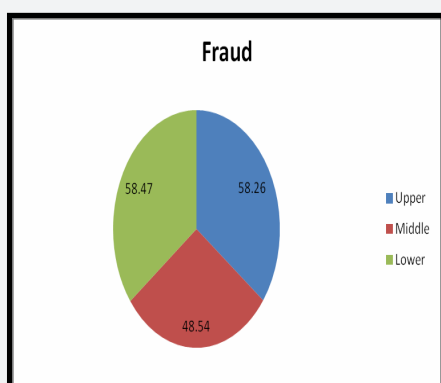


Figure 5: Percentage of occurrence of tremor in upper, middle and lower portion of characters in the handwriting samples of Fraud writers (N=40).

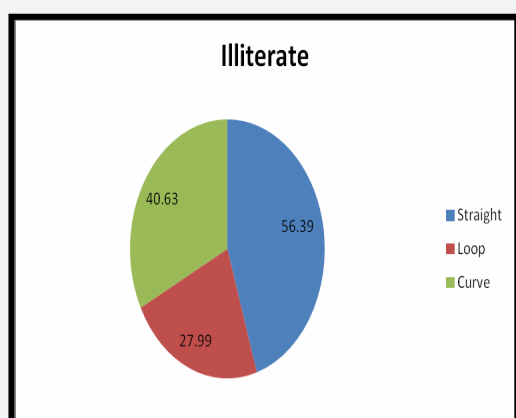


Figure 6: Percentage of occurrence of tremor in straight, loop and curved portion of characters in the handwriting samples of illiterate writers (N=40).

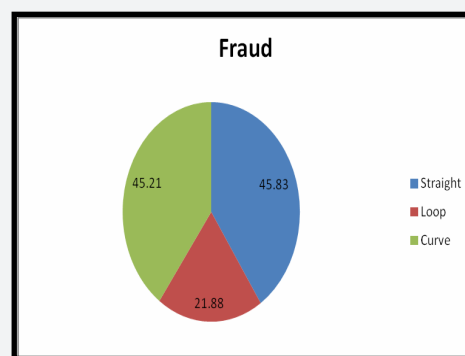


Figure 7: Percentage of occurrence of tremor in straight, loop and curved portion of characters in the handwriting samples of fraud writers (N=40).

Tremor Seen In Upper, Middle, Lower Part Of Characters and Numerals in Illiterate and Fraud Writers (N=80). A weak correlation (-0.140), (-0.083) and (+0.082) was observed in the tremor values of the upper, middle and lower region respectively of the characters and numerals in the handwriting samples of illiterate and fraud writers. Statistically significant variations at $p=0.05$ were observed in the tremors seen in the upper, middle and lower region of characters and numerals in handwritings of illiterate and fraud writers with chi-square value of 29.676 ($p<0.00001$; $df=2$).

Tremor Seen In Straight, Loop and Curved Part of Characters and Numerals in Illiterate and Fraud Writers (N=80). A positive correlation (+0.602), (+0.892) and (+0.719) was observed in the tremor values of the straight, loop and curved region respectively of the characters and numerals in the handwriting samples of illiterate and fraud writers. Statistically significant variations at $p=0.05$ were observed in the tremors seen in the straight, loop and curved region of characters and numerals in handwritings of illiterate and fraud writers with chi-square value of 49.116 ($p<0.00001$; $df=2$).

Conclusion

The upper, middle and lower region of the characters and numeral showed high percentages of tremors in the handwriting samples of illiterate writers (85.69%, 87.22% & 73.4% respectively) in comparison to handwriting in case of forgery (58.26%, 48.54% & 58.47% respectively). The straight and loop region of the characters and numeral showed more percentages of tremors in the handwriting samples of illiterate writers (56.39% & 27.99% respectively) in comparison to handwriting in case of forgery (45.83% & 21.88% respectively). However the curved part of the characters and numeral showed more percentages of tremors in the handwriting samples of fraud writers (45.21%) in comparison to handwriting of illiterate writers (40.63%). Also, the handwriting samples of illiterate and fraud writers showed statistically significant tremor variations in upper, middle, lower, straight, loop as well as curved region of writing characters and numerals.

Additionally it was observed that the tremors appearing in illiterate group were the most unpredictable, both in magnitude and locale. Particularly the magnitude of tremor varied a lot between the illiterate writers. Since they were uneducated they only copied the text without identifying the letters or understanding the text. Many of them made some complicated design of certain letters which they could not perceive and draw. Spelling mistakes could be occasionally seen owing to their unfamiliarity with the words and loss of focus. Whereas, the tremors in simulated fraud were considerably sudden, haphazard and unpredictable. It followed a hit and miss pattern. The same writer could write a specific letter very meticulously at one place but faltered at some other place. The simulated forged writings were full of hesitations, pen pauses, pen lifts, patching, retouching and showed all other inherent signs of forgery. These entire phenomena's can be attributed to the effort the forger applied in simulating a particular handwriting and match it as far as possible in appearance.

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