Novice Ideas: Handwriting Comparisons Conducted by an Untrained Individual

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Forensic analysis of questioned documents includes chemical analyses of paper and ink as well as handwriting comparisons. Several elements affect handwriting analyses, including the presence of discriminatory factors that can individualize a handwriting sample and whether the handwriting has been disguised. Five handwriting samples were gathered from six individuals comprising of one reference, three natural unknowns, and one disguised sample per person. A novice conducted analyses on every collected sample and conducted comparisons of the reference sample to the unknown and disguised samples in an attempt to correctly source the unknown and disguised samples. The novice showed a high level of accuracy in correctly sourcing the natural sample but made erroneous conclusions when analyzing the disguised samples.

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Forensic analysis of questioned documents includes chemical analyses of paper and ink as well as handwriting comparisons. Several elements affect handwriting analyses, including the presence of discriminatory factors that can individualize a handwriting sample and whether the handwriting has been disguised. Five handwriting samples were gathered from six individuals comprising of one reference, three natural unknowns, and one disguised sample per person. A novice conducted analyses on every collected sample and conducted comparisons of the reference sample to the unknown and disguised samples in an attempt to correctly source the unknown and disguised samples. The novice showed a high level of accuracy in correctly sourcing the natural sample but made erroneous conclusions when analyzing the disguised samples.

Introduction

Like many disciplines within forensic science, forensic document analysis was developed in response to a need within the justice system. This discipline includes handwriting analysis and comparisons; determining whether the document was printed and the type of device used to print it; determining if a document was altered; ascertaining the age of a document; and restoring missing elements of a document. Compared to other areas in forensic science, this discipline largely lacks research to support the claim that every individual has unique handwriting. Additionally, forensic document examiners, or FDEs, do not have adequate research to model their comparisons after. Comparisons made by FDEs between a known and questioned document are conducted to authenticate and determine the source of the questioned sample; however, without a solid research foundation, their comparisons become subjective.

During these comparisons, FDEs do not attempt to discern an individual's personality or character from their handwriting, as such assessments should be an indication that an FDE has not been properly trained (Vastrick, 2015). Vastrick notes that the completion of a 24-month, full time training program is the minimum requirement for an FDE to perform competently. As FDEs have worked to improve the accuracy of their analyses, the American Society for Testing and Materials Standard E-2290, Standard Guide for Examination of Handwritten Items was published to serve as a guide for FDEs (ASTM, 2015). Every five years the standards in the guide are reviewed and the guide is updated where necessary (Vastrick, 2015).

This study initially examines the ways in which FDEs source a handwriting sample, the areas in which FDEs experience trouble sourcing handwriting, and how FDEs perform compared

to non-examiners. It then analyzes a novice's ability to correctly match a known handwriting sample with its unknown match without the use of the published guide. The novice was an individual with prior knowledge of forensic document analysis but had no formal training in conducting handwriting analyses. The results of this research will show whether a novice can recognize the unique features of each person's handwriting in the known samples and locate those features in the unknown samples, whether natural or disguised handwriting. This research will demonstrate that some knowledge of the discipline can minimize misleading conclusions, which can be applied to forensic document examiners and compared to the analyses of non-examiners. The research also demonstrates that singular features are not enough to individualize a handwriting sample. Multiple similar features are needed to form a definitive conclusion of a match.

Literature Review

Discriminatory Elements

There are multiple key features to examine when determining the source of a handwriting sample. The first is to compare the same sections of the passage(s), if possible, which allows for the most effective analysis because it will be easier to observe similarities and differences (Ling, 2002). Ling details quantitative features, such as measurements, utilized to compare questioned documents to exemplars. Some measurements include word spacing; spacing between letters, such as between an 'i' and 't' when appearing as 'it'; height of letters; and the slopes of letters such as 'h', 'b', and 'd' (Ling, 2002). These measurements individually will not provide enough information to fully characterize the uniqueness of one's handwriting. Several of these measurements must be taken and analyzed together for the

greatest discriminatory power, but there is presently no minimum number of characteristics to determine a match (Ling, 2002). Additionally, Ling suggests looking at key letters or combinations that have been shown to have high discriminatory power. These key features include the letter 'k', the top of 'of' and 'th' combinations, and the point at which the letters are joined in a 'th' combination. Finally, these measurements are taken in various places of the sample for a comprehensive view of the variation within the individual's handwriting (Ling, 2002).

A similar study utilized the measurements of letters to determine if two handwriting samples are similar enough to be sourced to the same individual. Rika (2018) used a computer imaging system to measure the height and width of each letter, lower and upper case, and ran a statistical analysis to determine if the samples could be sourced to the same person. The results of the study show that of the 21 individuals' handwriting samples, at least 18 writers' texts showed enough similarity to not be random (2018). While this study is limited, it demonstrates a further potential for the unique characterization of handwriting to a single individual.

Difficulties for Examiners

An incorrect or misleading conclusion can be reached by FDEs despite their use of the various measurements and key features discussed to compare two handwriting samples. The frequency of incorrect conclusions was most often noted when the FDE was examining an individual's disguised or simulated handwriting (Bird, Found, Ballantyne, & Rogers, 2010a). Simulated handwriting displays features that would indicate the document was copied but does not necessarily mean it was written by a different individual (Sita, Found, & Rogers, 2002). Bird and colleagues (2010a) suggested two possible causes for this

phenomenon before conducting their study: examiners are misidentifying disguised handwriting as simulated handwriting and vice versa or examiners are considering the variation they observe as within the normal variation of an individual's handwriting. The results of the study led the researchers to two possible causes for incorrect conclusions by FDEs. The first was that examiners associated disguised or simulated handwriting with a different writer instead of as disguised or simulated (Bird et al., 2010a). Bird and colleagues (Bird et al., 2010a) also suggested that because few people can effectively disguise their handwriting, the variations in their disguised handwriting sample are seen as within normal variation range so the examiners classify it as genuine.

Sita and colleagues (2002) also conducted a study evaluating FDEs' conclusions and noted a number of trends from the examiners' conclusions. One trend seen among examiners was their increased rate of inconclusive results, demonstrating a greater sense of caution when conducting their analyses (Sita et al., 2002). By being cautious in their conclusion, FDEs minimize the chance that a guess will be made to reach a definitive conclusion. A second trend noticed was that experts had better results when examining more complex signatures, which is likely due to the increased level of detail available for comparisons (Sita et al., 2002). These details and trends that can be seen in the work of FDEs illustrate the level of skill and training needed to ensure the highest quality work possible is done for each analysis.

Examiners vs Non-examiners

The trends noted in Sita and colleagues' (2002) study was juxtaposed with the results from examinations conducted by non-examiners. The most notable conclusion from comparing the two groups was the difference in error rate and the number of

inconclusive conclusions (Sita et al., 2002). Both groups correctly identified a similar number of handwriting samples, but the examiners had a much lower error rate and more inconclusive results than the non-examiners (Sita et al., 2002). Results such as these suggest that non-examiners can do the work, but they are not as conservative in their conclusions. The high error rate combined with the lack of inconclusive results suggests that non-examiners are assigning conclusions without necessarily having the evidence to support their claim. Non-examiners were likely making an intuitive guess based on their observations as to whether the handwriting was genuine, disguised or simulated.

This was also noted by Kam, Abichandani, and Hewett (2015) in their study which showed laypersons had statistically significantly different conclusions and error rates than FDEs in most of the analyses conducted with natural and simulated handwriting. Participants were provided two questioned documents and a number of known documents and asked to determine whether one or both of the questioned documents came from the same source (Kam, Abichandani, & Hewett, 2015). When the second questioned document consisted of simulated handwriting, there was no significant difference between the conclusions of the examiners and laypersons (Kam et al., 2015). This is a possible indication that examiner error can be partially sourced to simulated handwriting.

Bird, Found, & Rogers (2010b) also reported a high error rate and few inconclusive conclusions within the results produced by the non-examiner group. The error rate was higher because the non-examiners gave more definitive conclusions (Bird et al., 2010b). FDEs were more cautious in their conclusions, which produced a lower error rate, and demonstrated that they were more accurate at identifying which handwriting sample was disguised

(Bird et al., 2010b). However, within the group of non-examiners, there were two participants who yielded results similar to those of the examiners; they were the only two who reported having prior knowledge of the discipline (Bird et al., 2010b). This result highlights the benefits of knowledge of the field and shows that training is necessary to maximize the success of the discipline. Those with some knowledge of the discipline performed better than those without any knowledge, but worse than those who have been trained in the discipline. Utilizing this study, it is reasonable to predict that the novice participating in this research should have some level of success in correctly sourcing the samples, but not the kind an FDE would experience.

Methodology

The research conducted in this study is exploratory and the data collected is cross sectional and qualitative. Participants for this study were gathered via a request made of members of San Jose State University's Forensic Science students. Six individuals volunteered and provided samples that were written in identical circumstances. Each individual was given paper of the same brand, a pen of the same brand, wrote on the same surface, wrote the same passage by dictation, and wrote in the same direction. However, the amount of pressure each individual used could not be controlled. Each individual wrote the same passage five times: four in their natural handwriting and once with an attempt to disguise their handwriting. The subjects were not instructed on how to disguise their handwriting, so it is likely they all used different techniques. One of each individuals' natural handwriting samples was labeled with their initials and was used as the reference sample. The remaining four samples were randomly assigned a number that correlated to a key with each individual's initials next to their numbered unknown. The novice in this study

has read a chapter in a forensics textbook on handwriting comparisons and had gone through a one week, approximately four hours, questioned documents course. The samples were analyzed and thorough notes were taken on all samples detailing letter shapes; passage formatting; spelling errors; capitalizations and grammar; and the spacing between letters and words. The dictated passage included numbers, which were also utilized for comparison by noting whether the numbers were written as numerals; if they were written out; or if they had any other features, such as a line through a zero. Natural handwriting samples were indiscriminately mixed with the disguised handwriting unknowns. The novice then conducted comparisons based on the notes taken from the known samples and the unknown samples to determine a possible match. Two possible matches were then visually compared noting similarities and differences to, possibly, determine the source of the unknown sample. Before determining the source of the unknown sample, the analyst identified a minimum of eight similarities between the unknown sample and the possible source sample, aligning with the recommended examined features in Ling's (2002) study. This information was recorded utilizing photographs and a notebook.

TABLE 1 - List of Variables

Background Variables	Controlled Variables
Writing pressure How handwriting was disguised	Paper brand Pen brand Writing surface Passage written Direction of writing

	Passage was dictated

Results

After the novice completed the comparisons of 24 unknown samples to six reference samples, 16 unknowns were correctly sourced to the correct reference sample with little hesitation and the remaining eight underwent a second examination. All of the disguised handwriting samples were within the eight samples that were examined a second time. Of these, six were correctly sourced to one of the reference samples, one was classified as inconclusive, and one was classified as a nonmatch. These conclusions were reached through the analysis and comparison of writing features previously outlined.

TABLE 2 - Conclusions Reached by Novice

	Match	Inconclusive	No Match
Natural Handwriting (18)	18	0	0
Disguised Handwriting (6)	4	1	1
Overall (24)	22	1	1

Discussion

The results examined by the novice were not completely unexpected, as previous research has indicated that prior knowledge of forensic handwriting comparisons has a positive effect on layperson results. Additionally, it was previously suggested that individuals were not proficient at disguising their

handwriting (Bird et al, 2010a). The 16 samples that were initially identified were all natural handwriting. The most distinctive features of these samples were the way numbers were written, how the sentences were formatted, spelling errors, capitalizations, and the letter combinations of 'of' and 'th'. There were, however, multiple samples that had 'the' combinations that were similar in their appearance. This feature that is, individually, similar to multiple reference sources, was combined with the other features noted in the sample to produce a strong distinguishing power. Of the remaining eight, five were identified as matches after reexamination and comparison of the samples line-by-line with the reference.

The first of the remaining three was a disguised sample and was correctly sourced because the author had similar capitalizations and a spelling error that was seen in only one reference sample. Without the spelling error, it is unlikely that the sample would have been accurately sourced. The second of the remaining samples was a disguised sample written in cursive and was declared inconclusive. There were few indicators that were consistent with one of the reference samples, including the slant of the writing and the long tails of the letters 'y' and 'g'. However, these similarities were not enough to definitively source the unknown sample to an author because similar features were observed in another reference sample. The remaining sample was disguised and determined to be a non-match as almost everything about this unknown sample was different from the author's natural handwriting. The only consistency between the unknown and the subject's natural handwriting were two capitalizations shared between the two.

The novice that conducted the analysis had an 8% error rate because the inconclusive and non-match sample did have a

source among the reference samples. This is not a high error rate when the small sample size is considered, which may have contributed to the high success when analyzing the natural handwriting samples. Each natural handwriting sample appeared distinct from each other with a simple examination. It is possible that with a larger sample size, the samples would have had more similarities in their appearance.

Conclusion

The results of this study show that a novice can accurately source natural handwriting. Disguised handwriting presented more of a challenge for the novice, leading to incorrect and ambiguous conclusions. These results can indicate that the comparison of questioned documents to known sample can be conducted well with minimal experience. However, this study is limited due to the small sample size and the obvious distinctions between the natural handwriting samples. Additionally, analyzing and comparing the well-disguised samples provided an increased level of difficulty that the novice struggled to work through. Without a comparison from an FDE, it is difficult to determine whether the prior knowledge of the novice had a positive effect on the results. If this experiment were to be repeated, efforts should be made to ensure the process is completely blind. For example, it would be better for the novice to not be in the room during the dictation and collection and having a third party shuffle the unknown samples.

This research has helped support the notion that prior knowledge of the discipline can have a positive effect on the analysis of questioned document evidence. Knowledge of the discipline would include basic information on how comparisons are conducted and what features are examined during these

analyses. This can be applied to jurors who, while not conducting the analyses, may better interpret and weigh handwriting comparisons that are presented as evidence. Furthermore, it supports trust in forensic document examiners, who have undergone training and have years of experience analyzing handwriting because the success of the novice indicates that more training and education should cause greater success for a professional.

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