Going Beyond the Lewinson-Zubin Assessment Scales: Refinement of Handwriting Analysis through Combination Techniques

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Abstract

Currently the Central Intelligence Agency uses the Lewinson-Zubin Assessment Scales to enhance the recruitment of covert personnel through handwriting analysis. Although many experts support the use of this particular method of analysis, a more effective manner in which personality assessments are performed may exist. Through the implementation and combination of additional methods with L-Z Analysis, more reliable results may be possible. Additionally, the process of gaining personality traits from handwriting data goes beyond the simple analytical phase. The methods used to collect, classify, extract features, and yield information from handwriting samples will have an impact on the significance of the measurements being obtained. It is also possible to gain more accurate results by creating a distinction between signatures and written text. By properly processing both types of data, from each subject, more information may ultimately be obtained. A robust handwriting assessment system must be a consolidation of all stages and methodologies used, in the end-to-end process, during the creation of a personality profile through automation.

1 Introduction

There exists a need to analyze handwriting on the basis that it provides a theoretical ability to determine personality characteristics or identity. The process has historically been performed by an individual trained in field of Graphology. Although slow, there have been many instances in which these types of studies have been successful in determining some commonalities in personality traits in relation to handwriting [1-6].

The author of this paper will reference several implementations of different methodologies and techniques, which will show some degree of significance in the assessment of personality. Although several algorithms exist, which attempt to aid a Graphologist in his/her study, they all seem to lack a comprehensive vision and only linearly approach the problem. It is suggested that one comprehensive and robust solution allow these individuals to assess samples using multiple methods. This will give
further depth in studying the textual data and determining a personality assessment with a greater degree of accuracy.

2 Demand for a More Effective Handwriting Analytical Process

The belief that handwriting can provide insight into one’s personality is based on the observation that different people have different handwriting. Handwriting based analysis has a wide variety of potential applications, from security, forensics, financial activities to archeology (e.g. ancient documents) [1]. The applications for an automated handwriting assessment system are seemingly endless. When considering the theoretical possibilities of a robust system, numerous uses come instantly to mind.

These benefits were often viewed in a theoretical sense, until modern computing and automation offered an ability to refine the processes and traverse a greater number of samples. “For a few years, searchers have agreed that it is necessary to reach a better knowledge of writing, in its patterns, of course, but also in the psychological and motor mechanisms it involves” [2]. Now, the potential for an effective and powerful handwriting assessment system is greater than ever.

The Central Intelligence Agency could greatly benefit from an effective handwriting analysis system, as the field of handwriting and personality assessment yields the favorable byproduct of increased efficiency. This paper will focus on the Lewinson-Zubin Assessment Scale, because it is the methodology that is currently being utilized by the CIA for various tasks, including the recruitment of potential spies [2]. Experts could provide the identities of potential spy recruits almost instantly after securing handwriting samples for a group of potential candidates.

The potential application for a robust handwriting analysis system in the CIA is stated clearly and without question by Olatunbosun, et. al., “If the US can’t wave cash in front of the eyes of terrorists and expect results, they should appeal to the idealism of the organization. The [United States] could use handwriting analysis software to target potential spy recruits within Al Qaeda and other terrorist organizations” [2]. The potential to create a new methodology in the recruitment of covert operatives is vital to national security; and therefore, an attempt to refine the existing tools in use throughout those security organizations should be made.

3 Lewinson-Zubin Assessment Scales

Sharif & Kabir suggest several possible measurements that can extract meaningful content and provide information on a subject’s personality [2]:
• Left and right page margins: The margins of a handwritten sample can take different forms, each of which has a specific meaning. For example, large and equal margins on both sides of a page show a law-abiding personality and good management characteristics.

• Word expansion: In graphology, a text with expanded words represents an honest and trustworthy personality.

• Letter size: A text may have small size or large size letters. A text with large letters indicates an extrovert personality while a text with small letters represents an introvert personality.

• Line and word spacing: According to graphologists a text with small line spacing belongs to a more narrow-minded individual or a collector”. Large line spacing represents a person who can make open-minded and situation-specific decisions. In other words, word spacing shows the extent to which an individual is close to his/her social environment.

• Line skew: The lines with an upward orientation indicate an optimistic character. On the other hand, downward orientation belongs to pessimistic characters.

• The ratio of vertical to horizontal elongation of words: A text with a high vertical elongation in comparison to horizontal one represents an individual with high ideals. The opposite represents a self-satisfied personality.

• Slant: The slant to the left represents a warm and friendly disposition, whereas the slant to the right represents a pessimistic and shy disposition.

Lewinson-Zubin Analysis denotes four special characteristics of handwriting – vertical, horizontal, depth, and form. Each letter can be analyzed by each of these four characters. The L-Z analysis can help distinguish the following dimensions of personality: the rational, the social-emotional, and the instinctual [3-4]. Through the feature extraction and analysis, a trained professional can provide insight into existing personality traits. This type of information can be invaluable, as was discussed in section 3.

As we can observe, the L-Z Assessment Scales seemingly address most of the characteristics of handwriting suggested above. Because of the adequacy of this particular method, it may appear to be the best solution. The author of this paper does not dispute that L-Z Analysis may yield the most significant result. Rather, it is believed that other methodologies could be used in conjunction with this method. Through
combination techniques, a Graphologist could achieve a higher level of certainty than by using the L-Z Assessment Scale alone.

Furthermore, the L-Z Assessment Scales seem to fail in addressing key portions of the analytical process of determining an individual personality profile from an end-to-end perspective. Other methodologies must be implemented, which can deal with specific stages in the collection, classification, and testing arenas. Without proper methods and techniques in place, the maximum potential of the L-Z Assessment Scales may never be achieved or will never be effective enough to be regarded as reliable.

4 Additional Standards Can Add Certainty

By implementing additional standards into any automated handwriting assessment system, a Graphologist can base an assessment of personality on multiple scales, potentially leading to more accurate information. By providing these additional measurements, methodologies, collection techniques, and classification algorithms a trained professional can make judgments based on multiple recommendations, rather than just a single assessment. Additionally, by strengthening the overall end-to-end process, the results could be more reliable, as the data would be more workable from an analytical perspective.

4.1 Gabor

Although Gabor is generally used for biometric identification, the concepts could help address additional aspects of the sample handwriting. An individual’s handwriting possesses a specific texture. In Gabor, the features which represent the content are spatial frequency and orientation. Through these features alone, it is possible to effectively analyze the handwriting data for significance. This methodology requires no segmentation or connected component analysis to yield reliable results [5].

The Gabor Assessment focus on textual concept such as: write specificity, completeness, and environment invariance. This would require a handwriting sample be based on a portion of text, which would already be determined. The subject would make a handwritten copy and measurements would be based on the analysis of the sample in respects to the original text. These texture features would provide interclass variability and intra-class similarities [5].

Additionally, these factors can be effectively used on text in different languages, which would add greater benefit to the intelligence community. In an analysis of Chinese text, the Gabor methods successfully identified the author at a reasonable level of significance. “The results show that the new method has good performance in Chinese [Handwriting based personal identification]” [5]. The ability to identify the identity of a particular
author could add reasonable benefit in the collection of sample data, if not provide additional metrics on which one could base an assessment of personality.

4.2 FD-D2

It is possible, under particular conditions, that fractal parameters are stable and discriminate enough to establish handwriting classifications according to style. It has been demonstrated that this methodology is applicable to the study of text and signatures [1]. Through this type of analysis, even more information regarding the textual content can be delivered via the proper professional observer.

Fractal geometry, when applied to textual data, provides interesting qualitative and quantitative description of the text, as illustrated in the following [1]:

- **The fractal dimension (FD)** is calculated from the slope of a particular zone. This part of the graph matches with the dilations when text semantic content is apparent. Thus a parameter describing the perception one can have of a handwriting sample from an adapted distance of observation.

- **The secondary dimension (D2)** is calculated from the slope of a particular region, generally a larger scale than a single word or phrase. This zone of the graph corresponds to the values of \( \eta \) when text is hidden by dilations. It can replicate the perception one has for a sample from a more remote point of view.

Analyzing the fractal dimension and the secondary dimension will allow the definition of the space with which a classification can be established. When these features are positioned on a graph, a clear link is established. This link tends to provide insight into the legibility of the sample [1]. It is intuitive to believe that, provided the information included in this paper, the degree of legibility in a particular handwritten piece of text will yield significant results. Failure to except this argument would require a rejection of the field of handwriting analysis in its entirety.

4.3 GMM vs. SVM

Automatically identifying sub-categories could be used to improve a system that performs handwriting analysis, as variability within a certain category is smaller than within a complete population, allowing experts to train specialized recognizers [6]. By training these systems, the author believes that a maximum potential can be recognized quickly and efficiently, regardless of the regional implementation.

Given that handwriting is un-constrained and any text can be used for classification, two different classifiers can be used and applied to the gender and handedness problem. Gaussian Mixture Model (GMM) is used to model the distribution of the features of each class, while support Vector Machine (SVM) directly attempts to maximize the ability to
discriminate between classes without modeling or estimating class conditional densities. Both sets of features can be used to train a system for the purpose of comparison [3].

The ability to allow handwriting assessment systems to learn from different sub-classes could provide the ability to analyze and compare samples in a different region or language. This could provide an immeasurable benefit to national security agencies. The analysis of handwriting, at least for the purpose of determining gender and handedness, could be seamlessly applied in foreign regions.

4.4 Old fashion human interaction...

It is important, as the author has stressed countless times, that a professional Graphologist be used in the process at all times. “The best approach for evaluating certain scales is to combine automated processing with input from an expert. This software is designed to be used in combination with a professional graphologist. The process of segmenting words and letters can be hard for a machine to distinguish and needs expert input to help the computer correctly analyze the sample” [3].

Various situations exist, which open the possibility to system errors or exceptions. “When the software scans the columns and determines there are no spaces, it erroneously concludes that the image has only one word. In this situation, the user must aid in segmenting the words” [3]. Essentially, cases exist in which the system could deliver completely inaccurate results based on the incorrect analysis of a particular word or word grouping.

Furthermore, in cases of decreased security clearance, simple things like an expert’s blog could help organizations allow multiple professional Graphologists to examine a large number of samples. This would expedite the process of providing human error control, as well as provide a number of professional opinions. Later in this paper, the importance of having multiple individuals analyzing a single sample will be illustrated in greater detail.

5 Additional Techniques Could Aid the Analytical Process

Through the use of innovative techniques, it may be possible to automate various processes in the end-to-end analysis of handwriting or signature samples, in an effort to make a reliable assessment of personality.

5.1 Handwriting Analysis is a process, not a single procedure...

Handwriting analysis, for the purpose of personality assessment, must be viewed as a multi-stage process to reach its full potential. Various stages of collections, classification, feature extraction, and data analysis must be performed with precision.
Failure to adequately address each stage will only limit the reliability and repeatability of any study.

5.2 Sample Collection

Without collecting enough data to work with, it will be impossible to verify the authenticity of our handwriting assessment system. This would impede our ability to move forward with the implementation of a handwriting assessment system with any degree of confidence. Using these techniques to identify samples and historical or existing data, these systems can become more intelligent, especially when performing analysis on data from a foreign region or in a different language.

5.3 Signatures vs. Handwriting Samples

This paper was intended to illustrate the additional dimensions that exist, which are not adequately addressed through L-Z Analysis. One of these aspects is the separation of signatures from handwriting samples that are just free flowing text. By comparing and contrasting these differences, in addition to the normal steps, it may be possible to increase the efficiency of a system. "The independence of behavior of our parameters regarding writing and signature shows that, when it is possible, the compared study of both writing and signature of a same writer may be the source of interesting complementary information" [1].

6 Conclusions

It is the author’s contention that by implementing various methodologies of gathering personality traits from handwriting, it would be possible to mimic the analysis of several individual Graphologists analyzing the same samples. Multiple individuals working on the same samples have a higher probability of making the most accurate assessment. If the group’s observation of a particularly significant handwriting characteristic is shared by the greatest number of members, it will most often carry the highest degree of certainty, at least to the existence or non-existence of a particular feature [7].

It would be inherent that these professionals are using their own professional judgment; and therefore, the implementation of multiple methodologies within one system would have a greater accuracy when all measurements associated with particular personality traits are shown to have high levels of significance amongst the group. As this author would argue, different individuals use different methodologies to gain similar results; and together, they often provide more validity to the particular observation [7].

Additionally, the entire process must be addressed within a handwriting assessment system. Different methodologies must be implemented throughout the various collection, classification, and feature extraction processes; and ultimately, it may be possible to create accurate personality assessments through handwriting analysis. Without refining data into sub-classes or gathering an adequate number of test samples, it may be
impossible to maximize the potential of these systems. Without a combination approach and effective end-to-end process consideration, these systems will never out-perform the trained experts currently working for the CIA.

7 Future Work

An implementation of software that performs all of these data collection, assessment, and classification tools would be needed to test the theoretical possibility of intelligent and robust handwriting assessment systems.

8 References


