

Forensic Handwriting Analysis to Determine the Psychophysiological Traits

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Abstract

In order to demonstrate the immense value and actuality of the investigations done by forensic handwriting expertises in the determination of the psychophysiological traits that lead to criminal behaviour of the performer of handwritten texts, the article analysed 2648 handwritten text samples and gave a new classification of handwriting features by dividing them into three main distinct categories. Based on the detailed forensic study of these samples, the author reaffirms that each person's handwriting is unique and unrepeatable and becomes subconsciously adopted to the individual's physiology, psychology, natural geographical conditions, etc. Hence, it is highly probable and reliable to determine a person's psychophysiological traits according to his/her handwriting even without seeing him/her personally. It was concluded that handwriting analysis has always been of urgent importance and necessity in preventing and fighting against various crimes and requires great experience, habits and skills from a forensic handwriting expert.

Keywords: Forensic Investigation, Handwritten Text, Psychophysiological Traits, Handwriting Process, Crime/Criminology

INTRODUCTION

The main goal of this article is to help regulate justice in the investigation of civil and criminal cases with the help of criminology, especially forensic handwriting analysis, which is applied in prevention and fighting against many types of crimes, such as (recently online) signature forging, homicide, suicide, drug trafficking, sexual offenses, blackmail, etc., as Lewis, 2014 and Morris, 2020 among many others stated.

The famous catchphrase “*Handwriting is brain writing*”, which was put forward by German physiologist W. Preyer in 1895 (Aleskovsky & Komissarova, 2016: 10) is in fact a scientific explanation of the term “handwriting” as “the writing of the brain, the handwriting of the brain”. The forensic research of determining the psychophysiological traits of the author of handwritten texts, which is also known as forensic document examination or graphology (Mookiah, 2023), is reflected, on the one hand, in the psychophysiological traits of the subject, and on the other hand, in the expression of these characteristics. In conducting such research, it is necessary to identify appropriate handwritten documents for the research, as forensic document examiners also do. They continue to certify their competence through standard testing and certification programs in almost every country and they try to demonstrate how these studies support the reliability of forensic document examination. According to Lewis (2014: 35), “forensic document examination is the application of science and analytical techniques to cases involving questioned documents” and “Forensic Document Examiner (FDE), Questioned Document Examiner, Document Analyst, Document Examiner, and Handwriting Expert are all titles applied to practitioners”. Furthermore, forensic handwriting identification, as also mentioned above, is based on the principle that no two people write exactly alike. Forensic document examiners are not graphologists. Graphologists attempt to determine character from the analysis of a person's handwriting. Forensic document examiners compare questioned writing with known writing for identification or elimination purposes (*idem*).

In general, research on forensic document examination has developed significantly for the last three decades, especially because of the increasing number of online forgery cases (Pervouchine & Leedham, 2007; Musayev & Javadov, 2011; Aliyev, 2012; Flynn, 2012; Nicolaidis, 2012; Ellen et al., 2018; Harrolson, 2012, 2013; Houmani et al., 2012; Heckerth & Boywitt, 2017 and many others²).

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² The references have been given in the order of the publication year.

As it is understood from the title of the article, this research deals with the forensic examination and determination of psychophysiological traits according to individual's handwriting and takes the principle of the uniqueness of each person's handwriting, because it is as unique and unrepeatable as fingerprints. "No two people write exactly alike. Individual characteristics develop in each person's handwriting, and they repeat themselves" (Lewis, 2014: 45).

There is a strong body of research by forensic graphologists, handwriting experts and academic researchers (Bradford & Bradford, 1992; Mohammed, 2010; Musayev & Javadov, 2011; Aliyev, 2012; Caliguiri & Mohammed, 2012; Nicolaidis, 2012; Taroni et al., 2012; Aleskovsky & Komissarova, 2016; Dewhurst et al., 2016; Agius et al., 2017; Frontini et al., 2017; Heckerroth & Boywitt, 2017; Johnson et al., 2017; Linden et al., 2017; Vera-Rodriguez et al., 2017; Vastrick et al., 2018; Mohammad, 2019; Galymzhanova, 2022 among many others). Also, a variety of classifications of handwriting traits have been given in forensic studies (Klages, 1941; Mantsvetova et al., 1971; Kupriyanova, 1982; Semyonov, 1983; Lewis, 2014; Morris, 2020, etc.). And, through this research, a new classification is given, which is going to be discussed in the following sections.

MATERIALS AND METHODS

The experimental base and materials consisting of handwritten texts were collected on the principle of volunteering from a number of prisoners of the penitentiary institutions of the Ministry of Justice of the Nakhchivan Autonomous Republic, as well as the academic staff of the Nakhchivan State University, and some other Azerbaijani citizens working in various professional fields.

According to the classification developed by V. E. Semyonov (1983: 34-38) for the analysis of special documents, the objects that are more informative for the study of psycho-calligraphy are letters, diaries, personal notes and other free handwritten examples. So, to collect experimental specimens, a text was compiled according to the Azerbaijani alphabet. The respondents copied (handwrote) that text on a piece of paper, then they were asked to write any text that crossed their minds at that time on one side of an A4 paper. This way, 3000 handwritten samples were obtained for the research, out of which 2648 handwritten samples were considered appropriate and suitable to conduct this research.

DISCUSSION

In general, for the forensic investigation to determine a person's psychophysiological traits according to his/her handwriting, one page long (approximately 150-200 word) handwritten text is sufficient. In exceptional cases, it can be enough to have two or three documents handwritten in different conditions and in different time periods to distinguish stable personality expressions from short-term psychophysiological conditions. At the same time, the awareness of the expert about the socio-demographic characteristics of the executor of the handwritten texts at the earliest stages of the research, the purpose of the document, the circumstances in which it was drawn up, the general psychological state of the executor and some biographical information play an important role in strengthening the determination of the obtained result.

It is known that all over the world, including the Republic of Azerbaijan, there are identity and non-identity (diagnostic and classifying) research methods for forensic examination. In the article, the problem that we are trying to solve is the issue reflecting the criminalistic research of determining the psychophysiological traits of the executor of handwritten texts related to the determination of group affiliation.

Based on the experience of forensic handwriting expertise, it is known that independently handwritten samples are of higher advantages than other samples. This is because the general features appearing in the performer's creative work are not the same as the sequence of general features or signs created in the process of copying. In the first case, the movement expands from phoneme to grapheme by introducing a generalized phonemic representation, the basis of which is the correct sound-letter analysis. Here, there is no support for the visual image of the letter, and the visualization of the grapheme realized in an individual graph is required. In this case, the influence of the performer's psychological traits, such as intelligence and temperament, is reduced in the formed letters. In the second case, the logical sequence of the action is the stage from visual perception of the letter to its graphic execution. This process is simple in its structure and there is almost no individuality in

the manifestation of symptoms. Therefore, the proposed requirements for taking handwriting samples seem more optimal for forensic research to determine the psychophysiological traits of the executor of handwritten texts.

During the experiment, it was observed that designed psychological tests that require independently written answers are sometimes offered to the respondents instead of calligraphy research. What measure is taken if the person has disappeared, or the accused person cannot be involved in the investigation, or the psychological tests mentioned in the confidential study of the person cannot be applied? Then, it is considered necessary to use the possibilities of criminalistic research to determine the psychophysiological traits of a person according to the manuscript text. Here it must be stated that the significance of psychophysiological traits determined based on the results of the conducted research has frequently been taken superior to the results of psychological tests applied to the individual.

The forensic investigation to determine the psychophysiological traits of a handwritten text performer is a creative process, which is determined by the ability to detect, recognize, and correctly evaluate the complex features or signs of the handwriting by applying professional intuition and experience as a handwriting expert. Thus, it is not accidental that in the research of forensic handwriting expertise, the general impression of manuscript and cursive handwriting is of great importance for the criminalistic research to determine the psychophysiological traits of the handwriting performer. German philosopher Ludwig Klages (1941: 82) also rightly noted that the criminalistic research of determining the psychophysiological traits of the performer cannot be separated from this trait.

In their studies, Muller & Enskat (1949), Pfanne (1961) and a few others collected the selected features of the cursive handwriting and concluded that the descriptions of the signs or features can be combined in three groups, which are the harmony, geometric sequence and graphology of writing. The tone of the writing is determined by the proportion of the main elements of the letters in the text and, according to many authors, it allows to judge the performer's talent, mental ability, presence of taste and psychological culture. Sometimes the image of individual letters may look awkward, crooked, with corrections, broken, but these features constitute psychophysiological traits as a whole. The degree of geometric consistency, the margins of the writing sheet, the pressing force, the direction of the handwriting, the distance between words and baselines, and the handwriting are determined by the equality of the general proportion of the writing. It determines the level of development of a person's will, nervous-psychic energy, conflict, the development of prevented impulses, the balance of psychological manifestation. Large deviations from the generally accepted writing order and pattern mainly reflect the degree of originality of the person and the degree of diversity of psychophysiological traits. The stronger the deviations from the rule of calligraphic writing, the easier the research will be.

After receiving data by means of handwriting evaluation according to the main categories, as a rule, the forensic research stage of determining the psychophysiological traits of the performer according to the handwritten text should be carried out in the following order: 1. Evaluation of the research object from the point of view of suitability; 2. Selection of the features; 3. Evaluation and assessment of the selected features and traits and 4. Preparation of the final report. If the document was executed without a signature (anonymous), drawing up a single conclusion about the psychophysiological profile of the executor and so on.

Once it is confirmed that the texts are appropriate for the investigation and before starting the analysis for the criminalistic determination of the psychophysiological traits of the executor of the handwritten texts, the requirements presented for the study of the handwritten texts must be implemented in the following manner:

- a) The handwritten text should be written according to the sample writing of the Azerbaijani language of the Latin alphabet and without the influence and contribution of the writing sample of other languages;
- b) The handwritten text under study must be executed by a person with a ballpoint pen or quill pen with an unaltered handwriting;
- c) The size of graphic material in the handwriting must not be less than one page.

When the manuscript text meets the presented requirements, the next stage of research can be conducted, that is, the stage of selecting the topographic, general and specific handwriting features. In the Best Practice Manual for the Forensic Handwriting Examination of the European Network of Forensic Science Institutes, these features are grouped into general, individual and class characteristics or features. However, in this article, some more features are taken into consideration, too.

It should be noted that although each feature of the handwriting reflects individual psychophysiological traits of the performer of the handwritten text, all the topographic, general and specific features observed during the investigation must be evaluated altogether as a complex assessment. Anyway, in the following sections, each of these features including their subcategories are looked into and discussed separately: 1. Topographic features; 2. General features; 3. Specific features.

Psychophysiological Traits According to Topographic Handwriting Features

Topographic features that are more informative in the criminalistic study of determining the psychophysiological traits of the executor of handwritten texts are the followings: topographic features are cursive handwriting signs that reflect the location of fragments of handwritten texts and the actions performed on a flat space.

Since the executed handwritten texts are sometimes far away from the left, right, upper and lower margins of the writing sheet, and sometimes closer, there are certain blank spaces on the edges of the writing sheet, and the shape and images of these blank spaces play an important role in determining a number of psychophysiological traits of the performer. The following are the conventional measurements to determine the outer blank spaces, according to Musayev & Javadov (2011: 89-92): (a) large – larger than 3 cm; (b) medium – 1-3 cm; (c) small - up to 1 cm.

The location of the initial and final movements in each line³ of the text relative to the previous line characterizes the structure of the marginal lines. The shape of the border lines is obtained by connecting the starting or ending points of the lines in the vertical direction with conventional lines. “When the handwritten text is executed, if the starting and ending points of the lines from the side cuts of the writing sheet change unevenly, the shape of the edge lines of the writing sheet will be broken, angular and wavy” (Aliyev, 2012: 39-42).

It is important to have visual control and the ability to measure the eye level to determine the signs during the study because if visual control gets lost, the expression of the sign is disturbed. The following five subcategories, and within them, twenty types, are the most characteristic topographic features identified during our research and experiments.

1.1 According to the location of the handwritten text relative to the left section of the writing sheet



1.1.1 There is no blank space on the left edge of the notepad - the lines are executed to the end of the left edge of the notepad. It characterizes aggressiveness and tendency to conflict.



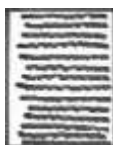
1.1.2 The size of the space on the left edge of the writing sheet is small. If the distance from the left section of the writing sheet to the beginning of the lines is up to 1 cm, the size of the left edges of the writing sheet is considered small. It characterizes the continuation of the influence of the events that happened in the past, conservatism, modesty, material distress, excitement, stress, aggressiveness, conflict, and lability.

³ The word “line” in this article is in many occasions used to refer to the “handwriting line” as a synonym of “a group of words”, not the “baseline” of a writing sheet.

1.1.3 The size of the space on the left edge of the writing sheet increases. If the distance from the left section of the writing sheet to the beginning of the lines is greater than 3 cm, the size of the left margins of the writing sheet is considered large. It expresses quick adaptation to new things, courage, the desire to live well, a lot of work experience, meticulousness, ethics, culture, and shyness. Because they keep a distance in social relations, they may be misunderstood by the people around them as self-satisfied, arrogant, etc.



1.1.4 The shape of the empty space on the left edge of the writing sheet is wavy. It occurs as a result of the lines sometimes moving closer to the left edge of the writing sheet, and sometimes moving away. Executors who execute the manuscript in this way take into account the impact of the past event in the decisions they will make during the day. It reflects the change of mood, falsehood, lability, tendency to conflict, etc.



1.1.5 The left edge of the writing sheet shrinks from top to bottom – The general appearance of the text is tilted to the right. It is a topographic feature indicating that the executors of the manuscript try to get out of the influence of the past but are unable to do so; some other psychophysiological traits are closedness, ability to keep secrets, lack of complete control over behavior and actions, as well as shyness and haste.



1.1.6 From top to bottom, the left margin grows - the overall appearance of the text is inclined to the left. It expresses freedom, the desire to move away from the influence of the past, aggressiveness, and tendency to conflict, etc.



1.2 The position of the handwritten text relative to the right section of the writing sheet:

1.2.1 There is no space on the right edge of the writing sheet. The lines are executed up to the right section of the writing sheet. It characterizes a tendency to talkativeness, social relations, lack of ability to keep secrets, stubbornness, aggressiveness.



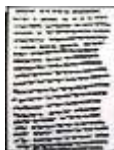
1.2.2 The blank space on the right edge of the writing sheet is small. If the distance from the right section of the writing sheet to the end point of the lines is up to 1 cm, the size of the right edges of the writing sheet is considered small. It mainly reflects impatience, tendency to conflict, etc.

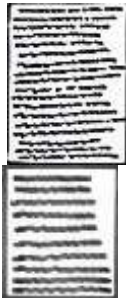


1.2.3 There is a large blank space on the right side of the writing sheet. If the distance from the right section of the paper to the end of the lines is greater than 2.5 cm, the size of the right margins of the paper is considered large. Suspicion, hesitancy, care, keeping distance in social relations, aesthetics, beauty, or superiority of appearance characterize the traits.



1.2.4 The shape of the space on the right edge of the writing sheet is wavy. In the execution of handwritten texts, the lines are sometimes closer to the right section of the writing sheet, and sometimes farther away. It expresses agitation, care, hesitation, lability, conflict, aggressiveness, etc.

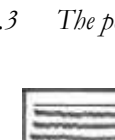




1.2.5 The shape of the space on the right edge of the writing sheet is angular. When the right edge of the handwritten text is connected vertically with conventional broken lines, the overall appearance is angular. Negative aggressiveness, conflict, lability, pedantry, stubbornness, internal psychological problem is a line sign reflecting psychophysiological traits.



1.2.6 From top to bottom, the right margin shrinks - the overall appearance of the handwritten text leans to the left. In addition to reflecting stubbornness, aggressiveness, it is a line sign that defines shyness and lack of courage, etc.



1.2.7 From top to bottom, the right margin increases - the overall appearance of the handwritten text is inclined to the right. At the beginning, he presents himself as positive energy, brave and stubborn, but later it is observed that these characteristics are not present. It expresses some characteristics such as hesitancy, cowardice, shyness, lack of courage.

1.3 *The position of the handwritten text relative to the upper section of the writing sheet:*



1.3.1 The size of the space at the top of the writing sheet is small. If the distance from the upper section of the writing sheet to the top of the first line of the text is less than 2.5 cm, the size of the upper edge of the writing sheet is considered small. It is a topographic sign that reveals lies, volatility, economic control, aggressiveness, conflict, instability, etc.



1.3.2 The size of the space at the top of the writing sheet is large. If the free distance from the upper section of the writing sheet to the upper part of the first line of the text is greater than 2.5 cm, the size of the upper edges of the writing sheet is considered large. It expresses empathy, organization, creativity, etc.



1.3.3 There is no space at the top of the writing sheet. When executing handwritten text, almost no space is left at the top of the writing sheet. Aggressiveness, tendency to conflict and lability, stubbornness, pedantry, etc. are topographic signs that characterize psychophysiological traits.

1.4 *The location of the handwritten text relative to the lower section of the writing sheet:*



1.4.1 The size of the space at the bottom of the writing sheet is small. If the distance from the lower section of the writing sheet to the bottom of the last line is less than 2.5 cm, the size of the lower edges of the writing sheet is considered small. It expresses impatience, haste, agitation, financial difficulty, tendency to conflict, aggressiveness, etc.



1.4.2 The size of the space at the bottom of the writing sheet is large. If the distance from the lower section of the writing sheet to the bottom of the last line is greater than 2.5 cm, the size of the lower edges of the writing sheet is considered large. Organization, ethics, changeable life, psychological fatigue, anxiety, lability reflect psychophysiological traits, etc.



1.4.3 There is no space at the bottom of the writing sheet. The text has been executed up to the bottom section of the writing sheet. It mainly characterizes the tendency to conflict and aggressiveness, financial distress, impatience, stubbornness, etc.

1.5 *Making all the edges of the writing sheet small or narrow:*



It is a form without any space on the top, bottom, left and right edges of the writing sheet. It is a topographic sign that determines financial difficulty, squeamishness, haste, impatience, excitability, aggressiveness, tendency to conflict and instability, etc.

Psychophysiological Traits According to General Handwriting Features

General features with a high frequency of occurrence in conducting a forensic investigation of the psychophysiological traits of the executor of handwritten texts are the following:

2.1. Cursive handwriting habit: In the theory and practice of forensic handwriting expertise, handwriting habit refers to the degree to which a person has handwriting execution techniques (Musayev & Javadov, 2011: 82-89). An indicator of the degree of formation of the writing habit is the automaticity of letter signs in the back right hemisphere of the brain and the ability to get used to fast writing. Indicators of habit often refer to the stability, correlation, speed, variability, and construction of traits. Writing speed refers to the speed with which a writing instrument is used and is divided into the following groups:

2.1.1. Low habit – Handwritten texts with low habit are called unformed lines with low speed, low coherence and less stability, which characterize the initial stage of the formation of the writing habit. At the initial stage of writing, in low-skilled handwritten texts, undulations, lack of precision in the execution of elements, a large number of angular movements in oval-shaped movements, unevenness in the location, distance between movements, and direction are observed. These signs deform letters and words, giving them an awkward, irregular structure. Handwriting with low skill is mainly found in elementary school students and in people who almost never uses the technique of handwriting.

2.1.2. Medium habit – Medium-skilled handwritten texts characterize manuscripts that have not completed the practical stage of rapid and coherent execution of writing. Mastering intermediate proficient writing requires more sophisticated control of the writing process. Here, the accuracy of the movement on the plane is higher compared to the initial stage, reflected by the continuity of the movement at the speed limit, and the so-called conventional writing speed is observed.

2.1.3. Highly skilled – Highly skilled handwritings are well-formed handwritten texts adapted to relatively high speed and characterized by high or near-high motor coordination. For such lines, in the process of fast execution of the movement, accuracy is observed relative to the form of writing marks chosen by the performer. The location and direction of the movement, the unevenness of the distance between them, are characteristic of highly skilled manuscripts. Individuals with high skill handwriting perform not only handwriting, but also other actions relatively quickly. Signs of high speed in writing are significant continuity of writing, pressure force is high at the beginning of the elements and lower at the end, and the structure of the letters is simplified. As a result of this habit, the differentiation of speed depends on the simple, simplified and complicated structure of the handwriting. In addition to relative stereotype, adaptation to different conditions, variability, and stability against confounding factors are characteristic of the reversed writing habit.

During our research, intermediate subtypes of these features such as above-average habit and below-average habit are also found.

2.2. The degree of complexity of actions reflected in the general structure of the line: Regarding the general structure of the line, highly skilled lines can be divided into 3 groups: according to the order of

writing, i.e. simple or simplified, easy or easified, complex or complicated. The characteristics of actions that allow us to comment on their simplicity, easiness and complexity have been explained by Musayev and Javadov (2011: 83-84). The main indicators of the degree of complexity are the formation of certain movement forms, direction, size, connection, quantity, sequence. Consider the following classification group of lines:

2.2.1. Lines with a simple structure: lines with a simple structure include lines that meet the requirements of the generally accepted writing rule and the system of movements. The handwriting process of a simple line is characterized by high speed and coordinated movements. Also, there are many letters of simple structure in words. It reflects aggressive, impatient, stubborn, conflict-prone traits.

2.2.2. Simplified lines: although they are similar to lines with a simple structure, the main difference is that the lines with a complex structure contain many signs that are simplified or attempted to be simplified. It is characterized by an attempt to simplify the elements here.

2.2.3. Lines with an easy structure: lines with an easy structure have an easier system of actions than the system of actions focused on lines that conform to the generally accepted writing rules. That is, it is a more primitive form of lines with a simple structure.

2.2.4. Easified lines: easified lines are similar to simplified lines. Such lines are formed by the fast writing of the performer. In the writing of easified lines, the depressed form of lines, that is, “U”-shaped lines, is more common. In the manuscript, there is a return to the straight form of the movement, the transition of angular movements to arc movements, and arc movements to straight movements, loss of elements in some letters and shortening of distances (Musayev and Javadov, 2011: 84).

2.2.5. Lines with a complex structure: lines with a complex structure are characterized by increased movements or lengthening of elements, greater connectivity, and the complexity of some elements. Prone to conflict, aggressive, stubborn, tends to attention and leadership traits.

2.2.6. Complicated lines: such handwritten texts are characterized by low writing speed, medium and medium-strong pressing force, and separate execution of letters and sometimes elements. The decoration of letters and the inappropriate extension of elements are observed. It is formed by the strong creative ability of the performer who executes the line in a complicated way and the active decoration of the line (*ibidem*: 85-88).

Sometimes increasing the size of letters or individual elements in the vertical and horizontal directions is considered as a special method of compounding. Repeatedly complicating the structure of letters can lead to its transformation into conventional letters. Apart from these, there are also intermediate groups of easified-simple and complicated-simple structures of handwritten texts. All these signs characterize the performer’s personal-individual and psychophysiological traits, expressed both in the manuscript as a whole and in the performance of individual elements.

2.3. The speed of movement in the execution of handwritten texts: The speed of movement in handwriting directly shows the speed of execution of the manuscript. The speed of writing is a habit that determines the speed at which the performer transmits his thoughts and ideas through the central nervous system, which controls the writing-movement habit, the organ that executes the writing and the frequency of the performer’s thinking. Some people’s quick thinking also affects their other actions, one of which is the writing-action habit. Here, the person who executes the text at a high speed usually omits one (last) letter, while he will write the next letters again by omitting some of them. For example, the word “came” is executed as “cam”. This feature characterizes the psychophysiological traits of aggressiveness, impatience, haste.

There are the following known types of writing speed:

2.3.1. Habitual low speed - characterizes the execution of letters and their elements with intervals, the execution of the beginning and end parts of the structure of the letter with blunt movements. For example, the execution of the dot and the second element of the letter “i” with a small oval movement, the strong execution of pressing force, the spread or abundance of ink at the starting point of the first letter of the word are determined by features which characterize the tendency to conflict and lability (*ibidem*: 80).

2.3.2. Accustomed high speed – it is characterized by a large connection, by thinning of the end parts of the elements, by the horizontal inclination towards right compared to the previous elements of the second element of the letter “r” and the third and fourth elements of the letter “ii”; by the horizontal extension to the right of the end parts of the third element of the letter “A” and the second element of the letter “r”, by connecting letters blunt movements and/or additional connecting lines (Musayev & Javadov, 2011: 81). It is a handwriting feature that reveals a tendency to conflict, aggressiveness, and impatience, etc.

2.3.3. Habitual average speed – It is characterized by the execution of oval-shaped elements, the type of combination of the elements of letters by contiguity, combinations, and in some words, by the absence of connection, compared to the writing order, and by the average pressure in handwriting. Also, manuscripts executed at unaccustomed low speed and unaccustomed accelerated speed indicate the handwritings of people prone to lability and conflict (*ibidem*: 80).

2.4. According to the general form of manuscript texts and words: Manuscripts have common forms such as “compressed”, “angular”, “without form” (mixed form) and so on.

2.4.1. Compressed form of handwritten texts - manuscripts executed in compressed form mainly characterize impatience, stubbornness, aggressiveness, internal psychological anxiety, tendency to conflict, etc. (See Figure 1).

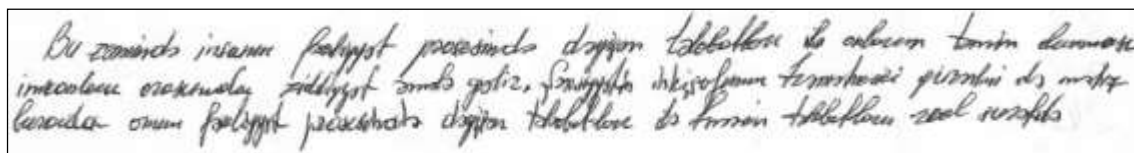


Figure 1

2.4.2. The angular form of handwritten texts is a handwriting feature that mainly determines aggressiveness, tendency to conflict, stubbornness. At the same time, such executors need to follow their own rules, freedom, skepticism, indecisiveness, emotionality, degree of passion, etc. (See: Figure 2).

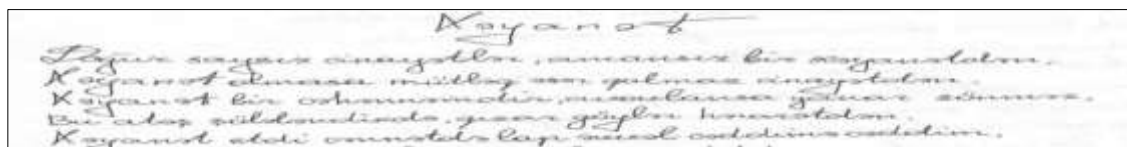


Figure 2

2.4.3. Formless - handwritten texts mainly represent emotional lability, indecision, changeability, stubbornness, etc. (See: Figure 3).

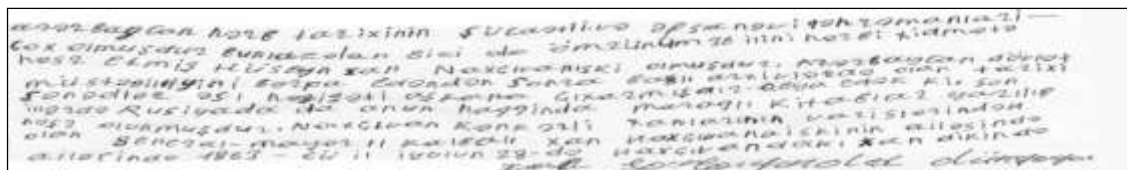


Figure 3

2.5. The inclinations of handwritten texts relative to the vertical axis: it is a handwriting feature that reflects emotion and thought. It characterizes the relationship between the inner and outer world of the person. In practice, the handwriting is “straight”, “left-leaning”, “extremely left-leaning”, “right-leaning”, “extremely right-leaning”, “both right-leaning and left-leaning”, “decreasing or increasing the inclination near the end of the word”, common signs such as “strong inclination of the exclamation mark to the right” are found. By studying these features, you can get information about the past that has left a mark on the psychology of the performer. Thus, according to this general sign, it is possible to determine the executive’s subordinate relations, emotional or cold-bloodedness, aggression, tendency to conflict, cunning, lability, indecisiveness, frequency of depression, stubbornness and other psychophysiological traits.

2.5.1. Straight – these are manuscripts inclined 85-95 degrees and they reflect diplomatic cunning, logic, experience, leadership, aggressiveness, conflict (Musayev & Javadov, 2011: 64) of the executor of the handwritten text.

2.5.2. Leaning to the left – manuscripts with an inclination of up to 45 degrees to the left are called left-leaning. It characterizes the superiority of logic, freedom, indecision and changeability, hypocrisy, the frequency of depression, conflict, lability.

2.5.3. Extremely left leaning – manuscripts that lean less than 45 degrees to the left are considered excessively left leaning. It mainly characterizes the traits of being cynical, stubborn, vindictive, afraid of loneliness, weak will (See Figure 4).

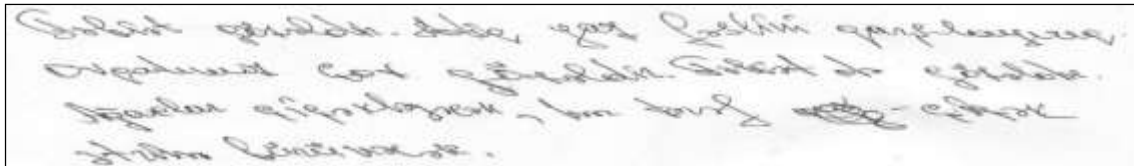


Figure 4

2.5.4. Right-leaning – manuscripts tilted to the right up to 100 degrees relative to the vertical axis are considered right-leaning. Right-leaning handwriting indicates the extent to which emotions control reason and logic. It means risk-taking, stubbornness, hatred, resentment, enmity, tendency to conflict.

2.5.5. Extremely right leaning – these manuscripts are considered to be excessively right leaned, inclined to the right more than 125 degrees relative to the vertical axis. It reflects conflict, aggressiveness.

2.5.6. In handwritten texts which are inclined both to the right and to the left, letters and words lean both to the right and to the left relative to the vertical axis. In addition to indicating changeability, lying, betrayal, inability to escape the influence of the event that happened in the past, it also characterizes emotional lability.

2.5.7. Decrease or increase of inclination near the end of the word expresses internal psychological anxiety, tendency to lability, fatigue, etc.

2.5.8. Inclination of exclamation mark to the right, multiple repetitions of “!” in a text which is inclined to the right too much reflects the signs of sensitivity, effectiveness, stubbornness, emotional sensitivity, aggressiveness, etc.

2.6. By size: The size of the manuscript refers to the width and height of individual letters. The mentioned dimensions are currently used in the research of forensic expertise.

2.6.1. Manuscripts up to 2 mm in size are considered small in size. This dimension of the manuscript indicates closedness, secrecy, impatience, aggressiveness, conflict, etc. It is also an indicator of being tall physically.

2.6.2. The size of manuscripts from 2 mm to 4 mm is considered average. Physically, it reflects the average height. It is evaluated together with other signs.

2.6.3. Manuscripts larger than 4 mm are considered large. In addition to reflecting stubbornness, ambition, constant attention, self-satisfaction, pride, aggression, it is also a sign of medium and medium-small height.

2.6.4. The execution of the manuscript in different sizes mainly indicates psychological problems. Lability as a psychophysiological trait, and aggressiveness, tendency to conflict, changeability, lying, etc., is characterised as individual-mental traits.

2.6.5. The increase in the size of the handwritten text, lines or letters towards the end of the word can express stress, fear, excitement, aggression, conflict, lability, etc.

2.6.6. The decrease in the size of the handwritten text, lines or letters towards the end of the word reflects sensitivity, closedness, diplomatic lying, impatience, aggressiveness, tendency to conflict, etc.

Other intermediate dimensions of the manuscript are evaluated together with a set of other features.

2.7. Inter-letter relation:

2.7.1. Unconnected - it is the separation of the writing instrument from the sheet after the execution of each letter. It reflects freedom, non-submissiveness, conflict, logics and indicates that the person does not like to work collectively, etc.

2.7.2. Connected – in the execution of letters, it is carried out adjacently without separating the writing instrument from the sheet. It reflects diplomacy, volatility, lability, etc.

2.7.3. Connected and unconnected – it is the execution of some letters in words either connected or unconnected. It expresses logic, variability, positive aggressiveness, etc.

2.7.4. The so-called syllabic combination of letters is the connected execution of letters in syllables. It is characterised by easy improvement, encyclopedic memory, aggressiveness, tendency to conflict, etc.

2.8. Inter-letter distance: it means that one letter in the word is performed closer or further apart than the other letter.

2.8.1. If the distance between the letters in the word is small, it reflects impatience, dissatisfaction, internal psychological tension, stress, aggressiveness, etc.

2.8.2. Lack of spacing between letters – in this case, letters seem to be stuck together, which characterizes aggressiveness, tendency to conflict, pedantry, etc.

2.9. The pressure force of the writing instrument: it is related to the characteristics of the central nervous system. The pressing force is classified as “strong”, “medium”, “weak”, “mixed” and “pressing force strengthens or weakens towards the end of the word or sentence” according to the size of the width of the main part of the element in relation to the width of the other parts and the degree of swelling on the back of the printed page are present.

2.9.1. Strong – the width of the main elements is performed more than twice compared to the width of the connecting elements. Also, it is possible to read the text from the traces formed on the back of the sheet. It mainly characterizes aggressiveness, stubbornness, struggle, non-adaptation, conflict, etc.

2.9.2. Middle – the width of the main elements is twice as large as the width of the connecting elements. Here, the traces formed on the back of the paper with writing can be felt and read. It reflects aggressiveness, stubbornness, combativeness, conflict, etc.

2.9.3. Weak – the width of the main elements is equal to the width of the connecting elements. The general appearance of the text is faded. It expresses courage, cowardice, weakness, shyness, lying, lability, etc.

2.9.4. Mixed – it is the implementation of pressure force in different degrees. It mostly characterizes emotional lability.

The pressing force is intensified at the end of the word or sentence – it reflects internal psychological anxiety, aggression, stubbornness, compromise, etc.

2.10. Form of connection between letters:

2.10.1. Angular: this connection between letters expresses conflict, aggressiveness, harshness, etc.

2.10.2. Oval – executed in right or left oval shapes. This sign is evaluated together with the sign of tendency of letters. It is a handwriting feature that expresses emotional lability.

2.10.3. Buttonhole-shaped – it is a form of sign created in the execution of inter-letter communication. It reflects more writing experience, less logical and mental ability, insincerity, etc.

2.10.4. Backslash is the most commonly used form of hyphenation in a text. Which expresses unnatural internal anxiety, stress, etc.

2.10.5. Bumpy – it is a rough, convex, crooked form of the relationship between letters which is characterized by psychological tension, stress, aggressiveness, conflict, lability, etc.

2.11. Arrangement of letters: this general feature is applied to manuscripts executed in the form of printed letters (Mantsvetova, 1971: 147-166).

2.11.1. Width – the distance between letters is measured conditionally, it is when the width of the letter “A” is greater than the width which reflects physical and psychological deficiency, lies, aggression.

2.11.2. Narrow – the distance between letters is measured by the condition that it is smaller than the width of the letter “A”, which reflects conflict, psychological tension, stubbornness, etc.

2.11.3. Mixed – the presence of both wide and narrow characters in the same text. It reflects emotionally lability, volatility, lying, aggression, conflict, etc.

2.12. The line of the writing line: The basis of writing relative to the blank surface is the location of the line, the direction of the lines. It is considered to be one of the important general handwriting features in conducting a criminalistic study of determining the psychophysiological traits of the executor of manuscript texts. Therefore, it is important that the experimental samples to be taken for research be on a white sheet of A4 format without lines. In order to accurately determine the direction of the lines in the studied manuscript text, it is necessary to draw up a conditional table. The result of the research conducted without drawing up a conditional table can be in the form of a probability.

2.12.1. Horizontal – it is the execution of lines in the horizontal direction, along a line (straight) from left to right that means diplomatic cunning, logic, leadership, endurance, stable thinking, stability of the central nervous system, etc. (See Figure 5).

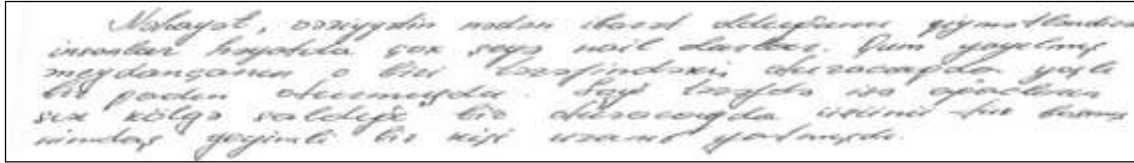


Figure 5

2.12.2. Upward slant – lines are executed from left to right, from bottom to top. It is a reflective handwriting feature of high motivation and energy, confidence in feelings, stubbornness, jealousy, ambition, etc. (See Figure 6).

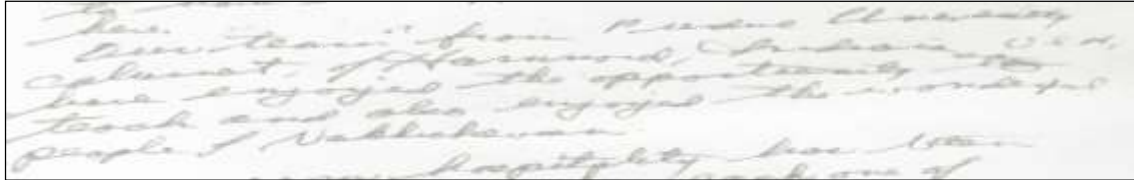


Figure 6

2.12.3. Excessive upward bias – the execution of the line from left to right, from the bottom to the top which characterizes the traits of dynamism and positivity of the mood, positive energy, diligence, jealousy, etc. (See Figure 7).



Figure 7

2.12.4. Downslope – the line is executed from left to right, from top to bottom which is a trait that expresses disbelief, fatigue, pessimism, disappointment, etc. (See Figure 8).

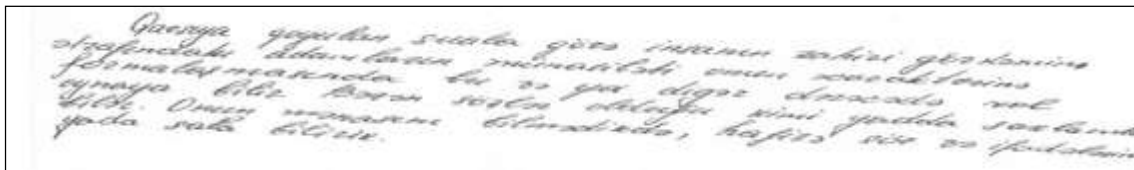


Figure 8

2.12.5. Convex, the execution of the line in the form of “∩” – the lines gradually rise up to the middle of the writing sheet, and then gradually descend towards the end of the line which defines emotion, depression, mood instability, lability, etc. (See Figure 9).

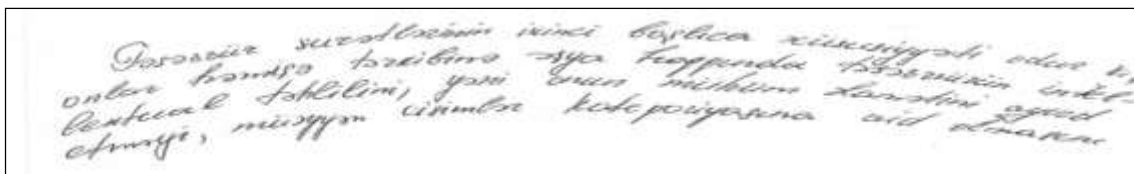


Figure 9

2.12.6. Sunken is the execution of the line in the form of a “U” – the lines gradually descend down to the middle of the writing sheet, and then gradually rise up towards the end of the line which is

characterized by changeability, falsehood, lability, aggressiveness, tendency to conflict, etc. (See Figure 10).

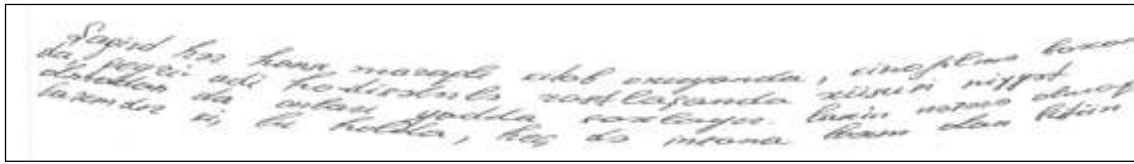


Figure 10

2.12.7. The wavy handwriting form is evaluated together with the “sunken” and “protruded” forms which reflects changeability, falsehood, indecisiveness, lability, pedantry, etc. (See Figure 11).

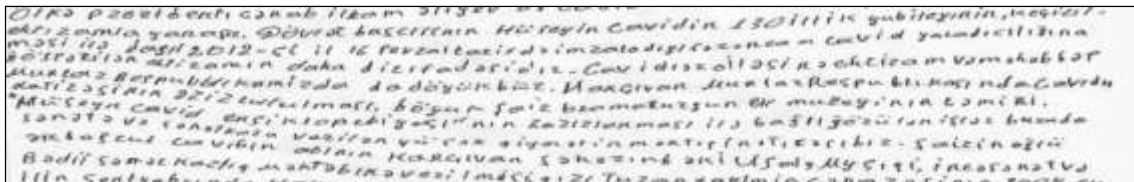


Figure 11

2.12.8. End of handwriting lines with a hyphen - when executing handwritten texts, a hyphen is used at the end of a line that is characterized by unbelief, suspicion, pedantry, stubbornness, aggressiveness, conflict, etc. (See Figure 12).

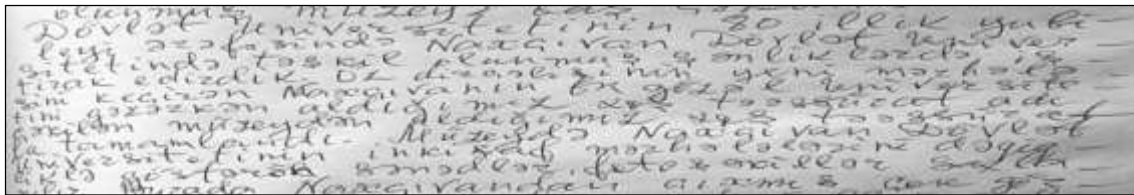


Figure 12

2.13. Line Spacing: The size of the line spacing is determined by the size of the space from the endpoints of the lower parts of the sub-line elements to the following lines. Line spacing has large, medium, small, and mixed sizes. It is a general feature mainly reflecting social relations.

2.13.1. Large – the distance between the lines is considered “large” due to the theoretical location of two or more lines between the lines. This sign means that the social distance is great, planning or organizing work;

2.13.2. Average – the distance between lines is considered “average” due to the theoretically comfortable placement of a line between lines or the execution of subline elements in such a way that they do not touch the following line. It is a common sign that reflects that thinking is transparent;

2.13.3. Small – the size of the interline distance is called “small” due to the form of execution of subline elements adjacent to the following line which defines intravertedness, shyness, impatience, lack of courage, etc. (See Figure 13).

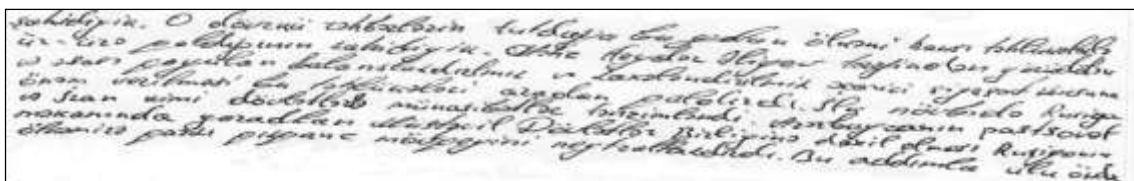


Figure 13

2.13.4. Mixed – different sizes of spacing between lines is called “mixed”. It characterizes indecisiveness, lying, social incompatibility and lability (See Figure 14).

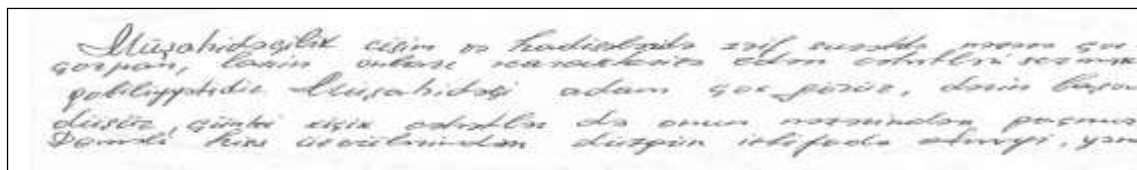


Figure 14

2.14. Interword distance: There are large, medium, small, mixed and no distance dimensions of interword distance:

2.14.1. Large - an interword distance between words that exceeds the size of the conventional two letters “a” is considered “large” which characterizes extravagance, psychological problem, measure of social distance, etc;

2.14.2. Average – the distance between words equal to the size of conventional letter “a” is considered “average” which expresses attention, accuracy, compliance with the rules, etc;

2.14.3. Small – an interword distance less than the size of a conventional letter “a” is called “small” which is a sign of social difficulty, impatience, thrift, excitement, stress, aggressiveness, internal psychological tension, conflict, etc;

2.14.4. There is no space between words – words are executed next to each other in the text and it reflects aggressiveness, tendency to conflict, lability, psychological tension, etc. (See Figure 15a & 15b);

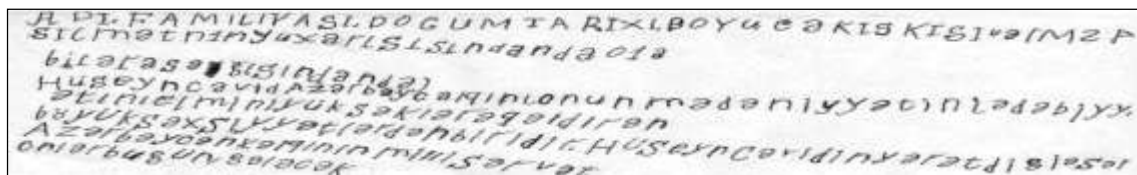


Figure 15a

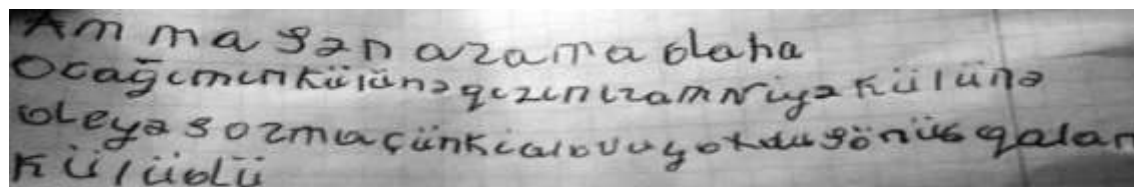


Figure 15b

2.14.5. Interword distance mixed – different dimensions of intersyllabic distance exist in a text which means social indecisiveness, conflict, lability, psychological problem (See Figure 16).

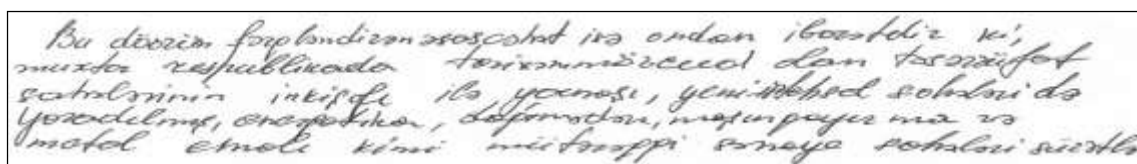


Figure 16

2.15. According to the shape and direction of the lines drawn under the words and lines: (2.15.1) straight, (2.15.2) convex, (2.15.3) depressed, (2.15.4) wavy, (2.15.5) long, (2.15.6) diffuse, (2.15.7) crooked, (2.15.8) broken, etc., and each of them indicates a certain psychophysiological trait, as well.

2.16. The order and form of punctuation marks: misuse of punctuation marks, punctuation marks being executed diligently, full stop marks not being executed at the end of the sentence, punctuation marks being executed in a bordered or small oval form, dash marks being executed instead of periods, hyphen marks being used quickly - quick execution, the signature ends with a dot or dash which characterizes tendency to lability, conflict, aggressiveness, etc.

Psychophysiological Traits According To Specific Handwriting Features

Below are some of the specific handwriting features that are less frequent and provide important informative information about the performer in the forensic research of determining the psychophysiological traits of the performer of handwritten texts. Specific features are divided into the following three groups (Musayev & Javadov, 2011: 113-136):

3.1. Specific features reflecting the formation of the habit of writing movement:

3.1.1. the speed of the movement in the execution of individual letters (See Figure 17. a, c);

3.1.2. the degree of complexity of the movement during the execution of letters (See Figure 17. a, b, c, e).

3.2. Specific features characterizing the structure of the movement:

3.2.1. the form of movement in the implementation of elements (See Figure 17. b1, b2, c);

3.2.2. the combination form of the movement in the execution of its elements (See Figure 17. ç1, ç2);

3.2.3. the type of combination of movement in the execution of elements (See Figure 17. a, ç2, d);

3.2.4. the direction of the movement in the execution of the elements (See Figure 17. a, b2, c, d);

3.2.5. the size of the movement in the vertical direction in the execution of the elements (See Figure 17. d, e);

3.2.6. the size of the movement in the horizontal direction during the execution of the elements (See Figure 17. a, b1);

3.2.7. the amount of movement in the execution of elements (See Figure 17. ç2, d, e);

3.2.8. the sequence of actions in the execution of elements (See Figure 3.17. ç1, e);

3.2.9. the pressing force of the movement in the implementation of the elements (See Figure 17. b2, c, e);

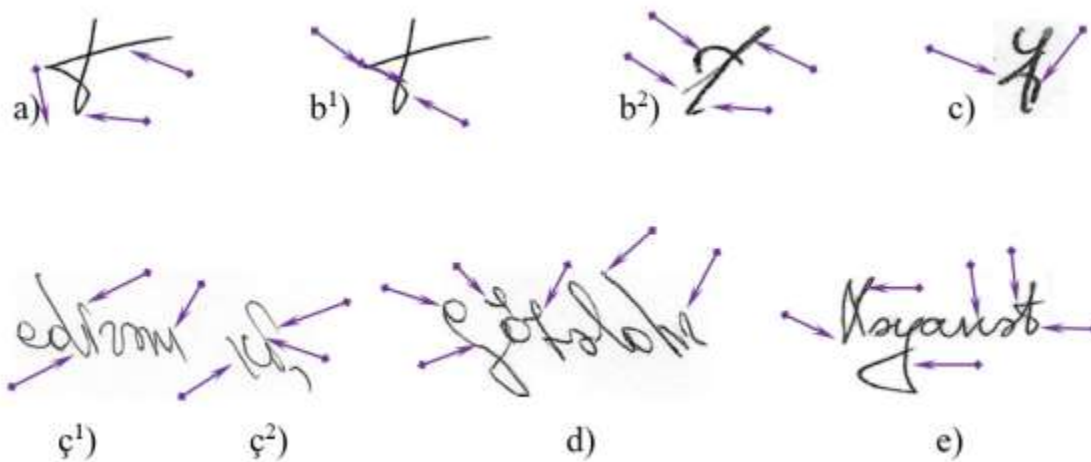


Figure 17

3.3. Specific features reflecting the relative location of the movement on the plane:

- 3.3.1. the location of the starting and ending points of the movement during the execution of the elements (See Figure 17. ç1, d, e; Figure 18. b);
- 3.3.2. the location of the starting point of the movement during the execution of the elements (See Figure 17. a, d, e; Figure 18. a);
- 3.3.3. the location of the end point of the movement during the execution of the elements (See Figure 17. ç1, e; Figure 18. a, d);
- 3.3.4. the location of the joint point of the movement during the execution of the elements (See Figure 17. e; Figure 18. b);
- 3.3.5. the location of the intersection point of the movement during the execution of the elements (See Figure 17. a, c, e; Figure 18. c, ç);
- 3.3.6. the relative position of the movement in the horizontal direction during the execution of the elements (See Figure 17. ç1, d; Figure 18. d);
- 3.3.7. the relative position of the movement in the vertical direction during the execution of the elements (See Figure 17. ç2; Figure 18. d).

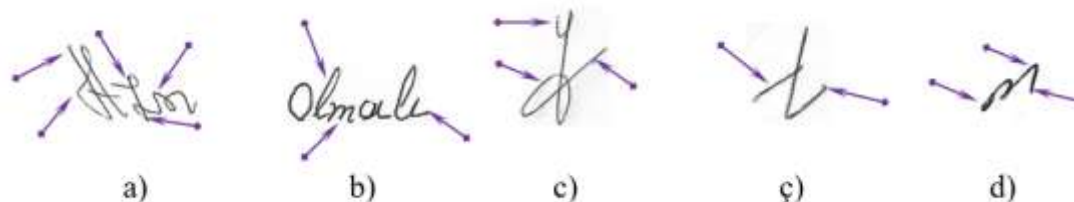


Figure 18

During the research, in addition to these, significant individual differences and some other features reflecting psychophysiological traits were also discovered and noted: for example, emotional instability – both the rightward inclination of the handwriting and the instability of the inclination; intravertedness and anger – straight handwriting which is inclined to the right, etc.

RESULTS

Handwriting features can be divided into three main distinct categories: topographic, general and specific handwriting features. The topographic handwriting features have 5 subcategories and 20 types; general handwriting features: 16 subcategories and 93 types; and specific handwriting features: 3 subcategories and 18 types.

This classification and the psychophysiological traits observed for each type let us conclude that there are three main psychophysiological traits that lead to criminal behaviour: *aggressiveness*, *(prone to) conflict* and *(prone to) lability*. Out of 2648 selected handwriting samples, altogether 199 distinct handwriting features were distinguished by grouping the topographic, general and specific features of handwriting habits. That is, for *aggressiveness* – 76 handwriting features (topographic – 16, general – 35, specific – 25) were distinguished according to the analysis of 913 handwriting samples. For *conflict* – 81 handwriting features (topographic – 16, general – 44, specific – 22) were distinguished by the analysis of 897 handwriting samples. And for *lability* – 42 handwriting features (topographic – 7, general – 22, specific – 13) were distinguished according to 838 handwriting samples.

How To Assess

In order to determine any of the “aggressive”, “prone to conflict” or “prone to lability” traits of the executor of the presented handwritten text, the handwriting expert conducts identification, diagnostic or classification research and then writes an expert report.

As discussed above, the trait level of the submitted manuscript is checked firstly. For example, it should be determined whether the studied manuscript was executed in an unusual psychophysiological state or not, or whether there is a fact of intentional change (Kupriyanova 1982: 37-43), along with some other aspects. If the submitted manuscript text is appropriate and/or suitable for the research, the second phase of the research, which covers searching, selecting and identifying the features, is started. In this second phase, the obtained topographic features are examined, found, identified and acquired in the submitted handwritten text. In the third phase of the research, the general handwriting features are looked for, identified and obtained in the handwritten text. Then, the fourth phase of the research is the stage of detecting, identifying and obtaining specific handwriting features in the submitted handwritten text.

Afterwards, at least 5-7 handwriting features from the obtained topographic features, again at least 5-7 handwriting features from the obtained general handwriting features, and at least 5-7 handwriting features from the obtained specific handwriting features must confirm or assert each other to form a complex unity, so that, it gives enough reasons to the handwriting expert to reach a definite positive conclusion on the handwritten text executor’s being “aggressive”, “prone to conflict” or “prone to emotional lability”. It means that the indicators of one of the psychophysiological traits must be present in 5-7 cases of each handwriting features category: 5-7 in topographic, 5-7 in general, 5-7 in specific. For instance, if at least 5-7 features from the topographic handwriting features indicate aggressiveness of the handwritten text executor, and at least 5-7 handwriting features from the general handwriting features show again aggressiveness, as well as if the aggressiveness is present in at least 5-7 handwriting features from the obtained specific handwriting features, then they altogether as a complex confirm the aggressiveness of the handwritten text executor. Only after obtaining this result, it can be said definitively that the executor of the handwritten text has an aggressive characteristic or aggressive psychophysiological trait. However, if the conducted research is not in accordance with the above explained research methodology, or if the obtained handwriting features do not confirm each other as a complex, or if the obtained handwriting features are less than 5, then it means that the executor of the handwritten text does not have any of the mentioned traits.

Based on the results of this research and on the professional experience, I dare to restate that the forensic investigation to determine the psychophysiological traits of a handwritten text performer is a significantly creative study which must be carried out by applying professional ability to detect, recognize, and correctly evaluate one’s psychophysiological traits according to the complex features of any handwriting as a handwriting expert. In other words, any handwriting examination and investigation obviously require extremely hard work, attention and great experience but it is perfectly possible to extract and report reliable forensic information about the psychophysiological traits of each person based on his/her handwriting and its features.

CONCLUSIONS

The above-mentioned new classification and carried experiments let us conclude that there are three main psychophysiological traits that lead to criminal behaviour: aggressiveness, (prone to) conflict and (prone to) lability. Another main conclusion is that the interpretation and assessment of the handwriting features and accordingly, of the psychophysiological traits lose their significance if they are evaluated individually or separately; the obtained results are considered reliable and correct when the topographic, general and specific features of the handwriting are assessed together for the expert report, as discussed through the article, mainly in “*How to assess*” section.

This type of forensic research is important and pivotal to prevent and fight against various types of crimes. For example, when the accused person confirms the crime before the trial and denies it during the trial, which indicates that this person is “unstable” and prone to lability, and of course, determining this and other traits in advance can be an extremely helpful tool to give the necessary resolution in time to prevent the prolongation

of the court process, or timely prevent and detect a number of crimes. Therefore, this type of analysis and research is a necessary helpful tool in the case of the accused persons who are wanted and missing, or the person whose presence is not possible or cannot be involved in the forensic investigation, or in cases of confidential studies of the person, as well as to carry out operational-search activities or measures, even in the attestation and recruitment of personnel in law enforcement agencies and so on.

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Biography

Emin Aliyev is a Lecturer in Criminology at Nakhchivan State University, Azerbaijan and a Handwriting expert at Forensic Center of the Ministry of Justice of the Nakhchivan Autonomous Republic of the Republic of Azerbaijan. He is carrying out his Ph.D. studies on Law and Criminology at the same department.

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