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FORMALISED HANDWRITING ANALYSIS AS A PSYCHOMETRIC ASSESSMENT INSTRUMENT

Formalised handwriting analysis can be a useful supplementary instrument for psychological expertise. It has distinguished advantages over traditional questionnaire-based psychometric instruments and differs from historically known and scientifically controversial graphology through objectivity, transparency and validity. The article presents several practical examples based on HSDetect software system for handwriting analysis.

Key words: *handwriting analysis, handwriting psychology, formalisation, computer-aided analysis, validation, expertise.*

Introduction. In expert practice, they use different psychometric methods to evaluate the psychological qualities of persons involved in a forensic, legal, or criminal investigation. Psychological examination in these fields especially requires methodological tools that are objective and reliable, because the responsibility of an expert is very high. The objects of psychological examination may be criminals, suspects, witnesses, family members, investigates, detectives, prosecutors, lowers, experts etc. Generally, legal and criminal psychological assessment uses the same methods and instruments as other application fields of psychology. However, it has strong specifics. First, often an explicit involvement of the person under investigation or expertise is not possible: the person is simply not available or refuses to participate in the testing. Secondly, the information by a person under investigation is not credible – the person would just manipulate his answers.

Method. That is why alternative or additional methods, which could enhance the level of objectivity and credibility, are very important. Last decades different non-verbal methods gained popularity among experts. One of such instruments is handwriting psychology. The method has certain advantages over more traditional questionnaire-based instruments:

– It provides wide coverage of personal characteristics;

– It is based on a more objective external-image and not the self-image of a person;

– It excludes social desirability, which is one of the major problems of psychometric instruments, especially questionnaire-based tests.

A tested person cannot prepare himself and thus influence the results.

Handwriting is a natural activity and a tested person does not have additional psychological stress, providing his handwriting sample. Moreover, experts can use already existing handwritten documents.

Handwriting psychology is language independent (for European languages) and does not require country adaptation.

The fact that handwriting reflects the psychological and health state of a person as well as his/her permanent psychological characteristics is well known. However, traditional graphology, a historical representor of handwriting psychology, lacks of profound scientific background and sufficient validation It has been often rightly criticised for this [1, 2]. Although graphology did have a long path of successful experiences, mainly in human resource assessment, it does not satisfy the actual requirements for a valid psychometric method. Graphology lacks systematization and objectivity: every graphologist works according to the method of his school (French, German, Italian, Spanish, or American), and these methods differ from each other. His or her work is not transparent. The manual and intuition-based procedure makes the result very dependent on the expert. Besides, the typical outcome is a plain text, which depends mostly upon the ability of the expert to compile such texts; it is the subject of an ambiguous interpretation. Actually, the criticism is aimed at the way graphology is being practiced, rather than the idea itself. It is true since very many purely qualified people who called themselves graphologists (the term is not protected) used to work in the area of assessment.

Handwriting psychology [3] allows solving the problems of traditional graphology at the same time keeping its positive experience, where it is appropriate. Developed methods of formalised handwriting analysis and computer-based tools, in our case HSDetect system [4, 5], demonstrate promising validation results [6, 7]. The formalization includes:

– Formal and unambiguous definition of handwriting signs and characteristics;

– Quantitative presentation of all handwriting characteristics;

– Quantitative evaluation of personality traits;

– Mathematical modelling of the trait value as a function of the evaluated handwriting characteristic levels.

Under a handwriting sign, we understand a general quality of handwriting, for example, letter size. A handwriting characteristic is a particular manifestation of a handwriting sign in the analysed sample. Letter size can have the following five characteristics: medium (2-3 mm), small (1-2 mm), very small (< 1 mm), large (3-5 mm), and very large (> 5 mm). Nowadays, despite numerous attempts to fully automate handwriting analysis, handwriting signs still cannot be evaluated automatically with computer-aided means. The available computer programs cover very few handwriting signs, they are not reliable and they are working only in very simple cases [5]. Therefore, handwriting signs must be still evaluated manually. A formal definition of handwriting signs and characteristics is very important. First, often handwriting experts do not agree on the evaluation of particular sample. Especially the sample is complicated and the sign is not regular. Secondly, unambiguity and modelling

requires a quantitative evaluation. Formal definition includes an algorithm of evaluation, which should work in all cases.

In HSDetect, both handwriting characteristics and personality traits are presented on the continuous scale from 0 to 1. Every trait is modelled as function of many handwriting characteristics by means of so-called graphometric functions. A graphometric function is a linear regression, where the level of a trait is the dependent variable and evaluations of handwriting characteristics – are independent ones. Such function includes up to several dozen of handwriting characteristics, which are additionally weighted by their influence on the trait. More detailed models are described in [2].

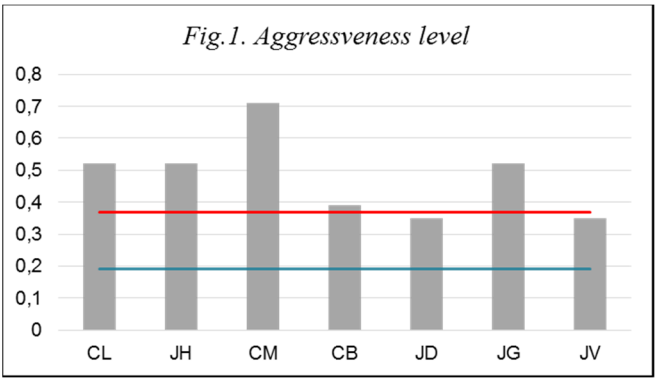
All handwritings characteristics in HSDetect are evaluated manually and are entered into the handwriting sign protocol. This protocol is processed by the program and all personal traits are algorithmically evaluated. HSDetect includes a database of hundreds evaluated of handwriting samples. These data enable the normalization of the evaluated traits. That means that the calculated level of a trait in a sample of a particular person reflects its relation to other people.

Below are several examples of handwriting analysis with HSDetect, which are relevant to psychological assessment, in particular for legal psychology, which includes forensic and criminal psychology [8].

Example 1. Evaluation of aggressiveness. Aggressiveness is expressed in the conscious or unconscious aspiration of a person to cause someone or something harm, destroy or damage [9]. It can manifest itself without any harmful actions or passive-aggressive behaviour or as well with verbal and physical aggression that inflicts violence. Aggressiveness is a relatively stable readiness for aggressive actions in various situations and should be understood as a personality trait.

The HSDetect model of aggressiveness includes 31 handwriting characteristics. Among them are angular connections, strong and uneven pressure, long in-stroke, elongated letter-form, smaller middle zone of letters, additional hooks at stroke ends, accented last letters, arrow or comma shape of i-points, an angular or triangular form of the lower zone, broken letters, irregular diacritic marks, overlapping upper and lower zones.

Fig.1. Aggressveness level



To illustrate the modelling of aggressiveness, we analysed the handwriting samples of seven famous American criminals (CL – Charles Luciano, JH John Hinckley, CM Charles Manson, CB Clyde Barrow, JD John Dillinger, JG John Gotti, JV Joseph Valachi), whose aggressivity was obvious [10]. The evaluated level of aggressiveness was compared to several hundred handwriting samples out of HSDetect database, which served as a control group. The results are shown in fig. 1. The blue line denotes the average value, which is 0.19. The standard deviation is 0.09. The red line shows the upper boundary of the 95 % confidence interval. The aggressiveness of “test persons” is definitely much higher than with “normal people”.

Example 2. Investigation of a suicide. When investigating a death with signs of suicide, one of the main questions is, in what psychological state was the person in the period preceding the death? Whether the person committed it voluntary or he/she was pushed to do that. Whether it was a real suicide or disguised murder.

When it happens that in the case file there is a suicide note, the content of which may indicate certain circumstances, including, indirectly, the state of mind of the expert. However, the content of such a note should be treated with a certain degree of caution, as it may turn out to be preparation or part of staging by unknown persons. In such cases, a psychological analysis of the handwriting could be a good aid for the investigation and the court, which will help draw some objective conclusions, irrespective of the motives of the note's author or the perpetrator. It is important that even if the author of the note was under the influence of alcohol, drugs or psychotropic substances, which could significantly affect the handwritten text, his handwriting will still contain much basic information about the personal characteristics of the defendant.

The case in question [11] involved a young woman from a small Armenian village. She had two children. The eldest son was a university student. The younger daughter was in the seventh grade. She found her mother hanged in the cowshed. The husband was a labourer, did not have a steady job and additionally was a hard drinker. According to neighbours, they lived very poorly. A woman was in charge of the household and the finances. According to the husband, the family had a small loan from the bank, which was almost paid off by the day of the woman's death. However, the investigation revealed that the woman had not fully repaid the loan, had taken out an additional loan herself and borrowed money from a neighbour, who was now demanding urgent repayment. In addition, the victim did not pay her son's school fees in full. She asked her relatives for help but they refused.

The investigation had a suicide note by the victim (right sample), as well as a letter handwritten by her three months before the tragic event (left sample). Both documents were written in Armenian (fig. 2).

The psychological analysis of the handwritten documents led to the conclusion, that the woman possessed personal characteristics, which can, in a certain sense, be considered as possible indicators of suicide, since they are quite typical. These are increased self-esteem, independence, determination, honesty

and straightforwardness, emotional instability, reticence, modesty, tendency to be depressive, nervousness, etc.

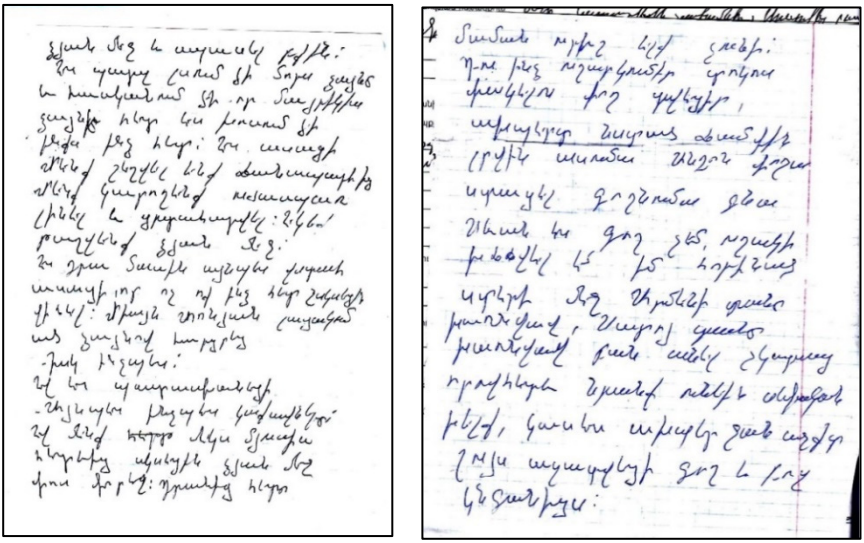


Fig. 2. Handwriting samples of a suicide victim

Moreover, when comparing the two handwriting samples, it was evident that emotional instability, depressiveness and other legally important psychological traits were even more evident in the specific period leading up to the woman's death. This conclusion is supported by the following handwriting characteristics of the second sample: increased general irregularity of handwriting, increased disconnection, reduced pressure, reduced width of the last letters, uneven and left margin, uneven and wide right margin, increased inter-letter distances, increased inter-line intervals and some others.

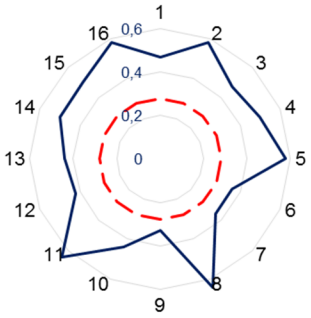
In this case, the results of the psychological analysis of the handwriting practically coincided with the conclusions of the investigation by Armenian experts, who had access to the contents of the handwritten documents and the testimony of witnesses.

Example 3. Markers of Alzheimer's disease in handwriting. Alzheimer's is the most common form of dementia. It can influence the decision-making of a person or make him/her more helpless and susceptible to manipulation. That is why it could be important to know the status of a person not only from the medical point of view. That relates to criminal investigations or, for instance, insurance cases.

Handwriting is a complex process that includes fine motor skills, cognitive and linguistic activity. It is sensitive to the changes of the person's medical condition, including Alzheimer's disease. That is why some characteristics of it could

serve as statistically validated markers of the disease. Most of the known researchers and proposed tests cover either just linguistic aspects of writing or obvious deterioration signs of fine motoric. Together with neurologists, we developed a complex test AD-HS, which includes 38 handwriting characteristics and 3 linguistic ones [12]. The resulting AD-Index changes from 0 (none of the markers is present) to 1 (all markers are present). It reflects the relation of the number of markers present in a handwriting sample to the total number of characteristics (41).

Fig. 3. Alzhimer's disease test



A pilot study included 16 subjects (probands). By all of them, Alzheimer's disease or at least cognitive impairment had been diagnosed. The AD-Index level of them is shown in fig. 3 with blue colour, the red dashed line shows the average level out of the HSDetect database (control group). All subjects have higher values and this difference is statistically significant.

Moreover, every subject besides the current handwriting sample provided old ones, made 10-20 years ago. Thus, the development of handwriting could be analysed. The number of deteriorated handwriting characteristics changes from five to fifteen with an average of 9.9, which shows that the development of the disease was clearly visible in the handwriting.

Additionally, 26 handwriting samples of prominent personalities with diagnosed Alzheimer's were analyzed. The time of the samples was not always known, so it was not clear, in what health status they had been written. In any case, by 24 persons AD-Index was higher than the average value.

Discussion. Handwriting analysis can be an efficient complementary instrument for psychological assessment. Optimally it should be applied as a part of complex expertise that includes as well other methods and procedures. Nobody would base his conclusions only on handwriting analysis. However, there are certain cases, when other instruments simply do not work, cannot be used, or are too unreliable. In any case, the procedures of handwriting analysis for an individual trait or a psychological construct must be thoroughly validated. First,

we must consider in particular the extremely intensive process of changing handwriting habits with the digitalization of life. Here new approaches to artificial intelligence could be especially useful. Secondly, additional evaluations are needed to build a distinguished normalizing database across different ages, educations, languages, and ethnises.

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ФОРМАЛІЗОВАНИЙ АНАЛІЗ ПОЧЕРКУ ЯК ПСИХОМЕТРИЧНИЙ ІНСТРУМЕНТ ОЦІНКИ

Ю. Чернов

Формалізований аналіз почерку може бути корисним додатковим інструментом для психологічної експертизи. Вона має відмінні переваги перед традиційними психометричними інструментами на основі опитувальників і відрізняється від історично відомої та науково суперечливої графології об'єктивністю, прозорістю та валідністю. У статті наведено кілька практичних прикладів на базі програмної системи HSDetect для аналізу рукописного тексту. Оптимально його застосовувати як частину комплексної експертизи, яка включає також інші методи та процедури. Ніхто не буде ґрунтувати свої висновки лише на аналізі почерку. Однак бувають випадки, коли інші інструменти просто не працюють, не можуть використовуватися або є занадто ненадійними. У будь-якому випадку, процедури аналізу почерку на індивідуальну рису чи психологічну конструкцію мають бути ретельно перевірені.

Ключові слова: аналіз почерку, психологія почерку, формалізація, комп'ютерний аналіз, валідація, експертиза.