

# Using graphic productions in medical — neuropsychological, psychiatric and neurological — diagnosis

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The purpose of this paper is a summary presentation of relations between handwriting studies and various scientific disciplines, showing their mutual interpenetration and reciprocal results in the context of “giving diagnoses” based on handwriting. This knowledge is invaluable material for analyses, reflections and findings made with regard to handwriting. The frames of the introduced theme are extremely broad, and the degree of their complexity is significant, taking into account the fact that in the vast majority reference is made to medical issues which are directly associated with the discussed matters. For that reason, the Author has restricted herself to presenting the most important elements (factors) related to the changes occurring in a person’s graphism.

The purpose of a psychological diagnosis is — first of all — to determine the level of development of orientation and cognitive processes, as well as to learn about, and describe the patient’s mental functions, personality traits and emotional reactions<sup>1</sup>. During an examination, a psychologist’s area of interest includes: intellectual performance, visual and auditory perception, motor and somatosensory functions, linguistic

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<sup>1</sup> B. Gawda, *Psychologiczna analiza pisma*, Lublin 1999, p. 53 et seq.

functions, visual memory, auditory memory, and perceptive and motor integration<sup>2</sup>. It sometimes happens that in the course of evaluating the aforementioned functions, the examiner additionally deals with an overlapping aetiological image of the disease from which the patient suffers, or a malfunction caused by a brain trauma.

A diminished life quality in the patients after craniocerebral traumas is primarily caused by the brain organic deficits they have experienced, which include sensomotor<sup>3</sup>, cognitive<sup>4</sup> and psychosocial deficits. Due to the diverse nature of brain traumas, the character of deficits is not uniform and predictable. The reason is because the physical forces leading to a trauma cause the occurrence of diversified damages — from massive to minor ones, and from those disseminated to the ones difficult to locate. Patients struggle with numerous consequences of traumas, including disorders in spoken and written communication, memory, physical and emotional balance, behaviour control. In terms of the type and scope of traumas, in each case those changes are a unique mosaic of disorders.

Neuropsychological diagnostics offers qualitative and quantitative identification of mental abilities performance, showing the strengths and weaknesses of cognitive processes in the examined person. The results may be used to record the current state of health, and — in comparison to the results obtained in the past — they allow for an evaluation of the illness progress and treatment effectiveness. In some cases, diagnostics provides quite significant data in the medical diagnosis process regarding the examined person, making it possible for physicians to give the right diagnosis.

The description of a female patient<sup>5</sup> after an acute craniocerebral trauma may serve as an example. The spectrum of disorders comprised

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<sup>2</sup> M. Calkiewicz, *Kryminalistyczne badania patologicznego pisma ręcznego*, Warszawa 2009, p. 109.

<sup>3</sup> They include sensation and movement in human development.

<sup>4</sup> Cognitive deficits can cover all areas of everyday functions, amongst others, they can regards such aspects as linguistic functions, attention, memory, perception executive functions and visual-spatial orientation. K. Koć-Bryczko, F. Pietraszkiewicz, "Psychologia w medycynie. Część 1 — deficyty poznawcze u osób po udarze mózgu", *Medycyna Ogólna i Nauki o Zdrowiu* 2012, vol. 18, no. 4, p. 340 et seq. monz.pl/fulltxt.php?ICID=1035199 (access: 9.10.2016).

<sup>5</sup> During a summer camp in July 1997, the girl had a car accident which caused a craniocerebral trauma involving brainstem bruising, rupture of the left cerebral hemi-

specific disorders, such as: motor and perceptive functions and speech, as well as non-specific disorders occurring within memory, attention, thinking and motivation. In the presented example, post-traumatic recovery of the lost reading and writing skills (this issue is of the Author's primary interest) was possible.

The pace of changes in the disorders' image was slow, although a progress in the cognitive functions, including reading and writing skills, was also noticeable.

During the first year of the therapy, her writing was distinguished by:

- a low graphomotor efficiency of the left hand, intensified muscle tension,

- correct copying of patterns combined with a low graphic level,

- writing simple dictated words and sentences which contained the recognised letters.

During the second year of the therapy, her writing was characterised by:

- an increase in the motor efficiency of the left hand, a minor improvement in the graphic level,

- a better knowledge of letters allowing for more precise and errorless writing down of words and short sentences,

- better writing from memory than writing of dictated phrases.

In the subsequent year of the therapy, one could note:

- a minor decrease of muscle tension of the left hand resulting in an improvement of the graphic level of the handwriting,

- initial writing automation,

- occurrence of orthographic sensitivity, questions about the correct spelling of the words,

- attempts of spontaneous writing<sup>6</sup>.

The beginnings of the rehabilitation were mainly focused on restoring the ability to distinguish objects and their images, as well as letters and numbers using sight and touch, and memorising their graphic pattern. Also

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sphere, with two-sided subdural haematoma, cerebral edema, fracture of humerus shaft. Directly after the accident, the patient's state was extremely severe. B. Daniluk, E. Zawadzka, „*Mamo, przeczytam Ci, co napisałam*” — dynamika zaburzeń w czytaniu i pisanu u dziewczynki po urazie czaszkowo-mózgowym, [in:] A. Herzyk et al., *Neuropsychologiczne konsekwencje urazów głowy. Jakość życia pacjentów*, Lublin 2003, p. 180.

<sup>6</sup> B. Daniluk, E. Zawadzka, op. cit., pp. 183–184.

improving visual analysis and synthesis function. Graphomotor exercises to increase precision of the left hand movements were introduced. Simultaneously, on the basis of the letters already memorised, exercises to copy, write the dictated words and short sentences, and reading them were gradually introduced. Global reading abilities to read short words started to gradually appear, however they did not include letter analysis skills. Over the subsequent years, there was a gradual increase in the patient's awareness of her own restrictions and difficulties, including the motor, cognitive and social ones, which increased her motivation to work. A broader scope of direct memory was observed, confabulations withdrew, and thinking efficiency improved. Text reading and writing skills (of dictated phrases, and spontaneous) were restored, with a correct letter analysis and synthesis in words. The patient's independence increased<sup>7</sup>.

In the presented case, diagnostics allowed for the proper impact to be evaluated and determined with regard to the implemented and continued neuropsychological rehabilitation.

It should be highlighted here that the literature offers various examples of methods useful for neuropsychological diagnosis<sup>8</sup>. One of the more interesting proposals, which combines clinical aspects and measurement, is the neuropsychological diagnosis procedure developed by I. Tonkonogi, L. Wasserman, S. Dorofsiewa and J. Meiersen. According to the authors, this procedure is devoted to diagnosing most of the mental functions, speech, reading, writing disorders, calculi<sup>9</sup>, gnosis<sup>10</sup>, praxis<sup>11</sup> and modally specific types of memory in persons with brain malfunction. A data analysis can serve as a basis for a diagnosis, however it also allows

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<sup>7</sup> Ibid., p. 184. Changes in a clinical image were analysed not only within the area of handwriting but also: letters recognition, reading, knowledge of numbers, and counting.

<sup>8</sup> E.g. *Neuropsychological diagnosis from the perspective* presented by Aleksander Luria; *Clinical and experimental model of diagnosis. Neuropsychological evaluation in clinical model using measurement. Research procedure* by Tonkonogi and partners. See: K. Jodzio, *Diagnostyka neuropsychologiczna w praktyce klinicznej*, Warszawa 2011.

<sup>9</sup> Disorders in arithmetic operations.

<sup>10</sup> A state of disturbed ability to recognise the familiar elements of the surroundings, with no disorders in the receptive part. Visual, auditory, tactile agnosia. P. Sobolewski, *Fizjologia i patologia układu nerwowego. Zagadnienia wybrane*, Sandomierz 2005, p. 115 et seq.

<sup>11</sup> Ability to perform complex purposeful movements.

for planning and performing neuropsychological rehabilitation activities. The proposal presented by Tonkonogi and other co-authors makes use of the plasticity of a diagnosis by developing two examination versions: a short one and a complete one, in order to adapt its course to the patient's abilities. The advantage of the discussed method is developing the ways to measure mental functions by presenting indexes and a scale for disorders assessment. While the first scale regards the examined mental functions, the other one is supplementary and it regards speech and the symptoms of its disorders<sup>12</sup>.

For handwriting, the neuropsychological examination procedure<sup>13</sup> includes:

1. Copying a sentence. The examined person is tasked with copying a short sentence whose words are printed in various fonts.
2. Writing down automated engrams. The examined person is asked to write down: Poland, first name and surname, the name of the city he/she lives in.
3. Creating words from separate letters. The examined person is tasked with making words from single letters.
4. Writing down the words dictated by the examiner.
5. Writing down sentences from dictation.
6. Independent writing. The examined person is asked to write a couple of his/her own sentences on a given topic<sup>14</sup>.

Sometimes the image of handwriting is also used in medical diagnostics, especially neurological and psychiatric. It is an auxiliary source of information about the disease progress or suspension, or the effectiveness of the implemented therapy. An analysis of written expression requires neurological and psychiatric examination, since both of the disorder categories are closely interrelated. In many cases of solely mental disorders, one can observe handwriting changes of neurological<sup>15</sup> nature, which requires further examinations. And vice-versa, when handwriting clearly

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<sup>12</sup> See: E.M. Szepietowska, *Badania neuropsychologiczne. Procedura i ocena*, Lublin 2002, p. 15 et seq.

<sup>13</sup> A clinical model involving measurement.

<sup>14</sup> E.M. Szepietowska, op. cit., p. 28. The developed method requires verification by applying it to patients from various clinical groups.

<sup>15</sup> Trembling, omitting letters in words.

trembles and is atactic, this indicates changes encountered in expressions which prove psychotic disorders that require psychiatric analysis<sup>16</sup>.

Identification of specific reading and/or writing difficulties in the examined person is not a simple and unambiguous task. It is not sufficient to simply become acquainted with the examined person's reading technique or to analyse his/her manuscripts. A reliable identification of irregularities within the specified area requires conducting numerous time-consuming specialist examinations and analyses<sup>17</sup>. Medical handwriting diagnostics for persons with mental diseases<sup>18</sup> is multipolar since it needs to take into account a lot of factors, starting from the type of disease<sup>19</sup> and ending with pharmacological therapy. An analysis of manuscripts does not offer a possibility to draw conclusions which are difficult to be expected here. Further to the above, no catalogue of disturbed graphic features appearing in the handwriting of persons with mental diseases can be produced since, in many cases, stabilising the mental structure of these patients is linked with their restoration to normal life, so that the patients can function in a relatively normal, proper way, and as a result, their graphism does not differ significantly from the handwriting of mentally healthy persons<sup>20</sup>. To that extent, only the probable conclusions, drawn with the highest caution, are justifiable.

One cannot also omit psychological diagnostics which is a very important element of a patient's diagnosis. It falls within the range of psychiatric diagnosis and it is indispensable to reach a holistic image of a particular person<sup>21</sup>.

The issue of performance is a broadly understood category, as it brings to mind various actions and situations of a positive nature, which are however sometimes dramatic. In terms of human personal abilities, we can speak about e.g. motor performance, everyday life performance,

<sup>16</sup> W. Chłopicki, J.S. Olbrycht, *Wypowiedzi na piśmie jako objaw zaburzeń psychicznych*, Warszawa 1959, p. 16 et seq; A. Klęsk, *Psychfizjologia i patologia pisma*, Lwów 1924.

<sup>17</sup> M. Całkiewicz, op. cit., p. 107 et seq.

<sup>18</sup> W. Chłopicki, J.S. Olbrycht, op. cit., p. 14 et seq.

<sup>19</sup> Ibid., pp. 218–238.

<sup>20</sup> Most likely, interrupting pharmacological therapy could cause noticeable changes in handwriting.

<sup>21</sup> The components of psychological diagnosis have been previously explained.

communication performance (writing, reading, speaking). The particular performance is made up of a phase of building and organising a person's activeness in respect of an object, stimulus or situation, and a phase of engaging sensual processes of the nervous system, they are also a series phenomenon which means that numerous and various processes, arranged according to a certain time sequence, take place inside of them. The idea of psychomotor performance should be defined as an acquired ability of high coordination of voluntary movements. A performance cannot be understood only as an effect of training or practicing, but more as a comprehensive group of phenomena occurring in the nervous system which results in muscles movement. Performance increases along with gaining practice and improving the execution of an activity. It is noticeable in handwriting or walking patterns. Nevertheless, this phenomenon undergoes some changes by diminishing perception as a result of a loss of motor performance which is directly related to the phenomenon of nervous system impairment<sup>22</sup>.

Changes in the sphere of human personal abilities usually take place outside his/her consciousness, both on the cellular level and in the organs, and they undoubtedly affect the graphic image of the handwriting produced by persons suffering from various diseases. Making diagnoses in such cases is incredibly difficult and sensitive at the same time from the perspective of distinguishing all the features typical of a particular disorder, and observable in handwriting<sup>23</sup>.

The literature<sup>24</sup> highlights the relations between the activity of writing and oral speech, and other higher actions such as memory, thinking, attention. The functioning of auditory and articulatory sensory-motor mechanisms common for speech and writing also allows for the processes of coding sound signs into relevant graphic signs. In turn, determining

<sup>22</sup> J. Rembowski, *Psychologiczne problemy starzenia się człowieka*, Warszawa-Poznań 1984, p. 57 et seq.

<sup>23</sup> In neurology-based diseases, it is difficult to unambiguously identify the features which are unambiguous determinants of a particular disease. Handwriting-based diagnosis can only be an introduction to taking up medical diagnostics. More in S. Skubisz, *Dowód z ekspertyzy pism patologicznych: na przykładzie choroby Alzheimerera, Parkinsona i stwardnienia rozsianego*, Kraków 2004, pp. 150–151.

<sup>24</sup> M. Klimkowski, *Pamięć człowieka i jej mechanizmy*, Lublin 1976; A.R. Łuria, *Problemy neuropsychologii i neurolingwistyki*, Warszawa 1976.

the graphic signs relevant to the text requires preservation of their spatial structure and a correct order of letters in words.

As far as the spatial arrangement of letters and the whole written text is a prerequisite relating to handwriting, preservation of the order of elements in texts, i.e. their temporary arrangement, is common for a spoken and a written text. Both these factors are aimed at accomplishing a specified objective, they form a task which requires planning and control. This is a common psycho-physiological premise of speech and writing activity<sup>25</sup>.

Persons with neurological diseases, e.g. contracting Alzheimer's disease<sup>26</sup>, suffer from mental degeneration, and their handwriting contains the handwriting features typical of elderly persons, e.g. omitting letters, repeating letters, incorrect connecting between letters, words, micrographia<sup>27</sup>. The patient loses control over the executive apparatus of the second signal system<sup>28</sup>. It can be accompanied by specific symptoms which are more noticeable in writing than in speech. The so-called logoclonia which consists in rhythmical repeating of words appears, whereas in writing it manifests itself through accumulation of speech sounds, especially the ending ones. Palilalia (derived from palin — from time to time, laleo — I speak) is a similar symptom consisting in repeating the same word or even sentence. In severe cases, the irregularities referred to above occur simultaneously in speech and in writing. In the second case, we deal with a state defined as paligraphia or palingraphia<sup>29</sup>. In the course

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<sup>25</sup> A.R. Łuria treats psychophysiological premises as a functional system conditioning a proper course of speech and writing. This system is excessively developed in the initial writing phase, however — along with acquiring this skill and developing the habit — the automation process takes place. This allows one to speak about a changing structure of the writing activity depending on the level of writing technique skills. A.R. Łuria, *Podstawy neuropsychologii*, Warszawa 1976.

<sup>26</sup> *Jak radzić sobie z chorobą Alzheimer*, Warszawa 1989.

<sup>27</sup> E. Bertrand, J. Dymecki, J. Rafałowska, "Choroby zwyrodnieniowe", [in:] J. Dymecki, J. Kulczycki, *Neuropatologia*, Wrocław 2005, p. 278.

<sup>28</sup> The notion characterising the way of providing information present only in humans, consisting in the use of speech and writing [http://www.edupedia.pl/words/index/show/125785\\_sownik\\_biologiczny-drugi\\_ukad\\_sygnalizacyjny.html](http://www.edupedia.pl/words/index/show/125785_sownik_biologiczny-drugi_ukad_sygnalizacyjny.html) (access: 18.10.2016).

<sup>29</sup> T. Bilikiewicz, *Psychiatria kliniczna*, Warszawa 1969, p. 77.

of the disease progress, all patients lose the ability to write, however the moment it happens is individual for each person<sup>30</sup>.

Another example presented here is Parkinson's disease in which certain symptoms that can be detected in handwriting may suggest a breakdown of writing at the motor level where it becomes slower and disautomated<sup>31</sup>. This is quite a typical symptom manifesting itself in small letters that become smaller and smaller in the course of writing, which can be noticed both in one line of the handwriting, and in the following lines. Nevertheless, a slowdown in writing does not always occur, and handwriting is not always illegible. Additionally in some patients, handwriting is disturbed by hand tremor. Tremor may depend on the position, or the so-called parkinsonian resting tremor may be observed which can be so intensified that it is noticeable also in motion. A slowdown in writing is the most significant symptom, and testing how long it takes the patient to write down a sentence can be an important element of evaluation of the patient's condition or the treatment effects. The subsequent stages of the disease comprise further difficulties related to the so-called freezing effect which occurs in the course of writing. At this stage, handwriting becomes illegible. With time, many patients discontinue writing attempts, taking them up only during neurological consultations, sometimes with a very good result<sup>32</sup>.

In case of disseminated brain damages, the deficits at the intellectual functioning level are miscellaneous. One may observe an occurrence of deep depression, euphoria, eutonia<sup>33</sup>, neurotic reactions, character-

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<sup>30</sup> Prior to a complete loss of writing skills, the patient reaches a stage where he/she is not able to write his/her surname on request. However, if a specimen signature is put in front of him/her, the patient is able to sign. In some cases, a patient is unable to put a signature without a specimen because he/she does not remember the the sequence in which the letters should occur. Patients are unable to remember the shape of various letters present in their name, surname or in the text they wish to write. J.E. Behrend, "Disease and its effect on handwriting", *Journal of Forensic Sciences* 1984, vol. 29, no. 1.

<sup>31</sup> A. Herzyk, D. Kadzielawa, *Związek mózg–zachowanie w ujęciu neuropsychologii klinicznej*, Lublin 2002, pp. 191–212.

<sup>32</sup> H. Petit, H. Allain, P. Vermersch, *Choroba Parkinsona — klinika i leczenie*, Warszawa 1997, p. 34 et seq.

<sup>33</sup> Elevated mood inadequate to the patient's physical condition, e.g. bliss.

pathic<sup>34</sup> disorders or even psychotic reactions. These states can occur in multiple sclerosis — a disease characterised by a great variety of symptoms. Disorders in the form of alexia, agraphia appear, and handwriting can signalise a state of danger to the organism, before concrete symptoms are recognisable. The pen becomes heavy, and the handwriting lines uneven, the rhythm and graphic order breaks down. Handwriting reflects the discomforting situation of the writing person. Additionally, also the remaining symptoms related to speech disorders and paralysis of upper and lower limbs with various strength intensify<sup>35</sup>. Its consequence are not only neurological disorders and psychopathological aberrations but also a change in the entire complex system of the patient's social interrelations. Diagnostics is extremely difficult because it is not easy to provide a description of "typical multiple sclerosis", as the disease is characterised by a great variety of symptoms. Further to the above, the beginning of the disease may have one or many symptoms, it can be typical or atypical, slow, less frequently acute or — exceptionally — paroxysmal<sup>36</sup>.

Summing up the above reflections, they can be concluded with a short comment of a slightly pessimistic resonance. Based on the manuscript itself, one is unable to give a diagnosis whether its executor suffers from a particular disease. To that extent, one should act with great caution when formulating conclusions. In many cases, it is difficult even to talk about a possibility for identifying any disease whatsoever on the basis of a manuscript<sup>37</sup>.

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<sup>34</sup> Characteropathy manifests itself in various ways, several types can be enumerated: patients with child-like silliness, stressed, irritable, sometimes aggressive, numb, rude, looking for conflicts, passive, apathetic, indifferent to their own fate, fearful, sometimes with phobias, hypochondrical.

<sup>35</sup> E. Herman, *Diagnostyka chorób układu nerwowego*, Warszawa 1982, pp. 371–373.

<sup>36</sup> E. Forsythe, *Jak żyć ze stwardnieniem rozsianym*, Warszawa 1986, p. 16.

<sup>37</sup> One can discuss deviation from a so-called norm which can be caused not only by irregularities resulting from the state of an organism, but it can be also affected by external factors.

## Summary

The problems indicated in the present publication result from various malfunctions or deficits caused e.g. by craniocerebral traumas. The sick persons struggle with numerous consequences of such traumas which directly translate into, amongst others, the spoken and written communication process. A psychological, neuropsychological, neurological and psychiatric diagnosis is a source of valuable information about the disease progress and suspension, or the effectiveness of the implemented therapy. The application of modern research views and positions contributes to the development of more effective impacts directing and supporting patients in their endeavour to live in dignity.

This publication is addressed primarily to students as a teaching aid during the forensic, criminal or civil procedure courses, but also to practitioners who — for their professional purposes — appoint handwriting experts, and who seek knowledge about handwriting research.

**Keywords:** handwriting, handwriting research, handwriting expert opinion, expert, craniocerebral traumas, spoken and written communication disorders, medical diagnosis, psychological diagnosis, neuropsychology, psychiatry, neurology.