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ANALYSIS OF BIOMETRIC PARAMETERS OF SIGNATURES MADE WITH THE GUIDED AND SUPPORTED HAND

Summary

Identification studies on biometric signatures have entered the subject area of scribal expertise in earnest for several years. The article presents theoretical possibilities for further expanding the field of biometric signatures, for example, to documents executed in notary offices or private wills drawn up on mobile devices equipped with an application that records the biometric parameters of the signatures made on these documents. While the examination of signatures from notarial documents should not pose significant research problems, they may arise in the case of wills, especially when there is suspicion that the signature was made with a so-called supported or guided hand.

From the experiments carried out by the authors of the article, it can be seen that the features of the biometric signature made:

- hand supported with coincident graphometric parameters with authentic signatures of the tester have compatible biometric parameters characterizing these signatures;
- hand guided at coincident or different from the original signatures of the tester have distinctly different biometric parameters characterizing these signatures.

It was also observed that the parameters of the biometric signature made by the guided hand are analogous to the biometric characteristics of the comparative signatures made by the forger in the name of the tester. The results of the experiment also made it possible to verify the phenomena hitherto operating in classical handwriting expertise describing signatures made by the guided and supported hand executed on a paper substrate.

Keywords: digital signature, biometric signature, biometric signature parameters,

identification testing of wills, guided hand signature, supported hand signature, signature identification testing, biometric signature identification testing

Introduction

The scope of use of biometric signatures and their role in everyday life are becoming wider and more common. An increasing number of financial institutions and companies, such as the Polish Post Office, Alior Bank, Orange, In-Post, etc., are using e-signatures or biometric signatures in their relationship with customers to confirm that a certain service has been provided to them, a contract has been concluded, etc. The legal value of these signatures according to Article 60 of the Civil Code[1] is compared with a "traditional" signature on paper, if it does not involve legal actions that require a special form for their effectiveness.

While the act of affixing biometric signatures to documents relating to specific forms of legal transactions: a notarial deed, a debt assumption agreement, a construction subcontract, a lease, a suretyship, or the granting of a general power of attorney or a power of proxy, seems possible, and will be soon, and will depend on one of the parties to the legal action, the notary, having a mobile device with the appropriate application, it seems unlikely, but not impossible – at least from the technical side, if one ignores the *strictly* legal aspects – to draw up a biometric will. From a theoretical, but also a practical point of view, such a situation may arise if the person wishing to make a will has a suitable recording device.

The special role played by the signature in our lives, combined with the new technology of its implementation has caused – for obvious reasons, namely the question of their authenticity – the interest in biometric signatures on the part of experts in the forensic examination of documents, as evidenced by many publications, including, as it seems, the basic one, which presents not only the research aspects of the study of signatures but also the possible variants of conclusions, entitled *Podpisy biometryczne i metodyka weryfikacji ich autentyczności* (*Biometric signatures and methodology for verifying their authenticity*)[2] developed by M. Goc and A. Łuszczuk.

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1 Law of April 23, 1964 – Civil Code, Journal of Laws. 2022.0.1360.

2 M. Goc, A. Łuszczuk, *Podpisy biometryczne i metodyka weryfikacji ich autentyczności*, in: V. Kwiatkowska-Wójcikiewicz, R. Krawczyk, D. Wilk (eds.), *Piękno kryminalistyki. Księga jubileuszowa Profesora Józefa Wójcikiewicza*, Scientific Society of Organization and Management, Toruń 2023, p. 317–341.

Course and results of the research experiment

This article deals with an aspect that is strictly theoretical for the time being, and is a presentation of the results of an experiment[3], referring to a particular form of signature made on a will, the authenticity of which, due to the degree of its deformation, may or may not be questioned, assuming that it was made, due to the reduced general health (psychomotor) condition of the testator, with the help of third parties. Their participation in the writing process, depending on this condition, could consist of:

- supporting the testator's hand while writing;
- guiding the testator's hand while writing.

The literature[4] presents the following ways for a third party to assist the testator in signing;

- two ways in which a third party supports the testator's hand to facilitate his signature – the first is wrist support, the second is palm support (see Fig. 1);

Fig. 1. Ways of supporting the testator's hand

Photo 1

Photo 2

Source: M. Hecker, *Forensische Handschriftenuntersuchung: eine systematische Darstellung von Forschung, Begutachtung und Beweiswer*, vol. 1, Kriminalistik Verlag, Heidelberg 1993.

[3] The experiment involved the authors of this article in charge of content issues and an IT specialist overseeing the functioning of the application.

[4] M. Hecker, *Forensische Handschriftenuntersuchung: eine systematische Darstellung von Forschung, Begutachtung und Beweiswer*, Kriminalistik Verlag, Heidelberg 1993, p. 259–261.

- a way of holding – embracing – by a third party the testator's hand with a pen to enable the writing process to take place (see Fig. 2).

Fig. 2. The way the testator's hand is held

Photo 3

Source: M. Hecker, op. cit.

It seems that in the case of a biometric will and the raised issue of the execution of a signature with a guided or supported hand, the analysis of the recorded biometric parameters of such a signature could be an additional factor, in addition to the traditionally analyzed graphic parameters[5] contained in its image (its bitmap), verifying the hypothesis put forward as to the actual manner of the signature.

Using one of the commercially available applications that record biometric parameters of handwriting, the authors conducted experiments to satisfy their research curiosity, the results of which will perhaps attempt to answer the issues raised above, as well as become a reason to continue them on a larger scale.

In addition to recording the image of the handwriting, the tested application recorded its main biometric parameters, which consisted of the variables:

- *x/t* – the change over time in the position of the pen relative to the *X*-axis,
- *y/t* – the change over time in the position of the pen relative to the *Y*-axis,
- *z/t* – change in the force of the pen during the execution of the signature.

[5] M. Goc, A. Łuszczuk, *Biometric signatures*..., op. cit.

The experiment was conducted in the following stages:

1) in the first, the "tester" on the tablet made some of his own legible, two-part signatures,
2) in the second with the participation of a third person, with the hand layout as in photo 1, the testator made several two-part signatures of his own,
3) in the third with the participation of a third person, with the hand layout as in photo 2, the testator made several two-part signatures of his own,
4) in the fourth, with the testator's hand layout as in photo 3, a third person made two-part signatures in the testator's name,
5) in the fifth, a "third" person, affixing the testator's signatures with his hand holding a pen, made specimens of two-part signatures in the testator's name.

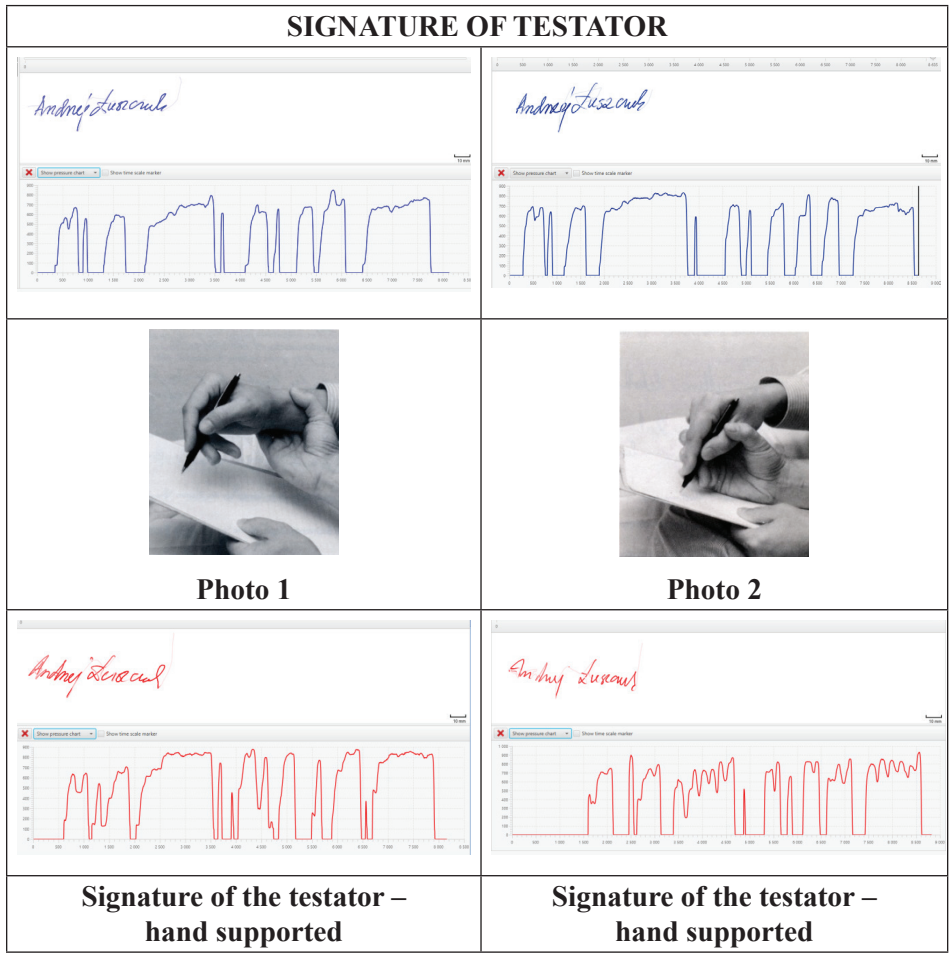
The comparative analysis of their graphical and graphometric features (for bitmaps) and their biometric parameters, carried out within all the signatures of the testator and those of the so-called third party submitted in the various stages of the experiment, showed – with the intrinsic variation that characterizes them, resulting from the range of individual deviations that characterize the testator's and the third party's handwriting – concordances that testify to their uniformity of execution.

It was assumed that for comparisons of the dynamic-biometric properties of signatures from different stages of the experiment, the *z/t* parameter presenting the change in the pressure of the pen on the tablet screen during the execution of signatures would be the basic one. The choice of parameter was determined by the way it was detected and recorded[6].

Below are images of the tester's signatures taken naturally (alone, without the help of a third party) and in two versions with the hand supported by a so-called third party – stages 1, 2, and 3 of the experiment.

[6] M. Goc, A. Łuszczuk, *Adiustacje w podpisach biometrycznych i ich wartość identyfikacyjna*, in: R. Cieśla (ed.), *Problematyka dowodu z dokumentu*, Wydawnictwo Uniwersytetu Wrocławskiego, Wrocław 2019, pp. 79–91; A. Przewor, Ł. Kocielnik, *Kryminalistyczna analiza podpisu biometrycznego*, "Człowiek i Dokumenty" 2021, no. 62, p. 22.

Fig. 3. Graph of how the pressure of the pen changes on the tablet screen



Source: own study.

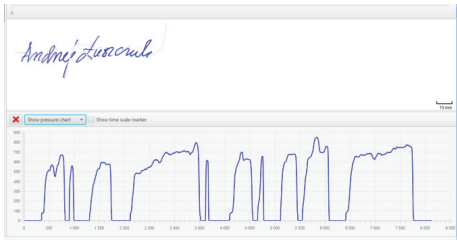
An analysis of the lines of graphs showing changes in pen force during the execution of signatures, including the general shape of the lines, the number of maxima and their form, the size relationships between peaks within maxima, the number, and size of intervals between maxima, and size relationships between intervals, showed that there are significant similarities and correspondences between them, as well as some differences. The scale of similarity and congruence testifies to the identical force with which the signatures were drawn, and therefore to their executive homogeneity, while the differences are within the scope of the performer's peculiar deviations, their individual characteristics enhanced and altered by the unnaturalness

of the process of executing these signatures. As can be seen in the above comparison, the range of compatibility of pressure force in making signatures naturally and with a supported hand as in the photo 1 is greater than the range of pressure accompanying writing with a supported hand as shown in Fig. 2.

The above observations allow us to claim that in the case of a testator's signature made with a supported hand, the biometric parameters of such a signature are consistent with the biometric parameters of his signatures made independently, despite the differences in their construction resulting from the general psychomotor condition aggravated by the way the signature is executed. A possible reference for interpreting the coercive force characterizing the signature could be the notation of the testator's name and surname, which customarily appears in the text of the will.

The following are images of the testator's signatures made naturally (on their own) and their versions made by a third party by the testator's hand – stage 4 of the experiment.

Fig. 4. Graph of how the pressure of the pen changes on the tablet screen

SIGNATURE OF TESTATOR	
	
 **Photo 3**	
Testator's signature – hand guided by a third-party	

Source: own study.

An analysis of the lines of graphs showing changes in pen strength during the execution of signatures, including the general shape of the lines, the number of maxima and their form, the size relationships between peaks within maxima, the number, and size of intervals between maxima, and size relationships between intervals, showed that there are significant differences between them. The magnitude of the differences testifies to the different forces with which the signatures were drawn, and therefore to their lack of executive homogeneity. The level of variation – including regarding construction – is not within the range of deviations of individual characteristics peculiar to the testator's signatures.

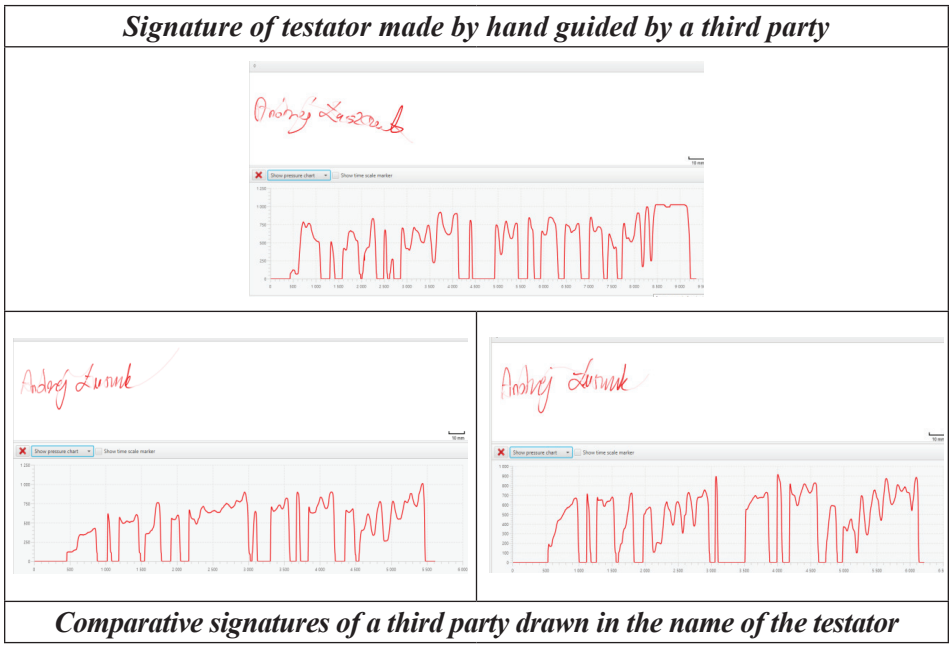
The above observations allow us to claim that when a third party uses the testator's hand with a pen to prepare a signature in his name, the biometric parameters are definitely different from those of signatures prepared by the testator himself.

A possible supplement for the interpretation of the situation presented above, affecting the final conclusions, could be a test of the force of pressure performed on the comparative material taken on a tablet identical/analogous to the one on which the evidentiary will was drawn up from the person participating in the act of drawing up the will[7]. Samples made by this person should reflect the content specificity of the evidentiary signature. The above assumption was verified in the 5th stage of the experiment.

Below are images of the testator's signatures made by a hand guided by a third party and versions of signatures in the testator's name – comparative – made by a so-called third party.

[7] M. Hecker, *Pobieranie próbek pisma do celów porównawczych w przypadkach, gdy zachodzi podejrzenie o udzieleniu pomocy w pisaniu*, vol. I, Publishing House of the University of Wroclaw, Wroclaw 2002, pp. 30–34; L. Michel, *Pomoc udzielana przy sporządzaniu własnoręcznych testamentów*, in: ibidem, pp. 2–6; B.G. Foley, J.H.. Kelly, *Guided hand signature research*, "Journal of Police Science and Administration" 1977, no. 2, pp. 227–231.

Fig. 5. Graph of changes in pen strength



Source: own study.

An analysis of the lines of graphs showing changes in pen strength during the execution of signatures, including the general shape of the lines, the number of maxima and their form, the size relationships between peaks within maxima, the number, and size of intervals between maxima, and size relationships between intervals, showed that there are significant differences between them, as well as some similarities and concordances. The magnitude of these correspondences and differences does not exclude the possibility that the disputed signature presented above was executed with the guided hand of the testator by a third party whose samples were analyzed and even makes such a possibility plausible. It cannot be ruled out that the extent of correspondence between the course and form of the graphs showing the force of pressure would have been greater if the comparative material taken from the so-called "third party" had also taken into account the signatures in the testator's name drawn by the hand of the person assigned to perform the sampling activity.

Summary

The above results of the experiment may indicate that, for the time being, the theoretical problem of examining both wills and biometric signatures for their authenticity, including deciding whether the testator's signature was created with a supported or guided hand, seems possible in the future. A condition of the research, after legislative authorization of such a form of will, would of course be the development of a research methodology after verifying in extensive research the assumptions and results of the experiment presented.

The result of the conducted experiment is also an opportunity to verify one of the points of the research methodology concerning the examination of testamentary signatures made with the supported and guided hand, mentioned in the classical scribal expertise in light of the citation: "Graphic features that characterize a manuscript created by a guided hand include: [...] increased pressure of the writing tool on the substrate often combined with irregular changes of the substrate"[8] regarding the wording: „increased pressure of the writing tool."

An evaluation of the force of writing between the testator's signatures and his signatures executed by his hand by a so-called "third party" did not reveal differences that would indicate an increased force of writing of the latter.

Since the apparatus test of this parameter did not show any variation, it should not be taken into account and evaluated all the more so in a classical handwriting expertise based solely on subjective microscopic analysis of the ink distribution in the lines forming the signature, which is not solely the effect of the pressure force of the pen on the substrate[9].

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[8] M. Leśniak, *Wartość dowodowa opinii pismoznawczej*, B.S. Training, Pinczow 2012, pp. 112–113.

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Law of April 23, 1964 – Civil Code, Journal of Laws. 2022.0.1360.

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