

Reference material in identification of digitally captured signatures

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Abstract

The development of the digital document authentication technology is making biometric signatures an increasingly common subject of forensic examination. The prerequisite for the reliable identification of their maker is properly collected reference material, whose role, as in the analysis of traditional signatures, remains crucial. In contrast to signatures made on a paper substrate, it is necessary to take into account the specificities of the device and software, such as the surface of the screen, the type of stylus and the data recording parameters. The practice of the Central Forensic Laboratory of the Police shows that samples taken on identical equipment and under identical technical conditions guarantee full comparability with evidence. At the same time, conventional manuscripts have an important supporting role. The growing importance of digitally captured signatures in business requires creating consistent standards for the collection and analysis of test material that would combine the experiences from handwriting examinations with new digital tools.

Keywords: collection of reference material, handwriting, digitally captured signatures, handwriting identification tests

1. Introduction

A prerequisite for handwriting identification testing is the availability of adequately collected reference material. For the substrate of traditional manuscripts, the preparation of such material is not a complicated task. Paper continues to be a popular material for signing various types of documents, and the methodology for collecting and sampling reference material has been described fairly extensively in the literature on handwriting analysis. In the context of digitally captured signatures, given the nature of the information medium, it is appropriate to modify the traditional model for collecting reference material. Ultimately, in both cases of analysis, the role of reference material is important, but, in relation to digitally captured signatures, this importance seems to be of a particular nature, especially in the context of the inno-

vation of the solution used and the observed rise in its popularity in business.

The Central Forensic Laboratory of the Police (CFLP) has been working on the analysis of digitally captured signatures for several years. The study of this type of material has led to dozens of opinions by CFLP experts in this area, as well as the development of certain conclusions regarding the collection of reference material. Several basic principles presented in this paper will be supplemented by real-life examples of analysis, thus demonstrating the importance of reference material in examining digitally captured signatures. Issues concerning the definition of digitally captured signatures, as well as their test value in forensic manuscript examination, have already been discussed in „Problemy kryminalistyki” (Przewor, Kocielnik 2021) and will therefore not be referred to in this paper.

2. Requirements regarding reference material

Reference material is essential for any comparative examinations. In general forensic terms, such a material is defined as traces intentionally acquired for identification purposes by procedural bodies, as well as one collected in various types of forensic registries and collections (Kulicki, 2009).

For traditional handwriting examinations, the literature makes specific demands on reference material (Oleksiewicz, 1998). Such a material should be comparable to the evidence manuscripts in terms of:

- the content,
- the graphic form,
- the substrate and its format,
- the tool and writing medium.

It is also important to assort an appropriate amount of reference material that fully represents individual writing proficiency. When collecting it, a popular and valid rule is: the more scant the evidence, the more extensive and varied the reference material (Kegel, 2002). When sampling reference material on request, attention can be paid to such factors as the angle of the writing, the size of the characters, the speed of writing (e.g. suggesting a change in the angle or characters, an increase or decrease in writing speed), the writing position, physical defects (Gruza, Goc, Moszczyński, 2011).

Three basic groups of reference material are reported in literature, which are classified according to their source of origin.

The first of these is the material written on request, i.e. handwriting samples taken from a person in the presence of a procedural body or an expert. The person submitting such writing samples is aware of the purpose of their use, and therefore there is a danger of masking the features of their own handwriting features (Widacki, 2002). The advantage of this kind of material is the authentication of the subject and acquisition of reliable handwriting samples. The procedural body or the expert who carries out such an activity should collect reference material in accordance with applicable rules. In turn, in the context of identification examination of digitally captured signatures, particular attention should be paid to the device and software corresponding to the evidence. Reference material taken in this way reduces the possibility of errors in inference.

Another group consists of other source material, i.e. all kinds of documents created in the past by the author with no connection to the pending investigation. Such a material has an important role in the comparative analysis of manuscripts (Kwieciński, 1934). Firstly, it can provide reliable reference material relevant to old documentary evidence in terms of time. Secondly, it can provide the basis for verifying the processes of natural or intentional change in one's handwriting features. The rising popularity of digitally captured signatures makes it possible to acquire relevant material also among this group of manuscripts. The procedural body, as the leading investigative authority, may request va-

rious entities to provide "other source" documents, including those signed with a digitally captured signature.

A third group of reference material is also mentioned in the literature on the subject, i.e. quasi "other source" material (Goc, Łuszczuk, Oleksiewicz, 2007). These are documents which bear handwritten notes made in the course of the pending investigation, e.g. interview reports, confrontation reports, examination reports, written reports of offences, return receipts of registered mail, etc. At present, law enforcement authorities in Poland do not have the possibility to sign procedural documents with a digitally captured signature, but an example of this type of documents in the proceedings files may be return receipts of registered mail of Poczta Polska S.A. – they are relevant to a given investigation, but were not made in direct connection with the act of taking reference material.

The aforementioned groups of reference manuscripts, as well as the conditions in which they are acquired, are equally relevant for the collection and sampling reference material for the purpose of forensic analysis of digitally captured signatures. For obvious reasons, the only difference concerns the writing substrate and tool, which are replaced by an electronic device and stylus. Viewed through the perspective of the requests handled by CFLP, it should be stated that identification examination of digitally captured signatures requires collecting material on a suitable device and application, but manuscripts on a paper substrate are also important. Rules for the sampling of reference material on electronic tools are presented below.

3. The tool

In most requests addressed to CFLP, which are delivered without prior contact with an expert, the reference material includes only records made on a paper substrate. However, it should be borne in mind that in the case of digitally captured signatures, the questioned material is produced on electronic devices, the surface of which may differ significantly from traditional paper. These differences are important from the point of view of analysis of handwriting features and the possible deviations which the surface of the device may cause during writing. The surface of electronic devices (regardless of the type of the recording technology used) is usually smooth and slippery, unlike the slightly rough texture of paper, which can affect how the writing tool is guided.

In the case of electronic devices, the most important element is the recording technology. Currently, there are devices on the market which use a variety of recording methods, e.g. electromagnetic, resistive, capacitive (Best Practice Manual for the Forensic Handwriting Examination, 2022). Depending on the technology used, the device may have different surfaces designed for writing (most often made of glass or plastic). From the expert's point of view, sampling reference material on a device with appropriate data recording technology may be more important than, for example, the brand or other functionalities of the device.

4. The software

Software and applications used for signing digital documents may have different standards for image quality, DPI, data acquisition and the recording technology used. The use of an identical software allows sampling handwriting patterns that are fully comparable to the questioned biometric signatures.

Selecting the right device and software is usually a difficult task for procedural bodies and cannot be carried out without the assistance of an entity that has this kind of solution. The number of applications and software, as well as the variety of electronic devices available, means that entities entering the world of authenticating digital documents with a biometric signature can, in principle, use the solutions of their choice without any restrictions. From the point of view of the procedural bodies and experts, this is cumbersome and, basically, digital tools can be completely different from investigation to investigation.

The following sections will present examples of actual expert opinions in which a variety of reference material was available, collected in accordance with the rules indicated above.

5. Example 1

The questioned biometric signature (Fig. 1) was submitted as an Electronic Proof of Receipt (EPO) of Poczta Polska S.A. and contained information sufficient to qualify it for further comparative examination. The reference material consisted of manuscripts on a paper substrate (Fig. 2) and made on an adequate device and application (Fig. 3). When sampling the material on a tablet, an attempt was made to mirror the real-life situation in which a customer signs for the receipt of mail. Boxes were created on paper sheets to reflect the size of the signature field on the tablet.

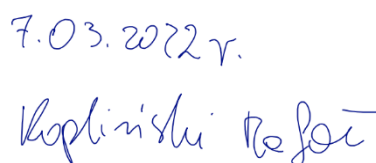


Fig. 1. The questioned signature

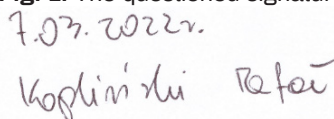


Fig. 2. Fig. 2. A reference signature made on a paper substrate

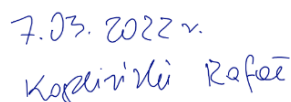


Fig. 3. A reference signature made on a tablet

Despite the extensiveness of the reference biometric signatures, some correspondence to the evidence could only be obtained in the material written on a paper substrate. Given as an example can be the single-element form of the first character in the questioned signature. A detailed analysis of the pressure within the element revealed the presence of capillarity (Fig. 4), which was also found in the reference manuscripts made on a paper substrate (Fig. 5).

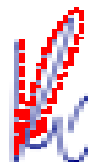


Fig. 4. The character in the evidence signature



Fig. 5. The characters in reference signatures on a paper substrate

The image of the biometric signature generated in .jpg and .png graphic files or visible on a digital pdf. document only allows the analysis of sets of synthetic, topographical, measurable, structural features and some motor features (e.g. impulse). Features such as the value of the pressure, the succession of characters, the speed of writing are observable through the prism of the numerical data recorded during the execution of the signature. The capillarity of the lines in the biometric signature means a reduction in the level of pressure without taking the stylus away from the tablet.

In the example in question, it was also an important part of the analysis to compare the features of the external topography, or rather the way in which the signature is situated in the designated tablet window. Significantly, consistencies were shown between both the material made on the tablet and the material on a paper substrate. The comparison between conventio-

nal and digital handwriting features was made possible by creating corresponding boxes and sections on sheets of paper. Below is the questioned material (Fig. 6) and the reference material written on a paper substrate (Fig. 7) and a tablet (Fig. 8).

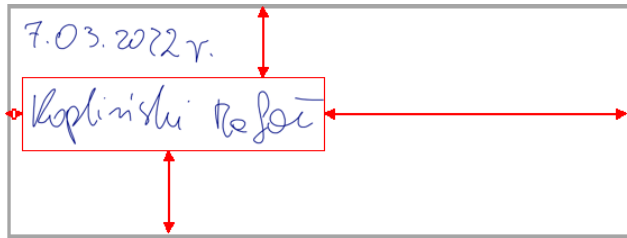


Fig. 6. The questioned signature

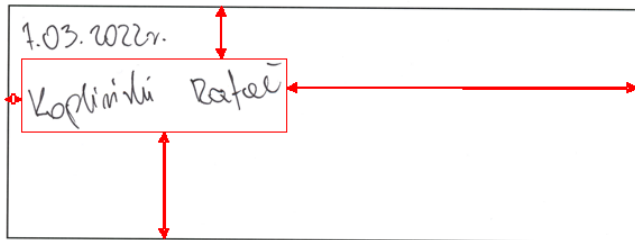


Fig. 7. A reference signature made on a paper substrate

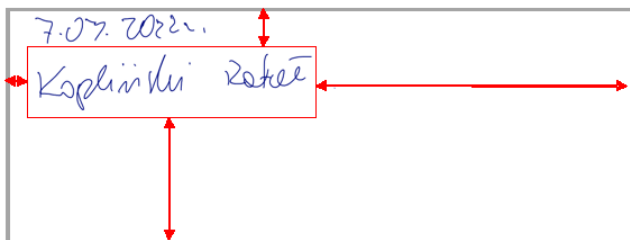


Fig. 8. A reference signature made on a tablet

6. Example 2

Another example is an examination request in which questioned signature was also an Electronic Proof of Receipt and the reference material was sampled in a similar manner as in the first example. In this case, the consistencies related to all sets of graphic features, but the order in which the different elements of questioned signature were written proved to be crucial. It should be noted that this is a feature that cannot be accurately confirmed in manuscripts made on a paper substrate, as opposed to those made on a tablet.

The questioned material (Fig. 9) provided an advantage in the form of complexity of the composition, which featured records relating to the surname, first name, date and, in addition, bracket marks. The order in which the individual elements were written, particularly within the bracket, was fairly unique and was confirmed in the reference material from one of the subjects (Fig. 10).

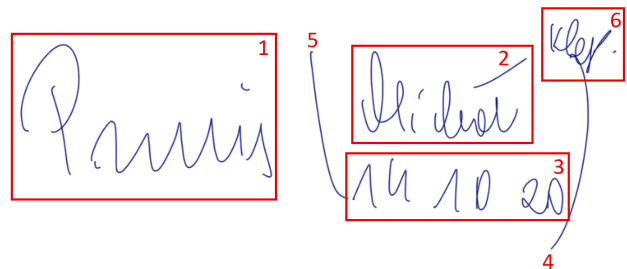


Fig. 9. The questioned composition

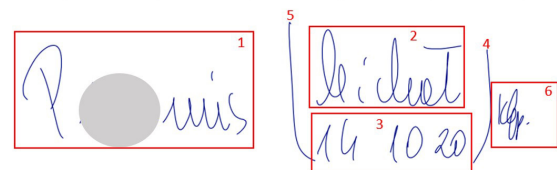


Fig. 10. A reference material made on a tablet

7. Example 3

The questioned biometric signature (Fig. 11) was affixed under a telecommunications service contract signed with a mobile network operator in Poland. The signature was written and recorded with the use of a publicly available digital document authentication application.

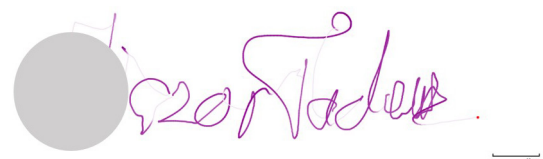


Fig. 11. The questioned signature

The request was fairly unique, as examination to verify authenticity could only be carried out on paper-based material. The person whose personal details were signed with the signature had died, and it was therefore not possible to obtain samples written on request on a suitable device and application. In this case, the basis for the examination was the very extensive and diverse other source material. The diversity concerned the conditions of execution of individual manuscripts (office, mail, own home notes), but also the timing (a broad

time range, including particularly the time of making the evidence signature). The final result of the analyses of this part of the examination led to the categorical exclusion of the authenticity of the evidence signature.

The second part of the request involved execution examination, where extensive and varied reference material was available, including biometric records submitted on an identical tablet and application. The reference material, as indicated above, was fairly extensive, with dictated samples taken on several occasions due to the person's various medical conditions. Ultimately, it was possible to find features in the reference material that correlated with the evidence (Fig. 12). Consistencies were observed in both the conventional material and that made on a tablet.

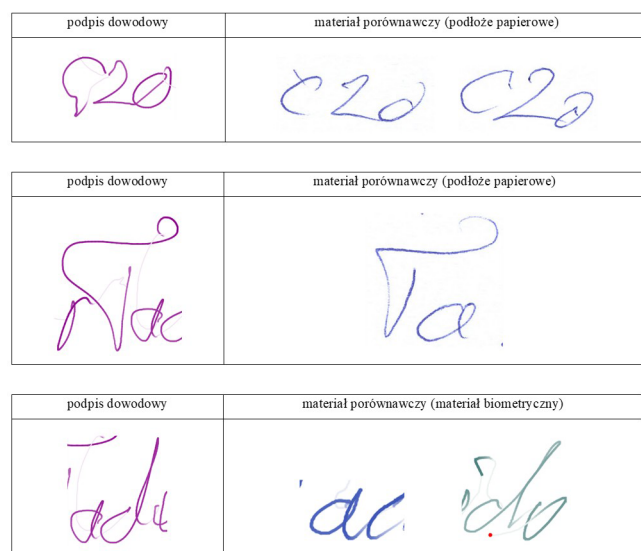


Fig 12. Summary of example features from the graphical-comparative analysis

8. Conclusions

It can be presumed that digitally captured signatures will be increasingly used by various types of authorities as well as public institutions in the coming years. This means that they will become an everyday subject of examination by forensic experts. Thus, the development of consistent guidelines, as well as broadening the body of practical knowledge based on real-life cases, will be an inevitable and extremely important process. A biometric signature, although seemingly similar to a classic signature on a paper substrate, represents a qualitatively new area of forensic examination. Not only does it require adaptation of the existing methods, but also the creation of new analytical tools that will allow full use of the examination capacities.

The above examples of real-life requests submitted to laboratories demonstrate the need for an appropriate approach to the collection of reference material. In the case of digitally captured signatures, one should not be limited to collecting material only on a tablet or only on paper. Where one group of materials cannot be acquired, it is important to focus on the other one and to reach as many places as possible where the subject

may have left his or her graphic footprint.

The role of reference material, whether it concerns traditional paper documents or digital records, remains crucial. It is its quality, quantity and consistency (comparability) with the evidence that determine the reliability of the final conclusions and the value of evidentiary opinion. In the case of digitally captured signatures, it becomes particularly important to take into account factors such as the type of device, the technical parameters of the software, or the stylus used.

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