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# Evidence for a 3-stage Model for the Process of Free-hand Forgery of Signatures and/or Handwriting

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**Abstract**
Questioned documents, suspected of resulting from free-hand forgery, are a challenge to Forensic Document Examiners (FDEs). This article hypothesizes that there is normally a unique sequence of contracting muscles required to produce a specific signature or handwriting; the hypothesis is supported by recent EMG studies in handwriting and by kinesiology. On this basis, a 3-stage model (ElAdApp) is outlined for analyzing the process of free-hand forgery of signatures or handwriting. Using this model to examine 35 cases of forgery, quasi-randomly selected out of 700 cases, evidence of its utility is presented with case studies and statistical data. The model is advocated as a useful tool for FDEs, and a contribution towards bolstering the scientific basis of forensic document examination.
***Keywords*****:** *forgery, signature, handwriting, kinesiology, adoption, application*

## 1. Introduction

The 2009 publication *Strengthening Forensic Science in the United States* – authored by the National Academy of Sciences and known worldwide as "The 2009 NAS Report" – stated that opinions in handwriting examination were based too much on subjective analysis rather than objective, science-based analysis (NRC 2009). Nowadays, court rulings require use of a scientific approach for the development and presentation of opinions of Forensic Document Examiners [FDEs] (Wakshull 2019).

Although it has been twelve years since the publication of the NAS report, there is still much research to be done in the field of forensic document examination, in order that the opinions of FDEs derive from strong scientific methods rather than subjective analysis. We should not underestimate the value of qualitative, empirical analysis for FDEs: however, courts worldwide demand reliable, objective evidence in order to issue a decision that the forgery of a signature and/or handwriting was committed by a specific person.

Handwriting is an extremely complex human task, performed as a result of a complex, cognitive process learned from childhood. Analysis of this process shows that handwriting consists of a sequence of coordinated movements of the muscles of the hand and the forearm, but there is also a contribution of the muscles of the arm and the shoulder region: in total, forty-three muscles participate, to a greater or lesser degree, in the act of handwriting, as shown by electromyogram (EMG) studies (Derbel 2020: 71; Mahmoud 2020).

The articulations of the hand and wrist are the most important in handwriting: less involved are the articulations of the elbow and the shoulder. The motor process of handwriting production can be divided into a series of subprocesses, which are thought to take place in separate modules – including the modules in the central nervous system. The final subprocess is the sequence of coordinated movements of muscles contributing to specific movements of the pen that produce a signature or handwriting. Handwriting in adults consists of sequences of muscle contractions, resulting in "strokes", e.g. fast movements of the thumb and index finger holding the writing medium (pen, pencil, etc,). These strokes last about 1/10 of a second in adults trained in handwriting since their childhood (Teulings 1996).

Typically, an adult skilled in handwriting performs the strokes so rapidly that there is no possible role of visual feedback in the form or dynamic characteristics of writing a particular letter of the alphabet or other symbol. Visual feedback is used only to arrange the written letters on the paper, controlling the distances between the letters (Danna 2015). The human brain sends instructions to the muscles, and the proper sequence of movements – the strokes – produces the signature or handwriting. The brain, through its "commanding cells" (the upper motor neurons located in the primary motor cortex or precentral gyrus) sends commands to the spinal cord to perform specific movements; these commands include subcommands for each particular muscle to contract in a specific way. Figure 1, below, shows the location of the precentral gyrus in the human brain.

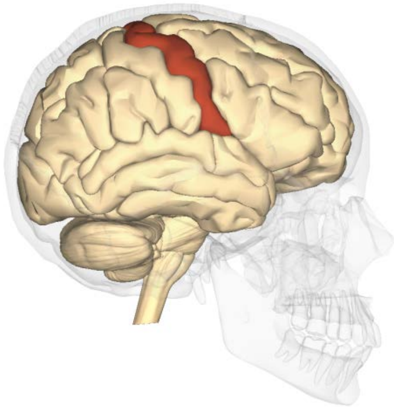

Fig. 1 Precentral gyrus, lateral view

Source: https://commons.wikimedia.org/wiki/File:Precentral_gyrus_-_lateral_view.png

It has traditionally been thought that the "commanding cells", the upper motor neurons, send commands only for movements, and a single upper motor neuron (UMN) cannot control a single muscle; moreover, the subcommands for the individual muscles are unconscious, and it is only the command for a specific movement that is conscious. This is generally true; however, there is recent strong evidence that sometimes a single UMN can control a single muscle (Russo et al. 2018; Antoni et al. 2017; Ajemian et al. 2008; Todorov 2000). A challenge for neuroscience is to understand the conscious and unconscious processes underlying construction of willed actions. In an article published in 2020, the researchers investigated the neural substrate of human motor awareness of patients who were awake during brain surgery (Fornia 2000).There is evidence that the primary cortex, through the cells in the precentral gyrus, exerts volitional control, thus commanding the initiation of movement. It also has the ability to suppress undesired movements. Therefore, the primary cortex can stop the execution of motor programs in the brain (Lemon et al. 2019; Ebbesen et al. 2017; Stinear et al. 2009).

A forger attempting, free-hand, to imitate the signature or handwriting of another person has to move the muscles of his upper extremity, holding the pen, in an appropriate manner. However, as explained above, he cannot consciously control the individual muscles of his upper extremity: this is the primary reason that forgeries are usually unsuccessful, and the fake signature or handwriting produced shows significant dissimilarities with the original. When two signatures show various suspicious similarities – sometimes exhibiting an identical shifted base – this is considered as a likely case of superimposition rather than free-hand forgery (Gupta et al. 2016). (It is well established, from many decades ago by the empirical data, that two signatures of the same person may be similar, but never identical). In such a case, the forgery can be proved by the FDE through examining the ink trail and indentation of the paper. It may be possible to detect residues of the materials used for tracing the signatures by superimposition. This forgery technique is also generally unsuccessful.

There is unanimous agreement in the studies of free-hand forgery that the forger has to move the muscles of his upper extremity in such a way that the resulting signature or handwriting has the desired form. The question is whether can this be done in different ways, or there is a unique way of doing it? To the knowledge of the author, there is no published scientific answer to this question to be found in FDE journals. Even in the latest textbooks of forensic document examination, there are no chapters on the anatomy and kinesiology of muscles and joints of the upper extremity: even experienced FDEs are not well informed on this topic. The author of the present study, collaborating with medical doctors (MDs), has tried to find the answer to this question. Study of many relevant articles and books dedicated to the subject (e.g., Kapandji 2010), and subsequent discussion with MDs, has led to the conclusion that there is a unique sequence of muscle movements required to produce a signature or handwriting convincingly similar to that of another person.

Four facts lead to this conclusion: a) that the forearm rests on the table, b) that the pen is held in a "tripod" manner, c) that the tip of the pen (more generally, the tip of the medium used for writing) moves in a plane, and d) that the signature or handwriting must be produced by moving the pen along a specific trajectory, the same as followed by the other person. These four facts restrict the mobility of the upper extremity. Applying standard knowledge of the anatomy, physiology, and kinesiology of muscles and joints, the conclusion is that there is only one sequence of specific muscles contracting that can produce a particular signature or handwriting. Only rarely is there an equivalent sequence of muscle movements that can accomplish this task. Figure 2, below, illustrates the restricted mobility.

Fig. 2 Position of the hand in writing

Source: https://commons.wikimedia.org/wiki/File:Hand-writing-exam-classroom.jpg

This one-to-one (1-1) hypothesis – namely, that a specific signature or handwriting is generated by a unique sequence of contracting muscles of the upper extremity – is also supported by recent research on the reconstruction of handwriting and other meaningful arm and hand movements from surface electromyography (sEMG) signals. Using computer algorithms, the researchers solved the inverse problem – that is, deducing which specific letter or figure was written, by examining the recorded sEMG signals of the relevant muscles of the hand or forearm (Chihi et al. 2020; Mahmoud et al. 2020; Abdelkrim 2019; Okorokova et al. 2015; Chen et al. 2017; Huang et al. 2010). The hypothesis of 1-1 correspondence, is also supported by research in robotics (Balasubramanian 2014).

## 2. Materials and method: defining a model approach

### 2.1 Principles of analysis with respect to sequences of muscle contractions

In the proposed model, analysis of documents is performed according to the sequence of contracting muscles used by the forger. Figure 3, below, illustrates this with an example. The two circles are similar, but if the trajectory is different – one traced clockwise in the original and the other anti(counter)-clockwise by the forger, the latter did not use the correct sequence of contracting muscles. To draw a circle clockwise, as in handwriting (the forearm resting on the table, the pen held with a tripod grip, the pen moving along the plane of the paper laid on the table) beginning from the top of the circle (red circles, top left), with the right hand, we must rotate the wrist clockwise using the muscle extensor carpi ulnaris (shown in Figure 3). This fact is confirmed by EMG studies (Chihi 2020). There are also other muscles contributing to this movement, but to make the example simpler we mention the most important. In contrast, to draw a circle anti-clockwise, when the tip of the pen is at the top of the circle (blue circle, top right), with the right hand we must use the abductor pollicis longus muscle which "abducts" the thumb – i.e., moves it away from the middle finger – so in this case the thumb moves anti-clockwise. This too is confirmed by EMG studies (Chihi 2020). In this case, where the right index finger holding the pen is moving anti-clockwise, a significant contribution is made by the contraction of the muscle right first dorsal interosseous, which abducts the right index finger, a fact confirmed by EMG studies (Linderman 2009). This muscle, the first dorsal interosseous, is not shown here, for reasons of simplicity.

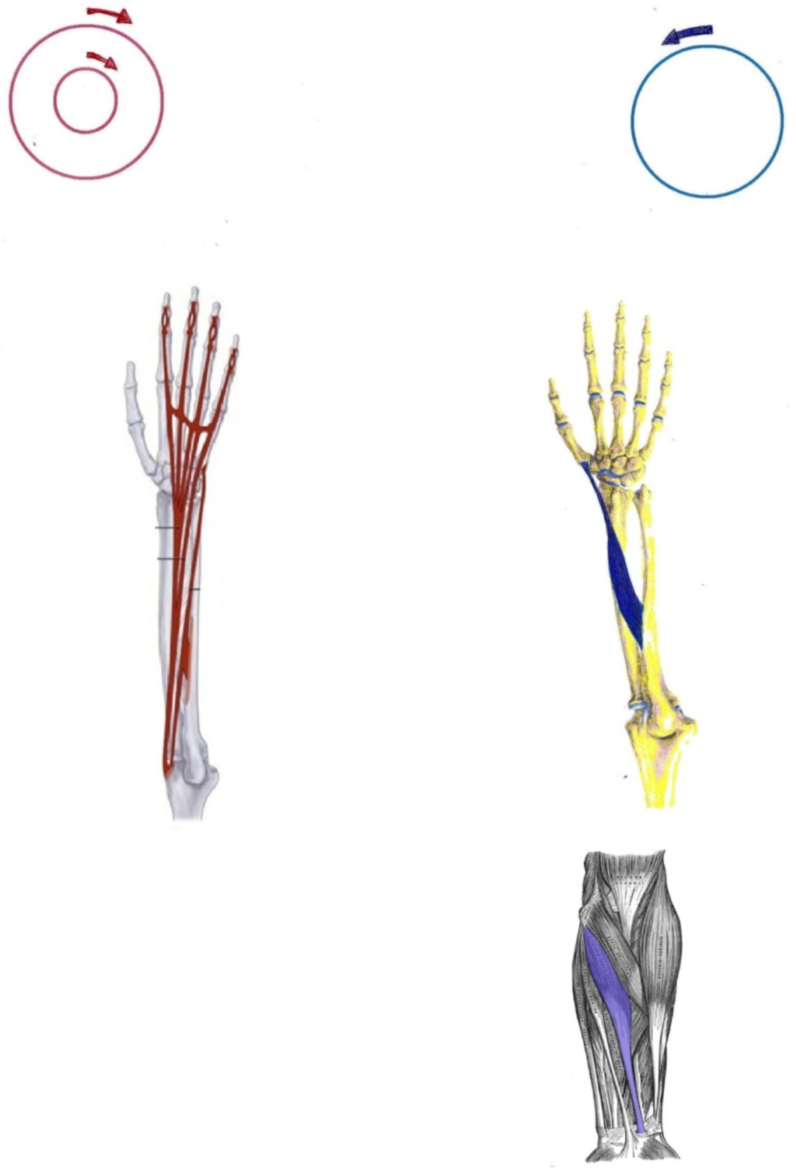

Fig. 3 Drawing, as in handwriting, circles clockwise (Red circles on the Left), and anti-clockwise (Blue circle on the Right): Different sequences of contracting muscles are required to perform each task

Sources:

https://commons.wikimedia.org/wiki/File:Extensor_carpi_ulnaris.png,
https://commons.wikimedia.org/wiki/File:Flexor-carpi-radialis.png

Also, the right wrist is rotating counter-clockwise, by the contribution of the action of the muscle right flexor carpi radialis (In Figure 3, bottom right image, the muscle flexor carpi radialis of the left hand is colored purple). Thus, drawing a clockwise circle, as in handwriting, in the case of the red circles in Fig. 3, the right hand has to follow a specific sequence of contracting muscles. The same sequence of contracting muscles is followed in both concentric red circles. The parameters of the individual contraction differ, but the sequence is the same: the same specific muscles must be used in a particular sequence, to draw any concentric circle

clockwise. The four parameters of the contraction of a muscle are: the time span required for the muscle to obtain the desired length, measured from the initiation of the contraction, the strength of the contraction (based on how many muscle bundles contract), the duration of the contraction (the time interval that the muscle remains contracted), and the different length, that the muscle acquires with each contraction. The length of the muscle may be reduced more or less by the corresponding contraction, which is voluntary (Hall 2010).
For the anti-clockwise drawn circle, the blue one, a different sequence of contracting muscles must be used. If a person writes the circular part of the letter "a" with an anti-clockwise trajectory, while the forger uses a clockwise trajectory with a different sequence of muscle contractions, this is strong evidence of forgery – even if the form of the letter "a" is similar in both documents. The trajectory of the pen can be discerned from the ink trail and the indentation of the paper.

## 2.2 Specification of the ElAdApp model

ElAdApp conceptualizes the forgery of signatures or handwriting as consisting of three stages: Elimination, Adoption and Application. We shall consider each stage, in turn.

### 2.2.1 The Elimination stage

The suppressing of the forger's own habits in handwriting – i.e., suppression of the learned sequences of contracting muscles that generate handwriting – is the first stage of the effort of the forger to accomplish a forgery. The suppression is made by the primary cortex of the brain: this is a difficult task, because the subcommands to individual muscles are generally unconscious. If, after sufficient practice, the forger succeeds in suppressing his own handwriting habits, then he eliminates the corresponding series of strokes and, moreover, the corresponding traces from the document produced. A successful suppression of personal handwriting habits constitutes the Elimination stage of forgery.

### 2.2.2 The Adoption stage

The second stage is that of Adoption. The forger tries to simulate the signature or handwriting of another person: guided by the form of the signature or writing of the person, he makes an effort to use appropriate sequences of muscle contractions, to generate traces similar to those of the other person. The term "adoption" is used, because although the forger uses some previously learned strokes, within a different sequence of strokes, he also needs to adopt new strokes in an effort to imitate the genuine artefact. An already-learned stroke of the forger – normally used to form part of a letter, in his own personal style – can be used successfully to imitate part of a letter written in the style of the person. To simulate successfully the genuine article, the forger has to modify his handwriting motor programs, adopt new ones, and must then execute the sequence of contracting muscles required to produce the signature or handwriting.

Achieving the correct specific sequence of contracting muscles is not enough: each individual muscle contraction that is part of the correct specific sequence must also have the appropriate parameters – e.g., the appropriate speed of completion of the contraction, the required length of contracted muscle, the required strength and duration of the contraction. If the forger succeeds in executing the correct series of muscle contractions, he has completed the Adoption stage of the forgery. Executing the correct sequence of muscle contractions is not enough to produce a forgery convincingly similar to the genuine item, if the parameters of the individual contractions are not the appropriate: however, the correct sequence of contracting muscles is an essential, *sine qua non*, stage of forgery.

### 2.2.3 The Application stage

The third and final stage of forgery is the Application. The forger has practised extensively trying to suppress his own habits in handwriting and to imitate the genuine item, before producing the final document. He proceeds then to produce the final document: by this point, he should have suppressed his own handwriting habits, instead using the correct specific sequence of contracting muscles required to simulate the genuine artefact. Of course, this is insufficient, as pointed out previously, and the individual muscle contractions must also have the appropriate parameters. Lacking these, the forgery is revealed through careful examination of the document.

### 2.3 The method of examination: using ElAdApp

The model proposed by the author – ElAdApp (Elimination, Adoption, Application) – is used for the analysis of 35 cases of forgery of signatures and/or handwriting. These 35 cases are selected quasi-randomly, out of more than 700 cases (mostly in Greece, 10 in Cyprus, 1 in the USA), examined by the author as a professional FDE over the last 20 years. Moreover, the author has personal experience of hundreds of cases in Italy, where he completed his studies in the field of forensic document examination. These cases in Italy were examined by the author for theoretical or educational purposes in his duties as an instructor in a private university and a private school of Forensic Document Examination and Forensic Grapho-Pathology.

The 35 cases in the sample were examined using the well-established procedure of Forensic Document Examination whereby forgery of signatures and/or handwriting is proven with undisputed evidence. Then the 35 cases were classified using the model ElAdApp.

First, the 35 cases were analyzed for evidence of the inability of the forger to suppress his own motor programs in handwriting – for example, traces from strokes generated by sequences of contracting muscles different from the sequences of contracting muscles used to generate the genuine signature or handwriting. Such a case would be when a stroke had an opposite direction to the corresponding strokes in the genuine artefact. Thus, if in a suspect document the stroke had a clockwise direction while the corresponding stroke in the genuine document had an anti-clockwise direction, this was evidence that the forger was unable to suppress his own handwriting habits.

Next, the 35 cases were analyzed to find series of strokes similar to those produced by the same sequence of contracting muscles. Similarity of the form of certain letters or part of a signature in the questioned document, in comparison with the genuine one, was not enough. Rather, the trajectory (the path) also had to be the same in order to classify the sequences in the suspected document as being the same as in the genuine one.

Finally, the findings of the analysis of the 35 cases, according to the above criteria, were classified and a statistical analysis was performed.

## 3. Results

### 3.1 Statistical findings

Out of the 35 examined cases of suspect documents, 18 were cases of questioned signatures in different kinds of document (private contracts, bank contracts, bank cheques, receipts), and 17 were questioned wills (testaments). This distribution is summarized in Table 1, below.

Table 1: Division of Specimens

| ***Signatures*** | ***Wills/Testaments*** | ***Total*** |
|---|---|---|
| 18 (51%) | 17 (49%) | 35 |

Within this distribution, some cases concerned only one document whereas others involved multiple documents. Specifically, the majority of wills involved only one document (n=1), whereas the majority of other cases (signatures) involved multiple documents (n>1). Table 2, below, shows the distribution.

Table 2: Distribution of document numbers by case type

| ***Signatures*** | | ***Wills/Testaments*** | | ***Total*** |
|---|---|---|---|---|
| **n=1** | **n>1** | **n=1** | **n>1** | |
| 5 | 13 | 13 | 4 | 35 |

Overall, the 35 cases are split roughly equally between those with only one document, and those with more. This is shown in Table 3, below.

Table 3: Overall distribution by number of documents in each case

| ***n=1*** | ***n>1*** | ***TOTAL*** |
|---|---|---|
| 18 (51%) | 17 (49%) | 35 |

It is clear from the above that forgers are more likely to simulate signatures in multiple documents than texts in multiple documents. The explanation is quite obvious, since forging a whole document (such as a will or testament) is a more demanding and complicated task than forging a simple signature. Signatures contain less extended graphics and are unconsciously considered as easier to forge. However, although it is very often more difficult for the forger to reproduce successfully a signature or squiggle, it is also more demanding for the FDE to demonstrate the simulation, because the graphic elements are arithmetically fewer.

As part of the process of document examination, the cases were categorized according to the stage in the forgery process that was reached. Table 4, below, shows the distribution of cases by stage.

Table 4: Distribution of cases by stage of forgery

| | **S T A G E** | | |
|---|---|---|---|
| | ***Elimination*** | ***Adoption*** | ***Application*** |
| *Wills/Testaments* | 2 | 6 | 9 |
| *Signatures* | 2 | 7 | 9 |
| ***Total*** | ***4 (11%)*** | ***13 (37%)*** | ***18 (51%)*** |

The evidence suggests that usually forgers overestimate their abilities in stage 1, and are likely to arrive at stage 3 – application. As shown in Table 4, 51% arrived at that final stage, 37% reached stage 2, and a mere 11% remained in stage 1. In most cases the aspiring forger tries quite successfully to Adopt the model to imitate, but he fails in the final and most demanding phase, that of Application. This means that the forger has been unable to block completely his handwriting automation, and although he has used mainly the correct specific sequence of contracting muscles, the individual contractions of the muscles did not have the appropriate parameters. He can't constantly apply the necessary control to his automated graphic expression, although he might be quite capable of conceptualizing the form of letters to imitate.

## 3.2 Sample cases

Case #1

In the following example, the testator is almost 78 years old. The forger is a neighbour, not much younger, who tried to take advantage of the lack of descendants. Medical documentation indicates that the forger in the date referred to in the testament was in a coma and was transferred by ambulance to the hospital's ICU, so it was impossible for him to have written it. The forger did not really try to imitate the genuine handwriting, but rather to reproduce an impression of a general notion of the reduced graphic ability of elderly people. Although he was aware of the timeline of hospital admission, he suggested indirectly the composition of the text just before hospitalization. For this reason, the content and meaning of the text of the testament are limited to basic data – the inheritance and the heir's name.

Sometimes, historical particularities regarding even the personality of the forger define his choices in order to apply his project and invigorate his claim of the suspected document's genuineness. These choices are not always intelligent or well-aimed.

Figure 4, below, shows a redacted copy of the testament (X). The graphic skill of the testator seems very poor. Could it be possible for this hand to present such flexibility in the final part of the text (shown enlarged, right), taking into consideration that a hand with such difficulty in writing would normally be exhausted after several rows of writing?

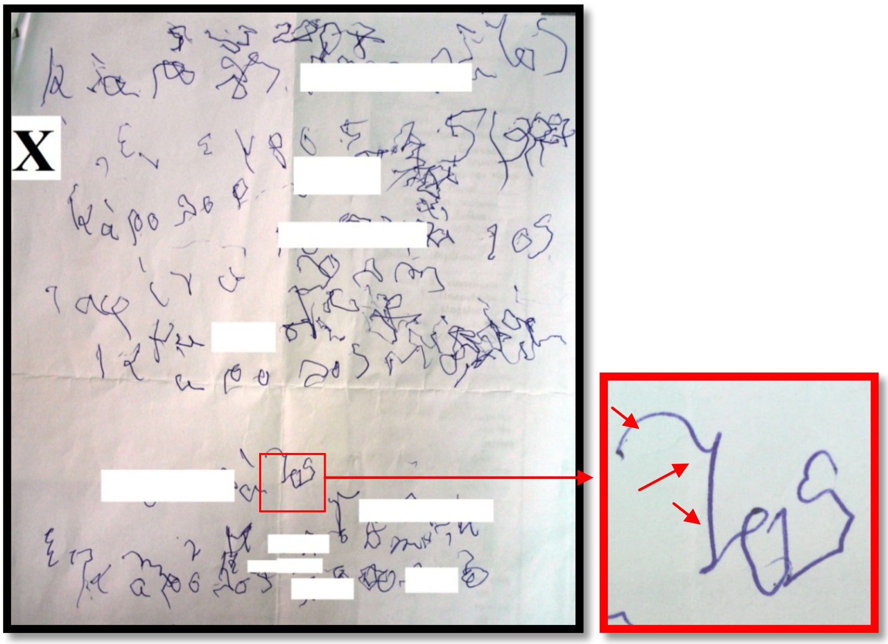


Fig. 4 Testament X and magnified section

The same point of the same letter “τ” presents a different ideation in genuine specimens of the same chronological period (Fig. 4: A6, A8). The forger did not manage to Eliminate his flexibility and his own ideation of the letter’s model. He tried to recreate a fake environment of pathological aspects in the quality of the traces, following the records of clinical deterioration of the testator’s health.

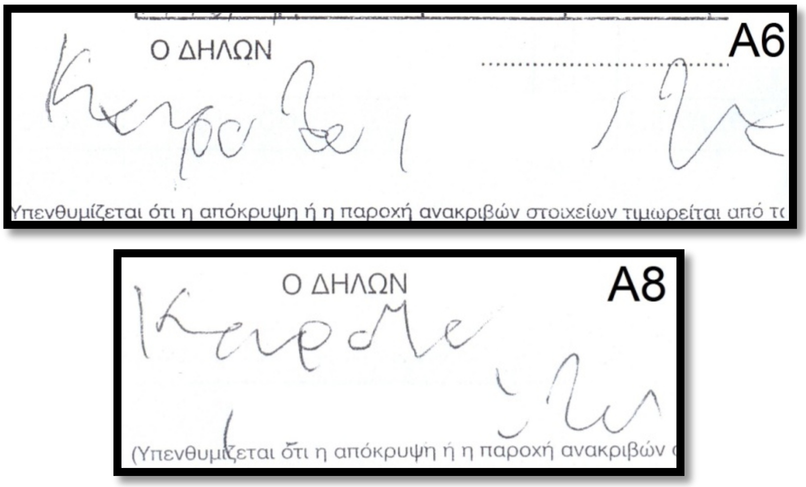


Fig. 5 Genuine contemporary handwriting samples of the testator

<u>Case #2</u>

As shown in Fig. 5, below, the initial part (on the left) of the questioned signature X begins with a stroke in clockwise direction, in contrast with the initial part of genuine signatures which begin with anti-clockwise direction. The forger could not suppress his motor habit, and began the questioned signature with a stroke with opposite direction from the initial stroke in genuine signatures. Also, the final part of the questioned signature X is generated with an obviously different sequence of movements, as the final part of the signature X is a stroke with direction away from the centre of the right wrist, while the final part in the genuine signatures is a stroke towards the centre of the right wrist. Holding a pencil in a “tripod” grip and following the trajectory of a photocopy of the questioned signature X, and doing then the same for the genuine ones, we can “feel”, by

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proprioception, that the sequence of muscle contractions is very different in the suspect case, compared to the genuine signatures. Examining further the middle part of the suspect signature, which is a simple squiggle with few particular elements, we observe that the forger did not succeed in his effort to simulate the same characteristics (such as the different proportions in the dimensions of the loops in the middle part of the squiggle, and the different distances between them). Moreover, the axes of the loops are almost parallel in the genuine signatures, whereas in the suspect signature the axes of the loops converge in the upper part: this needs a different sequence of muscle contractions than was used in the genuine signatures.

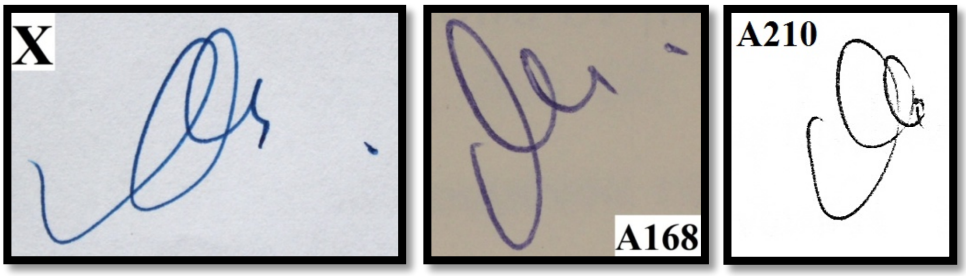


Fig. 6: Suspect signature (X), and two genuine samples

Case #3

In Fig. 6, below, the forger tries in suspect signatures X22, X24 to morphologically imitate the genuine model (samples indicated with A). Although he has identified the two dynamic components of the model (the sequences of the contracting muscles), he does not succeed in the Application of them in the forged specimens.

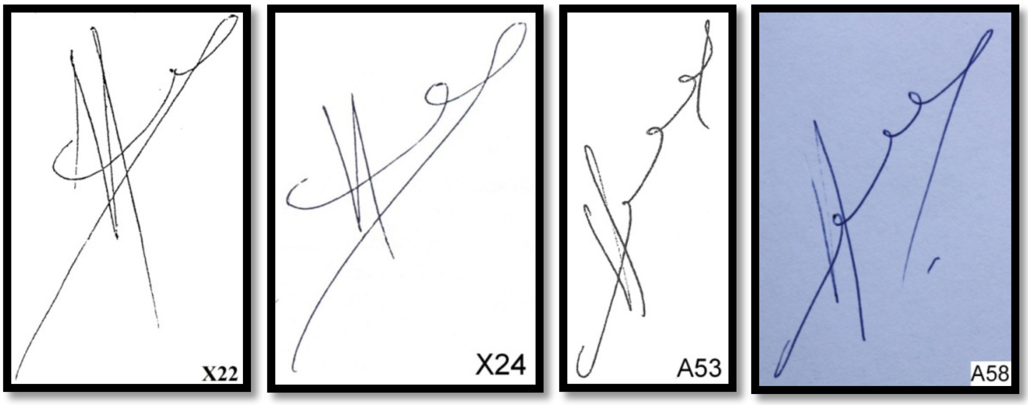


Fig.7: Suspect signatures (X), and two genuine samples (A)

### 3.3 Discussion

The proposed model ElAdApp (Eliminate, Adopt, Apply) demands in practice an extremely complicated procedure in order to analyze the available material, study the case, define the FDE's conclusion and demonstrate the results. We have to point out that the most difficult part of the procedure relates to the contemporaneous and dynamic interaction of these phases, which lead (or not) to the intentional reproduction, imitation, simulation or forgery of a specimen.

The ability and practice of the forger define success or otherwise. Very often, the result is that the forged product "is screaming" out about the lack of spontaneity of the writing: it betrays the attempt to artificially reproduce the genuine graphic nature, but also abounds in internal contradictions as to the dynamic background of traces.

The knowledge, experience and investigative mentality of the FDE can orientate him in the correct direction in his research, having in mind the procedural steps of simulation. Profound analysis, stage by stage, and the differentiated deepening of the analytical study of every sector of the above procedure, but as "reverse engineering" (from the graphic product, through the kinetic mechanism in its anatomical aspect, to the mental source of it), can bring the expert to the decodification of the forgery.

In the analysis of the statistics of the examined specimens, we find out that in most cases the forger arrives, although he usually fails, in the last stage of ElAdAp, the stage of Application. The most common tendency is the attempt to reproduce the standard writing or signature, which is the model to imitate. That means that the forger does not really act spontaneously or impulsively in the production of the forgery, but in most cases he has already defined a project of action.

## 4. Conclusions

The forgery of a signature or handwriting is a serious criminal offence in all countries, punishable by a range of penalties, according to the specific circumstances and legal jurisdiction. In this context, the three-stage model of ElAdApp (Elimination, Adoption, Application) is proposed as an indispensable tool for the detection and scientific proof of free-hand forgery of a signature or handwriting. In the model, the first stage is the effort of the forger to eliminate, with practice, his own personal writing habits (i.e., commands from the brain to execute sequences of muscle contractions of his upper limb, to generate handwriting). The second stage is the effort of the forger, by practicing, to adopt some new sequences of muscle contractions in order to execute the correct sequence of muscle contractions required to generate a signature or handwriting similar to the genuine artefact. The third stage of free-hand forgery of a signature or handwriting is the final production of the forged document. After the forger has eliminated his own habits in handwriting, and adopted new motor programs, he executes the correct specific sequence of contracting muscles, which must be the same as the sequence used by the genuine signatory. To imitate completely the genuine artefact, the correct sequence of contracting muscles is not enough, since the individual muscle contractions must also have the appropriate parameters.

Justifying the parameters of the ElAdApp model, the author proposes a scientific hypothesis – namely, that the anatomy, physiology and kinesiology of muscles and joints, applied with the four restrictions of handwriting taken into consideration, a) that the forearm rests on the table, b) that the pen is held in a "tripod" manner, c) that the tip of the pen (more generally, the tip of the medium used for writing) moves in a plane, and d) that the signature or handwriting must be produced by moving the pen along a specific trajectory (path), lead to the clear conclusion that there is normally only one specific sequence of muscle contractions of the upper limb able to generate a specific genuine signature or handwriting. This conclusion is also supported by recent research using electromyography (EMG).

The statistical results from the 35 examined cases of free-hand forgery suggest that about 51% of forgers reach the final stage of application, with 37% remaining in the second stage and only 11% failing to proceed beyond the first stage. These ratios are near-identical for both simple forgery of signatures and the more complex task of forging an entire document (e.g., wills and testaments).

Thus, this model makes some significant progress in attempting to base forensic document examination on robust, scientific evidence rather than subjective interpretations by FDEs. As such, it is advocated as an important device to guide FDEs in their work.

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**Biography**

Pàvlos Kipouràs was born in Athens, Greece in 1973. Graduate of Law School in 'Dimokriteion University of Thrace" in Greece in 1996. Graduate of Judicial Graphology in "Università degli Studi di Urbino 'Carlo Bo'" of Italy in 2000. MSc of Graphological Expertise & Professional Consultancy in "Università degli studi di Urbino 'Carlo Bo'" in 2006, Graduate in Graphological Techniques Università degli studi di Urbino 'Carlo Bo' of Italy in 2008. PhD "Judicial Graphology as an Expertise" Dimokriteion University of Thrace, Greece 2009. Diploma of Specialization in Criminalistic Graphology "Università Pegaso" of Italy in 2013. Grad. in Graphometric signatures Centro Studi Grafologici, Italy, 2020. He is an Attorney at Law since 1998, Document Examiner/Judicial Graphologist since 2001 and Professional Graphologist since 2006. Advisor of the «State Commitee of Cinematography» of the Greek Ministry of Civilization since 2012. Prof of "History of the Greek Writing" of "Pegaso University" of Italy (2015-2016), Prof of "History of the Greek Writing" and "Elements of Greek Writing" of the "Scuola Forense di Grafologia" (SFG) of Naples, Italy (2016-2021) and Prof of "Graphopathology in Greek Writing" of "Scuola di Grafopatologia Forense" (SGF) (2018-2021) of Naples, Italy. Specialist in Graphometric signatures (2020) and Senior Researcher of South Ural State University of Russia since 09/2020. Member of the Athens Bar Association of Lawyers, ΠΕΔΙΚΓΡΑΦ (Greek Association of Document Examiners), Associazione Grafologica Italiana (AGI), CIGMe (Centro Internazionale di Grafologia Medica), Slovak Graphological Society, CeSGraf (Centro Studi Grafologici), AGRAGI (Associazione Grafologica Giudiziaria), Associazione Nazionale Grafologi Forensi ed Esperti Documentali (Anigrafed). Interested in research in graphometric signatures, speaker in 37 international conferences and seminars throughout world (from Brazil to China), author of articles and author of the book "Judicial Graphology as an Expertise" published in 2009 in Greece (Ed. Ant.N.Sakkoulas),