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# Development of Instrumental Credibility Examination of Testimonies[3]

History of instrumental credibility examination of testimonies reaches back to the 19th century when the first steps were taken to create an instrument suitable for lie detection. The past one and a half century was all about polygraph, the very first instrument created, and about the ongoing modernization of the applicable examination methods, nevertheless, in the past decades polygraph examination seems to lose its exclusivity, due to the appearance of other devices proving that polygraph is not the only and exclusive method of credibility examination of testimonies, moreover, it's worth to give consideration to new inventions and to the development of other devices. The aim of this study is to introduce the development path of instrumental credibility examination of testimonies, furthermore, to explore the development potential of the polygraph and other devices already introduced in Hungary.

## *I. Modern age and the instrumental credibility examination*

Being rather coincidental, the reliability of traditional law's lie detection measures seems quite weak from today's perspective, but by the 19th century the need for the reification of lie detection on the base of instrumental measures was identified. Various measures of lie detection were known to the ancient world, yet, the results were rather unpredictable. Of course, there was a chance to identify the offender, but since the measures were not reliable, they might have concluded in an innocent person's guiltiness or resulted in the fact that the actual offender succeeded to avoid adjudication due to the malfunctions of the system. In this era such observations as dryness of the mouth of someone threatened by identification (for example, rice test lie detection or the measures ordeal bean, whereas at the end of the interrogation they examined whether the powdered rice or the beans stayed dry[4]) were the grounds of lie detection, while later in the medieval world, God, as the final ordeal was expected to protect the non-guilty and express such shadow in various water or iron tests, finally, via tilt.[5] From the 13th century torture techniques were found to be the best method to identify guilt or prove someone's innocence.[6]

By the 19th century, lie detection techniques of either mystic of torture means were gone, giving space to the antecedents of the polygraph. One of the pioneers, French cardiovascular physiologist Étienne-Jules Marey attempted to create an instrument suitable

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[3] The work was created in commission of the National University of Public Service under the priority project KÖFOP-2.1.2-VEKOP-15-2016-00001 titled „Public Service Development Establishing Good Governance" in the Ludovika Research Group.
[4] Árpád Budaházi: Polygraph Examinations. Blessing or Curse. Lap Lambert Academic Publishing. Saarbrücken, 2015. p. 12
[5] Béli Gábor: Magyar jogtörténet. A tradicionális jog [Gábor Béli: The history of Hungarian law. Traditional law]. Dialóg Campus Kiadó, Budapest-Pécs, 1999, p. 272
[6] Hanson F. Allan: Testing testing. Social consequences of the examined life. University of California Press, Berkeley and Los Angeles, California, USA, 1993. p. 40

for lie detection.[7] In his research, he's examined blood circulation and later he's created an instrument measuring the pulse. The mechanical device he called sphygmograph connected a capsule measuring pressure (a rubber pipe) to a stylus detecting the periodical changes of arterial pressure, tracing an ink line transforming the motion on a piece of paper in the shape of a curve. The results of the examination were concluded in a register, recording the rapidity, strength and uniformity of the arterial pulse.[8] He also used the devise to examine the change of respiration.[9] Charles Verdin's (1882) lie detection device was also measuring the arterial pulse[10], and in 1893, Rudolf Rothe has also invented a device examining blood pressure, pulse and respiration.[11]

Turin's physician Lombroso determined deception correlations of a testimony by monitoring changes of blood pressure, the volume of organs and physiological changes.[12] In his early researches, Lombroso aimed to detect criminal offenses by using a hydro-sphygmograph. Basically, his device was a blood pressure measuring instrument, but later in 1893, he adapted Marley's sphygmograph and completed his first lie detecting device.[13] During one of his surveys using the device, he could determine that the suspect did not commit the twenty-thousand Franks railway robbery, but he stole passports and other documents. Hearing the questions related to the latter actions the suspect's blood pressure started to drop, assuming that he might have conducted the criminal offenses.[14] Lombroso's device called the pleithysmograph can be considered as the antecedent of the polygraph. [15] The researches of the Italian physiologist, Mosso led him to the conclusion that the treat of identification causes the raise of pulse.[16] He has invented a device he called 'scientific cradle'. He used a large bowl placed on diagonal axes, allowing the possibility to examine the balance state of the person. The subject was laid on the cradle and was stimulated by threatening narratives explored during the analysis of his past records, resulting the cradle's traversing in the direction of the head.[17] According to Mosso's deductions, the fear from being identified causes the blood rushing to the brain.[18]

Italian psychologist, Benussi has examined respiration.[19] According to his findings the fear from being detected results in change of respiration.[20] In 1914, Benussi based his

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[7] Mark E. Silverman: Etienne-Jules Marey: 19th Century Cardiovascular Physiologist and Inventor of Cinematography. Clinical Cardiology, Vol. 19., 1996/4. p. 339

[8] BSZKI Poligráfos Vizsgálati Osztály: A poligráf rövid története [BSZKI Polygraph Research Department: Short history of the polygraph] http://www.bszki.hu/page.php?556 (downloaded: 19.09.2016)

[9] Mark E. Silverman: Etienne-Jules Marey: 19th Century Cardiovascular Physiologist and Inventor of Cinematography. Clinical Cardiology, Vol. 19., 1996/4. p. 339

[10] Geoffrey C. Bunn: The Truth Machine: A Social History of the Lie Detector. The Johns Hopkins University Press, Baltimore, 2012. p. 71

[11] Rudolf Rothe: Specialitäten physiologischer Apparate: Preliminary catalog. Prága, 1893. p. 11.

[12] Agárdi Tamás – Kármán Gabriella: A hazugságvizsgálatról más szemmel [Tamás, Agárdi – Gabriella, Kármán: Lie detection from another angle]. Journal of Internal Affairs, Vol. 47, 1999/10. p. 92

[13] BSZKI Poligráfos Vizsgálati Osztály: A poligráf rövid története [BSZKI Polygraph Research Department: Short history of the polygraph]. http://www.bszki.hu/page.php?556 (downloaded: 19.09.2016)

[14] James Allan Matte: Forensic Psychophysiology Using the Polygraph. Scientific Truth verification –Lie Detection. J.A.M. Publications, Williamsville, New York, USA, 1996. p. 13

[15] Philip Ash: A History of Honesty Testing. In. John W. Jones ed.: Preemployment Honesty Testing: Current Research and Future Directions. Quorum Books, New York-Westport, Connecticut-London, 1991. p. 3

[16] James Allan Matte: Forensic Psychophysiology Using the Polygraph. Scientific Truth verification –Lie Detection. J.A.M. Publications, Williamsville, New York, USA, 1996. p. 12

[17] Szíjártó István: A pszichofiziológiai (poligráf) vizsgálat és eredményeinek felhasználási lehetősége az élet elleni bűncselekmények felderítésében [István Szíjártó: Pscychophysiology (polygraph) examination and the possibilities of using its results in investigating criminal offenses against life] Tansegédlet. Rendőrtiszti Főiskola, Budapest, 1990. p. 8

[18] Nathan J. Gordon: Essentials of Polygraph and Polygraph Testing. CRC Press, Boca Raton, 2017. p. 8

[19] Donald Krapohl - Pamela Shaw: Fundamentals of Polygraph Practice. Academic Press. San Diego, 2015. p. 12

experiments on the grounds that the analysis of the duration of breathing in and out might be proper to detect deception. Researchers have already found that the emotional state effects the respiratory patterns, however, no significant experiments were concluded until 1914. Benussi have created a fictive witness situation, whereas the subject had to play the role of the witness before an imaginary court. A card was handed to him with alphabetic and numeric characters. The subject had to make true or false statements on the content of the card. The person paying the role of the judge asked if the inscription of the card contained letters or numbers, and finally, the witness had to read the content of the card. If his task was to lie, he had to give false answers, but he had to present his lie as if it was true. The judge participating in the experiment was only to determine whether the witness was telling the truth, only on the grounds of the witness's behaviour, nevertheless, the person supervising the experiment based his opinion on the graphic representation of the subject's respiration. He proved that the cycles of breathing in and out show significant alterations in case of false statements. Harold Burt, Landis and Gulette reproduced and reasserted this experiment several times, and they came to the same conclusions with Benussi's early analyses.[21]

American psychiatrist, Münsterberg has joined the development of the device. He reckoned that the analysis of the measurable physiological changes of the human body – such as pulse, blood circulation, skin resistance and respiration – may assume whether the suspect has conducted the criminal offence or not.[22] In 1908, English heart specialist James Mackenzie has created the ink polygraph[23], analysing the reactions of cardio-vascular patients, the pulse and blood pressure.[24]

## *II. The birth of the modern polygraph*

The device we may really call a polygraph was born in 1921 (although historians mostly define its antecedents as polygraphs, it is only Larson's polygraph that was actually an appropriate device for lie detection). Californian police officer and med student of the University of California, Berkeley, John Larson has fully developed the first modern polygraph that could simultaneously provide readings on blood pressure, pulse and respiration.[25] Larson, often referred as the father of the polygraph has is also credited to develop the test of relevant and irrelevant questions.[26] He'd ask relevant and irrelevant question from the subject during the polygraph examination, allowing only 'yes' or 'no' answers. The relevant question was objecting the conduct of the criminal offense, querying whether the subject has committed the offense. On the contrary, irrelevant questions were not related to the criminal act. The subject's bodily reactions reflecting to the relevant questions allowed him to assume the guiltiness of the subject. In the spring of 1921, Larson has tried the

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[20] John Galianos: Brief History of the Polygraph http://home.total.net/~galcar/html/brief_history_of_the_polygraph.html (downloaded: 16.09.2016)

[21] Szíjártó István: A pszichofiziológiai (poligráf) vizsgálat és eredményeinek felhasználási lehetősége az élet elleni bűncselekmények felderítésében [István Szíjártó: Pscychophysiology (polygraph) examination and the possibilities of using its results in investigating criminal offenses against life] Tansegédlet. Rendőrtiszti Főiskola, Budapest, 1990. pp. 7-8

[22] John L. Andreassi: Psychophysiology. Human behaviour and physiological response. Lawrence Erlbaum Associates, Mahwah, New Yersey, USA, 2007. p. 509

[23] Fred E. Inbau: The First Polygraph. Journal of Criminal Law and Criminology 1953/5, Vol. 43. p. 681.

[24] Kerekes Tamás: A poligráf használatának története fényképeken [Tamás Kerekes: Photographic history of the polygraph]. https://prezi.com/pde5-6t1lf-z/a-poligrafos-vizsgalatok-tortenete-kepekben/ (downloaded: 20.02.2018)

[25] Polygraph/Lie Detector FAQs. International League of Polygraph Examiners http://www.theilpe.com/faq_eng.html (downloaded: 16.02.2018)

[26] David E. Newton: DNA Evidence and Forensic Science. Infobase Learning. New York, 2008. p. 102

polygraph on Berkeley Police Chief, Vollmer and also on the officers. Results of the analyses have convinced Vollmer on the enormous potential of Larson's device. Not much later, he could use the instrument in action, detecting the offender of the theft series committed at the University of California.[27] He was able to identify the thief out of thirty-eight female college students.[28] In the very same year, the polygraph has been used in a San Francisco operation, searching for a missing priest suspected to be killed. In a few days, a local baker has found a body on the seashore, proved to be the missing priest. The witness has shown fascinated interest in the finder's fee. However, the authorities decided to use the polygraph in order to determine, whether the witness had anything to do with the murder, and the device proved a lie. Results were introduced to the interrogated witness who finally confessed the crime.[29]

The forth channel, recording the skins electric resistance was the innovation of Keeler's modern device, very similar to today's polygraph. In 1939, Keeler has connected a galvanograph to the device measuring blood pressure, pulse and respiration. Such instrument was suitable for systematic detection of psychogalvanic reactions. Research on the electrodermal activity has already started in the 19th century. Experiments on bioelectric phenomenon led by Féré started in 1888, proving that human skin shows electric resistance. A weak current electronic installation was connected to the subject forearm, including a galvanometer in the current allowing the measurement of electrodermal activity. According to Jackues-Arséne d'Arsonval's hypothesis the skin's resistance is caused by the stimulus of certain glands.[30] Tarchanoff has connected two randomly chosen areas of the skin with the galvanometer.[31] Organoleptic stimulus or activating the brain generates recordable changes in such small currents.[32] Sticker has discovered galvanometricaly detectable reactions by stimulating the brain in 1897. According to his findings, a change of galvanic electrodermal activity can be detected if the subject is asked questions or is shown images that generate emotional effects (stimulate the emotional responses).[33] In 1907 Veragouth has jointly used this with Jung's verbal association test[34], and ten years later Marston has used this method during lie detection examinations. In 1915, psychology student Marston started to analyse systolic blood pressure symptoms, as the sign of deceptive answers.[35] Marston's device was completed in 1914, measuring galvanic electrodermal activity that can also be caused by the perspiration of the subject's palm. The method was used at the interrogation of spies during

[27] Jim Fisher: The Polygraph Wars. http://jimfisher.edinboro.edu/forensics/polywar1.html (downloaded: 16.02.2018)

[28] Don Grubin – Lars Madsen: Lie detection and the polygraph: A historical review. The Journal of Forensic Psychiatry & Psychology, June 2005/2, Vol. 16. p. 360.

[29] Szlavikovics István Gábor: A poligráf alkalmazásának lehetőségei és korlátai [István Gábor Szlavikovics: Possibilities and boundaries of the polygraph]. In: DRINÓCZI Tímea (ed.): Studia Iuvenum Iurisperitorum, Pécs, 2006. p. 321

[30] Szíjártó István: A pszichofiziológiai (poligráf) vizsgálat és eredményeinek felhasználási lehetősége az élet elleni bűncselekmények felderítésében [István Szíjártó: Pscychophysiology (polygraph) examination and the possibilities of using its results in investigating criminal offenses against life] Tansegédlet. Rendőrtiszti Főiskola, Budapest, 1990. pp. 10-11

[31] Jan Widacki: Discoverers of the Galvanic Skin Response. In: European Polygraph 2015/4. Vol. 9. pp. 213-214.

[32] Szíjártó István: A pszichofiziológiai (poligráf) vizsgálat és eredményeinek felhasználási lehetősége az élet elleni bűncselekmények felderítésében [István Szíjártó: Pscychophysiology (polygraph) examination and the possibilities of using its results in investigating criminal offenses against life] Tansegédlet. Rendőrtiszti Főiskola, Budapest, 1990. p. 10

[33] Nathan J. Gordon: Essentials of Polygraph and Polygraph Testing. CRC Press, Boca Raton, 2017. p. 11.

[34] Christopher D. GREEN: Classics in the History of Psychology. http://psychclassics.yorku.ca/Jung/Association/lecture1.htm (downloaded:16.02.2018)

[35] Henry T. Greely – Judy Illes: Neuroscie-Based Lie Detection. The Urgent Need for Regulation. American Journal of Law Medicine, 2007/2-3. Vol. 33. pp. 385-386

World War I. [36] C. M. Wilson has developed a device for the proper examination of galvanic reactions at Northwestern University's criminalistics laboratory in 1935. Keeler was doing research in the same laboratory as well.[37] The fact that the American intelligence commonly used this method at the POW camps of Western-Germany at the end of World War II. was a significant contribution to the widespread of Keeler's polygraph.[38] In 1948 Keeler established the world's first polygraph academy in Chicago, where numerous representatives of later prominent polygraph experts could learn the knack of handling the examination.[39] Further development of the polygraph's querying techniques concentrating exclusively on the variation of relevant and irrelevant questions is another one of Keeler's breakthroughs. He invented the card test, during which the subject had to choose one card and he would identify the card picked by the subject by using the polygraph.[40] The card test demonstrated and convinced the examinee that he can be identified.[41] Keeler has successfully used polygraph in several cases, for example, he'd examine suspect Virgil Kirkland amongst others, whereas the results of examination confirmed that he'd killed his sweetheart Arlene Draves.[42] He'd also use the device in Joseph Walker's case, a murderer of an eighteen year old girl.[43] Keeler's fame has further developed by his examinations of American army soldiers accused by conduction criminal offenses after World War II.[44], and as the result of his tests a couple dozens of suspect were acquitted.[45] For Keeler' polygraph, it is now generally accepted, that in order that an instrument may be employed as a polygraph, it must possess a minimum of three units each measuring distinct biological parameters – a pneumograph (a unit measuring the volume changes of respiration), a sphygmograph (a unit measuring the changes of blood pressure) and a GBR (a unit measuring the electric resistance or conductivity of human skin).[46]

In 1945, Reid has added another channel to Keeler's four-channel polygraph, so the device was able to measure muscle activity as well. Reid has created a special armchair that could sense and measure the motions of the subject's arms and legs. However, he discovered that voluntary muscle activities may effect the figures measured.[47] Reid has further developed Keeler's questioning techniques and established the (modified) general question test in 1947,

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[36] Par Anders Granhag – Leif A. Strömwall: The Detection of Deceit. In: Richard N. Kocsis (Ed.): Applied Criminal Psychology: A Guide to Forensic Behavioral Sciences. Charles C Thomas Publisher. Springfield, 2009. p. 110

[37] Jennifer Devroye: The rise and fall of the American Institute of Criminal Law and Criminology. The Journal of Criminal Law & Crimonology, 2010/1. Volume 100. p. 30

[38] A. M. Larin: Polygraph and personal rights in criminal procedures, Magyar Jog (Hungarian Law), Vol. 29, issue 4, April, 1982, p. 354

[39] Andryi Volyk: History of the Polygraph. http://www.argo-a.com.ua/eng/history.html (downloaded: 20.02.2018)

[40] Ken Alder: The Lie Detectors. http://www.kenalder.com/liedetectors/portrait.htm (downloaded 16.02.2018.)

[41] Ken Alder: America's Two Gadgets Of Bombs and Polygraph. The University of Chicago Press on behalf of The History of Science Society Isis 2007/1. Vol. 98. p. 127.

[42] Kirkland loses 'lie detector'. The Pittsburgh Press, 1931/325. Volume 47. 21 May 1931. p. 3

[43] Kerekes Tamás: A poligráf használatának története fényképeken [Tamás Kerekes: Photographic history of the polygraph]. https://prezi.com/pde5-6t1lf-z/a-poligrafos-vizsgalatok-tortenete-kepekben/ (downloaded: 20.02.2018)

[44] BSZKI Poligráfos Vizsgálati Osztály: A poligráf rövid története [BSZKI Polygraph Research Department: Short history of the polygraph]. http://www.bszki.hu/page.php?556 (downloaded: 19.09.2016)

[45] Árpád Budaházi: Conditions and Requirements of Polygraph Examination. European Polygraph 2012/3 (21) p. 162

[46] Agárdi Tamás – Kármán Gabriella: A hazugságvizsgálatról más szemmel [Tamás Agárdi – Gabriella Kármán: Lie detection from another angle]. Belügyi Szemle, Vol. 47, 1999/10. p. 92

[47] John Galianos: Brief History of the Polygraph http://home.total.net/~galcar/html/brief_history_of_the_polygraph.html (downloaded: 16.02.2018)

a breakthrough in the methodology of polygraph examinations.[48] Reid placed a so-called control (comparison) question in between the sequence of previously varied relevant and irrelevant test format, exploring the examinee's past, whereas not denying undesirable for the subject, therefore he is expected to deny the conduct of the given offense (for example, have you stolen anything during your previous employment?). The expectation is that innocent examinees's bodily reactions will be stronger to control (comparison) questions than to critical (relevant) questions, consequently, it is unlikely that he's conducted the offense subject to the polygraph. Nevertheless, there is a risk that poorly drawn-up control questions will not have any effect on the examinee, thus he will react to the critical question related to the conduct of the offense more strongly, even if he is not the actual offender.[49] Such anomalies may occur if examinee otherwise admitting occasional consumption is asked whether he's involved in trading (otherwise denied by the subject).[50] Should the polygraph examiner be wrong to assume that the examinee is not only a consumer but also a drug dealer and asks the wrong control question, the examinee may give more intense reaction to the question on the robbery than the control question on trading drugs. This may easily lead us to the conclusion that the otherwise innocent examinee is the offender. Consequently, it is priority that the polygraph examiner should ask the proper control questions.

*III. Polygraph developments in the second half of the 2th century*

In 1959, David Lykken established the Guilty Knowledge Test (GKT).[51] The initial of the test is the assumption that there are elements of the criminal offense only the perpetrator may be aware of. The sequence of questions contain both critical and neutral questions, for example, in case the investigating authority is aware of the fact that the victim has been poisoned, such killing method shall be subject to critical questions, while other possible ways of taking life such as strangling, shooting or stabbing the victim shall be mentioned amongst neutral questions. The sequence of test questions is applicable if the examinee denies to have committed the offense or denies to have any knowledge on the killing method. The fact that the subject reacts to strangling as the way of murdering the victim may presume that that the perpetrator is being examined. It can be further confirmed by the results of the general questions test, if the examinee reacts to the question whether he is the perpetrator of the criminal offense or not. Both the general questions test and the GTK sequences are universally used methods of polygraph examinations. Possible risk factor to the Guilty Knowledge Test is represented by the following example, the examinee does not react to the question referring to poisoning for did not commit the criminal offense, but he conceals the information that the victim has been poisoned learned from his associates from the investigating authorities (thus knowing the killing method from someone else makes him react to critical questions).

[48] William G. Iacono: Encouraging Encouraging the use of the Guilty Knowledge Test (GKT): what the GKT has to offer law enforcement. In: Bruno Verschuere – Gershon Ben-Shakhar – Ewout Meijer (Eds.): Memory detection: Theory and application of the Concealed Information Test. Cambridge University Press. Cambridge, 2011. p. 13

[49] Árpád Budaházi: Testing Procedure of the Polygraph Examination. Studia Iurisprudentia 2015/1. https://studia.law.ubbcluj.ro/articole/2015 (downloaded: 22.02.2018)

[50] David T. Lykken: The GSR in the Detection of Guilt. Journal of Applied Psychology 1959/6. Vol. 3. p. 385

[51] James Allan Matté, Forensic Psychophysiology Using the Polygraph: Scientific Truth Verification – Lie Detection. J.A.M. Publications, Williamsville - New York, 1996. p. 420

With regards to its present practice[52], we must further recognise Celeve Backster's numerical analysis[53], first introduced in the 1960-ies, using numerical scores as polygraph units to define if the examinee genuinely denies to have committed the criminal act or having any information on the case. Joseph F. Kubis, researcher of Fordham University, New York, was first to use computer applications examining the polygraph results at the end of the 1970-ies. Kubis expected objectivity from computerised polygraph analysis.[54] It was the beginning of the change of eras when the path of inventions has taken analogue polygraph measures to become digital devices. Starting in the early 1980-ies, John C. Kircher's and David C. Raskin's surveys on computerised polygraph have led to the development of the Computer Assisted Polygraph System at the University of Utah by 1988, including the first algorithm used for evaluating psychological data collected for diagnostic purposes. By 1992, polygraph has officially stepped into a new era, the era of computers, whereas modern digital technology replaced the analogue devices[55]. Lafayette polygraph system has topped the markets from the beginning[56], we may further state that no significant changes in the system can be reckoned since 1992, of course, the modernisation of the device and the related software is continuous, however, more considerable changes characterised the previous decades.

*IV. Methodical changes of the polygraph examinations*

Besides the device, the analytical methodology has also gone through a major development. Closed responses (yes / no) have remained fundamental until today, but the examination methods have changed significantly. At the early stages, tests containing relevant and irrelevant questions were common, even Larson's polygraph examination of 1921 used relevant and irrelevant questions, but upon Reid's innovation in 1947 the control questions were included in the test sequences, making the system of general question test the ground of polygraph investigation, resulting in a much more efficient analysis. Lykken's Guilty Knowledge Test of 1959 has further increased the efficiency of the method, allowing the identification of the perpetrator when using the polygraph to detect whether the examinee has any information on the circumstances of the committed criminal offense only possibly known by the perpetrator, also assisting the investigators to obtain further information previously unknown by the authorities. For example, on the location of the missing body, whereas the polygraph examiner detected the geographical location where the body was buried upon the bodily reactions of the examinee. Thanks to Keeler's researches, the card test became part of the methodology from the 1920-ies, however, it is somehow forced back, even in Hungarian practice, to the benefit of a longer interview preceding the investigation. Furthermore, control questions were replaced by comparison questions in the general question test, parallel to the entering of the score method assuring the objectivity of the examination, as it also reached Hungary in the past few years. Polygraph examinations grew mature and became a well-established method in the past more-than-one century, nevertheless, the innovations will continue for technological development. It is enough to refer to technological innovations of

[52] Don Grubin – Lars Madsen: Lie detection and the polygraph: A historical review. The Journal of Forensic Psychiatry & Psychology, June 2005/2, Vol. 16. p. 361

[53] James Allan Matté: Forensic Psychophysiology Using the Polygraph: Scientific Truth Verification – Lie Detection. J.A.M. Publications, Williamsville - New York, 1996. p. 420

[54] Ken Alder: The Lie Detectors. http://www.kenalder.com/liedetectors/portrait.htm (downloaded: 16.02.2018)

[55] Kerekes Tamás: A poligráf használatának története fényképeken [Tamás Kerekes: Photographic history of the polygraph]. https://prezi.com/pde5-6t1lf-z/a-poligrafos-vizsgalatok-tortenete-kepekben/ (downloaded: 20.02.2018)

[56] Farkas László: A tudományos grafológia néhány területe [László Farkas: Some areas of scientific graphology]. Pécsi Határőr Tudományos Közlemények, IV. 2005. p. 243

medical equipment in the 19th and 20th centuries, to the researches and observations on the physiological changes of the human body, leading to modern lie detection devices such as the modern polygraph on the one hand, while the challenges of combating terrorism or organised crime require further development of questioning techniques, for example, for it's necessary to define the types of questions that can successfully be asked in order to identify a person who can be associated with a terrorist or an organised criminal group, or detecting a suspect trying to infiltrate into a governmental institution. There's no doubt that such assessment tests used for filtering go far beyond general criminal procedures, yet, they do require continuous development likely to the polygraph measures used in criminal proceedings. Presumably, the device will not go through considerable changes, similarly, the system of questioning techniques will not change significantly either, since the polygraph method is approved and well established today.

*V. Introduction of graphometer as the alternative of the polygraph in Hungary*

Primarily used by the intelligence, polygraph was introduced in Hungary in the 1970-ies, however, it has been used in open criminal procedures by the 1980-ies. The method was already known and commonly used when forensic expert of graphology László Szidnai and computer engineer András Kiss have developed graphomter in 1994.[57] Graphometer is a computer supported graphology based method developed parallel to the worldwide introduction of computerised polygraph. However, contrary to the polygraph, the graphometer does not measure physiological changes, for it is connected to a digitalised tablet and a special pen, capable of recording pressure figures of the moment and forwarding such date for further processing to a computer. The examiner of the graphometer collects information on the vibration of the pen, the speed and amplitude of the motions. During the maximum twenty-five minute examination, the device records 125 positions of the pin of the pen on the tablet and above it up to a certain height per second, furthermore, it records 600 measured data per second on the pressure of the pin of the pen in a fine resolution determined in grams.[58] This is considerably more information than anything expected from the measures of classic graphology at the present, that is why co-authors Tamás Agárdi and Gabriella Kármán believe that notwithstanding to the measures and achievements of classic graphology enabling authorities to detect general or – in case of certain question – situational deception of the examinee, 'computerised graphology increase the precision of the method'.[59] Computers help to increase and fasten the number of precisely specified and measurable parameters of writing.[60]

Fundamentally, the graphometer analyses the level of the specific experience, whereas the experience can already be pictured through the micro-motoric motions in the air before actually writing the answers to the questions, it can also appear and be detected in between motions, that is if contradictory to the written pictogram, can be understood as the sign of deception. Contray to the polygraph, the subject does not give a 'yes' or 'no' answer to the questions asked, but draws a pictogram of a circle or triangle, namely, first a triangle, than when the question is asked for the second time (control examination) draws a circle on the

[57] Farkas László: A tudományos grafológia néhány területe [László Farkas: Some areas of scientific graphology]. Pécsi Határőr Tudományos Közlemények, IV. 2005. pp. 244-245

[58] Agárdi Tamás – Kármán Gabriella: A hazugságvizsgálatról más szemmel [Tamás Agárdi – Gabriella Kármán: Lie detection from another angle]. Belügyi Szemle, Vol. 47, 1999/10. p. 93

[59] Fenyvesi Csaba: A kriminalisztika jövőbeli fejlesztési lehetőségei, kihívásai [Csaba Fenyvesi: Future development potential and challenges of criminalistics]. Pro Futuro, 2013/2 p. 53

[60] Ferentzi Tünde: Tökéletes hazugságvizsgáló? [Tünde Ferentzi: Perfect lie detector?] Zsaru Rendőrségi Magazin, 2011/12, p. 23

piece of paper place above the digital tablet.[61] At different levels of experience the actual experience means that the examinee was actually present at the given event and his memories, his brain control immediately project this fact from the territories of his unconscious through the motion he made in the air. During the 'lived-by' experience the examinee projects the pictures of a memory, detectable after the numeric phase and prior to the pictogram recording the exact, conscious answer. Should he mark a period or comma after the number, such sign can be detected in the surroundings of the period or comma sign in the motion carried out in the air. If there is no sign in this stage, it indicates that most probably he does not have a lively experience. In case of a true, 'lived-by' experiment, his memory projects s conscious answer, upon which the examinee marks his answer of conscious deception in the form of a visible and stressful pictogram, or he is trying to escape from his experience earned in an undesired situation. At this stage, it possible that the examinee was present at the location or at the given situation, yet, he did not actively participate in the action, he only 'witnessed' the criminal offense. According to the examiner, the actively experienced, the 'lived-by', and even the 'lived-through' experiences can differentiated using the graphometer.[62]

Prevalence and awareness of the graphometer is far from polygraph's visibility. The lack of its foreign practice is another obstacle to widen its acknowledgement. Contrary to polygraph, since the results of validation experiments are still not summarized, this method is not validated yet, the applicability or non-applicability of the method entirely relies on professional experience. Nevertheless, we must speak about experience, since graphometer has played a significant role in a couple hundreds of criminal cases, and experiences proved that it stood up to the requirements of sound credibility examination, hence it could not only identify the perpetrator but likely to polygraph examinations, it could also induce admission statements. Without any serious developments the parameters of the special pen, the digital surface and the software remained steady, nevertheless, there are some minor modifications regarding the methodology of the analysis. However, we do not expect any considerable modernisation of the graphometric lie detection examination.

### *VI. Layered Voice Analysis*

Layered voice analysis (henceforth LVA) has been developed by the Israeli company Nemesysco in 1997. The device provides analysis on a voice segment level, determining whether the speech segment was at low risk or high risk of being deceptive.[63] Vocal cords channel traces of brain activity, and LVA is capable of picturing changes of the voice minute by minute, it detects and classifies the anomalies and alterations in terms of stress, excitement, confusion, deception and other relevant emotional states. Fundamentally, the method is based on the presumption that lying is a result of a deep logical process executed in the brain with the particular intention of deception. LVA is capable of detecting the associated intention behind deception and lies.[64] Focusing on the development of the method, we must first

[61] Farkas László: A grafométer az írásanalitika alapműszere [László Farkas: Graphometer, fundamental instrument of writing analysis] https://www.irasanalitika.com/ujdonsagok/grafometeres-hazugsagvizsgalat (downloaded: 21.02.2018)

[62] William J. MAYEW – Mohan VENKATACHALAM: The Power of Voice. Managerial Affective States and Future Firm Performance. Journal of Finance Forthcoming, January 20, 2011. p. 10

[63] ANIMA Polygraph's organisational and human security risk analyst technology http://www.polygraph.hu/hangelemzes-szervezeti-human-biztonsag-kockazatelemzo-technologia.html (downloaded: 22.02.2018)

[64] Budaházi Árpád: Poligráf. Műszeres vallomásellenőrzés a bűnügyekben [Árpád Budaházi: Polygraph. Instrumental credibility examination of testimonies in criminal cases]. NKE Szolgáltató Kft., Budapest, 2014. p. 226

concentrate on modernisation, namely on software developments, since technically there is only a microphone is attached to the LVA voice analysing system. On the path of its development, we must note that the method has reached the areas of law enforcement form its original grounds of human protection and human resources, whereas experts confirmed its benefits in criminal proceedings at the interrogation of witnesses, for example, to define which one of the witnesses possess the most relevant information on the conduct of the criminal act. However, it may mislead the investigation if the witness unwillingly adds fictional sequences of his own imagination into his testimony, and represents the story as if it actually happened. Should the method be suitable for choosing the appropriate witnesses, it could make the investigation much faster and efficient. Furthermore, the device is expected mark the moment when the subject *'can be broken'* during the interrogation in order to make a confession. Experts also believe that the device is suitable to evaluate the state of the investigation and to determine whether the investigating authorities should wait for further relevant and sincere data.

Apart from other devices, it is the benefit of LVA that it does not require neutral surroundings, and the number of persons present at the examination is also irrelevant. While closed questions and closed answers *('yes', 'no')* define the polygraph credibility examination, also the computer graphometer and the graphometric analysis, there are no such restrictions at the voice analysis, therefore, it's allowed to speak coherently, also, there are no restrictions related the person controlling the conversation, thus even the member of the authority may query the subject. Consequently, LVA is more likely to be related to interrogation than any other instrumental method.[65] However, it is a problem that LVA cannot be considered as a sufficiently validated method, nevertheless, the fact that LVA is being used in several countries is definitely an advantage compared to the graphometer's practice, however, even in foreign countries its significance falls well short of the polygraph's publicity.[66]

Examining the relations of LVA and polygraph we may find that LVA might be capable to narrow the range of persons where further exploration of polygraph examination is needed, thus the method identifies the sequences in the examinee's statement that assume deception. In such cases the cause of a lie might be examined by the polygraph. However, there is risk that the questions taken at the LVA analysis narrow the possibilities of using the polygraph, since the questions may suggest information related to the case that might make it impossible to compile the question series of the Guilty Knowledge Test (take note that it may apply to the graphometer analysis prevailing polygraph examination). Should the examinee state that he is aware of the fact that the victim has been poisoned, the sequences related to the way of murder can not be applied.

LVA method has both an online and an offline version. For example, the online version might be suitable for the orientation of the interrogation (however, it is impossible in Hungary, since it is not used during interrogation). In case of the offline version, the proceeding expert analyses the conversation and summarizes the results retrospectively.

[65]Budaházi Árpád: Poligráf. Műszeres vallomásellenőrzés a bűnügyekben [Árpád Budaházi: Polygraph. Instrumental credibility examination of testimonies in criminal cases]. NKE Szolgáltató Kft., Budapest, 2014. p. 226

[66] Árpád Budaházi – Zsanett Fantoly: Instrumental Credibility Examination of Testimonies in the New Criminal Procedural Code. Jogelméleti Szemle 2017/4. p. 14

*VII. Brain fingerprinting*

We might see brain fingerprinting as the future method of credibility examinations. Fundamentally, the method relies on the fact that human brain stores memories, and the events of exaggerated stress – like conducting a criminal offense – are fixed stronger in the memory. *Lawrence A. Farwell* has discovered a *'MERMER'* frequency in the brain, one of the elements of the greater brain frequency known as P300. According to *Eszter Póczos 'much more accurate results can be achieved in the field of mapping brain activities with the help of the new brain frequency.'*[67] EEG (electroencephalogram) sensors are used in the analysis to detect the electric brain functions of the subject generated by various external stimulus. In case of a *MERMER* response the examiner concludes that the information connected to the effect is stored in the subject's memory. On the contrary, irrelevant stimulus does not result in a *MERMER* response.[68] In other words, the method of brain fingerprinting is similar to the approach of Guilty Knowledge Test, however, instead of questions it uses pictures, and the question is whether the examinee recognises the critical picture or not. The premiss of brain fingerprinting used during a criminal procedure is that only the perpetrator's brain would produce a MERMER response, since he is the only person with detailed information on the criminal offense. On the other hand, the person who really does not know anything about the conditions of the criminal act, since did not conduct such action will not produce any MERMER response.[69]

Being under development is definitely the handicap of the method, its introduction takes time, moreover, further validation tests are required besides the fact that the method itself needs to be further adjusted. Farwell has only used brain fingerprinting method in three criminal cases in the US. Out of these three cases, it was only Terry Harrington's criminal suit where it was referred before the court. However, the court has established its position on the admissibility and acceptability of brain fingerprinting as an evidence in this particular case. Iowa District Court denied the appeal on legal grounds in 2000 and stated that brain fingerprinting has an evidentiary nature, since its scientific fundaments are beyond doubt. However, Harrington has filed an appeal against Iowa District Court's decision in 2001, and the Supreme Court of Iowa granted Harrington a new trial.[70] Although the Supreme Court if Iowa was undoubtedly aware of Farwell's expert opinion based on brain fingerprinting, the breach of Brady doctrine has brought remedy to Harrington, namely, the defendant was not confronted with the state attorney's chief witness since he has withdrawn his testimony, after gaining knowledge about the results of brain fingerprinting concluded on the defendant. In the lights of the new evidence and with regards to the fact that the witness testifying in the first degree case has withdrawn his testimony, there was no ground of conviction, so Harrington was released in 2003 without re-trial, vacating his conviction and sentence. He's received a remedy of USD 12 Million for the years he' has spent in jail.[71]

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[67] Póczos Eszter: A hazugságvizsgálat jövőképe [Eszter Póczos: Future vision of lie detection]. Belügyi Szemle, 2006/5. p. 102

[68] http://www.larryfarwell.com/Chemistry-dr-larry-farwell-brain-fingerprinting-dr-lawrence-farwell.html (downloaded 22.02.2018)

[69] Sarah E. Stoller – Paul Root Wolpe, Emerging Neurotechnologies for Lie Detection and the Fifth Amendment. American Journal of Law Medicine, 2007/2-3. Boston University School of Law. p. 362

[70] Harrington v. State, 659. N.W.2nd 509 (Iowa 2003)

[71] Farwell: Brain Fingerprinting Ruled Admissible in Court. Innocent Man Freed After 24 Years in Prison. http://www.larryfarwell.com/Harrington-Summary-dr-larry-farwell-brain-fingerprinting-dr-lawrence-farwell.html (downloaded 22.02.2018)

The method was used in 1999 in James B. Grinder's case during the investigation. Finally, the procedure was closed with a plea deal.[72] During the investigation, Grinder was shown the murder weapon, specific methods of killing the victim, the object the perpetrator used to bind the victim's hands, the crime scene and the belongings of the victim found not far from the location of the offense after discovering the criminal act. According to the results of the brain fingerprinting test all this information was stored and present in Grinder's brain.[73] Aware of the conclusions of the analysis Grinder was facing certain conviction and a death sentence. He pled guilty to rape and murder of the victim, and he agreed to conclude a plea deal, and in exchange - instead of death penalty - he agreed to a life sentence without parole. He is currently serving his lifelong penalty and he is recklessly filing requests for clemency. Uniquely, in this case Grinder did not only confess murdering victim Julie Helton, but after the brain fingerprinting examination he gave detailed confession to the murder of three more young girls.[74]

The court proceeding in Jimmy Ray Slaughter's criminal case ruled that brain fingerprinting was not admissible as evidence. Convict Jimmy Ray Slaughter facing a death sentence have plead for new trial referring to the test result of brain fingerprinting and other evidence at the Court of Criminal Appeals of Oklahoma in 2004. The appealer did not only refer to the beneficial results of brain fingerprinting, but also referred to the exempting results of DNS analysis and further evidence proving his innocence. The court denied the appeal of the convict on the death row, referring to issue of brain fingerprinting as well, denying its admissibility in criminal procedures. According to the ruling, there was not enough information on the new method that would allow its admissibility as evidence.[75]

With regards to development, brain fingerprinting is a young technology of considerable potential used by for example, the FBI and CIA in the US, however, it has not much account in criminal procedures yet.

## *VIII. Concluding remarks*

Besides the polygraph, both LVA and graphometer is suitable for human risk analysis and assessment, and admission tests, moreover, their admissible in criminal procedures, during the investigation as well. However, polygraph is the only adequately validated method, consequently its publicity and acknowledgement is broader that of other techniques. However, its maturity also implies that there is less need for its further development, and the same applies for the likely mature graphometer, however, the latter's development has seized earlier. With the coming into effect of the new criminal procedural code (Act XC. of 2017) Layered Voice Analysis will possibly gain more grounds in criminal cases (since the new Act generally allows the admission of instrumental credibility examination breaking up the former exclusivity of the polygraph), thus practice will prove the expectations related to this method. Admission of brain fingerprinting in criminal procedures will take longer, however, it does

[72] Dr Farwell conducts a Brain Fingerprinting test on serial killer J. B. Grinder. http://www.larryfarwell.com/Grinder-Summary-dr-larry-farwell-brain-fingerprinting-dr-lawrence-farwell.html (downloaded 22.02.2018)

[73] Clive Williams: Scanner for terrorism – brain fingerprinting offers new hope for anti-terrorism fight. http://www.smh.com.au/comment/scanning-for-terrorism--brain-fingerprinting-offers-new-hope-in-antiterrorism-fight-20160106-gm08k1.html (downloaded 22.02.2018)

[74] Farwell: Brain Fingerprinting Test Helps to Bring a serial Killer to Justice. www.reddict.com [downloaded 27.01.2018]

[75] Tom Paulson: 'Brain Fingerprinting' Touted as Truth Meter. http://www.larryfarwell.com/Seattle-PI-dr-larry-farwell-brain-fingerprinting-dr-lawrence-farwell.html (downloaded 22.02.2018)

has the potential to become a popular credibility examination technique. Of course, these are only presumptions, nevertheless, it is obvious that law enforcement shall not remain without instrumental measures. Overlooking the past century we may find that proper usage and management definitely assist the authorities participating in criminal procedures.