



Jan Widacki*

Andrzej Frycz Modrzewski Kraków University,
Kraków, Poland

Attempts at Lie Detection Based on Scientific Premises on the End of 19 Century and in the First Half of the 20 Century

Попытки выявления лжи на основе научных предпосылок
в конце XIX – первой половине XX века

Key words: history of lie detection, scientific basis of lie detection

1. The word associated test

In 1892, in the psychological conference, Hugo Münsterberg expressed the belief that it is not a lie that is detected, but the emotions that accompany it (Burt 1965). The **Word Association Test** proves that the reactions accompanying a lie consist not only of emotions but also a certain intellectual effort, necessary on behalf of the lying person. It goes without saying and is supported by Trovillo (Trovillo 1938/39) that the first to have described the essence of a test using word associations was Francis Galton (1822–1911) in 1879 (Galton 1879). Later some other researchers, notably Wilhelm Wundt, Max Wertheimer, and Melanie Klein, but also Carl Jung, conducted experiments with the test and tried to use it to justify their theories and hypotheses (as ex-

* jan.widacki@gmail.com

plained below). The assumptions of the word association test are as follows: there is someone suspected of having assaulted a woman in a park, snatching her handbag and terrorising her with a knife, and now denies it, claiming that he not only made no assault but moreover knows no circumstances of the event. A special list of clues that include such words as “knife”, “park”, and “handbag” is drafted for him. Then the suspect is instructed that as the list will be read out to the suspect, who is supposed to answer immediately with the first word that comes to mind on hearing it. Reading the cues one by one, the experimenters measure the time after which the subject uttered the word associated with the cue. In advanced laboratory experiments, both of the researcher and the subject spoke to the so-called sound key, in which the airwave produced by the utterance broke an electric circuit, and the sound key was connected to a timer. In more primitive cases, time was measured with a stopwatch. It was assumed that on hearing “the critical words” (in this case, “knife”, “park”, and “handbag”) the person who lies saying that he or she does not know the details of the event will take a longer time to build associations than in the case of the remaining cues. That extension of the reaction time is caused by the subject’s self-control, as they control themselves so as not to “spill” some information. Briefly speaking, in case of the critical queues, a liar (deceptive person hiding information) is forced to a greater intellectual effort, which firstly extends the time of response in a way automatically, and secondly calls for mobilisation of the attention and increases the activity of the organism.

Udo Undeutsch informs that late in the 19th century Professor Hans Gross (1847–1915), a pioneer of criminalistics, at the time lecturing at the German University in Prague, presented students with novelties from literature in the field and also told them about Wundt’s work on the verbal associations test. One of his students was Max Wertheimer (1880–1943), who took interest in the test of verbal association, recognising it a perfect tool for identification of the perpetrator. Wertheimer became so much hooked on forensic psychology that he abandoned his legal studies to enrol into the Department of Philosophy and study psychology. In 1906 he defended a doctoral dissertation devoted among others to the verbal association test at the University of Würzburg.

At the same time a Swiss psychiatrist, Eugen Bleuler (1857–1939), known especially for coining the term “schizophrenia”, applied the word association test to check whether there are differences in word associations between sane and insane individuals (Undeutsch 2007). One of his assistants was Carl Jung (1875–1961), who, influenced by Bleuler, tried (together with Franz Riklin) to use the word association test to verify empirically some claims of Freud (Jung, Riklin 1905). Thus, the word association test was used mostly in psychology and psychiatry, to test memory, the subconscious, and associations in both sane and insane individuals. However, Jung improved the test for forensic purposes and used it himself successfully in two criminal cases.



Fig. 1. Carl G. Jung

A Russian physiologist, Alexander Luria (1902–77) complemented the method of lie detection with the use of verbal association by the simultaneous studying of involuntary movements of fingers. Luria believed that a lie entails the conflict of two reactions. Answering a verbal hint (stimulus), the subject selects a true or false word. Luria believed that such a conflict disorganises the subject's behaviour, and therefore that it would be enough to find a simple behavioural scheme that will be disorganised. Luria made his subjects press a key (a rubber bulb connected to a sensor) at the time of uttering the associated word, holding the other hand on an identical key. Both the keys were so constructed that they recorded not only the main presses, conscious and purposeful, but also all the changes in the pressure. In this way, Luria registered not only the time of reaction (extended after the critical cues, i.e. connected to the event) but also the uncertainty and hesitation of the subject, manifested in the change of the force with which the key was pressed (Luria 1932).

2. First attempts at instrumental lie detection based on the observation of physiological correlates of emotions

2.1. Lie detection based on plethysmograph indications

The plethysmograph was one of the first instruments constructed to observe and measure the changes in the volume of the body resulting from the changes in blood supply. The first plethysmograph (hydroplethysmograph) was, constructed by Angelo Mosso, and made use of the comments of Karl Ludwig. It is also known that Mosso's experiments and devices were used by Cesare Lombroso for his purposes, as he also tried to prove empirically the hypotheses about the physiological distinctiveness of born criminals. It is not aware of any experiments in lie detection using this device.

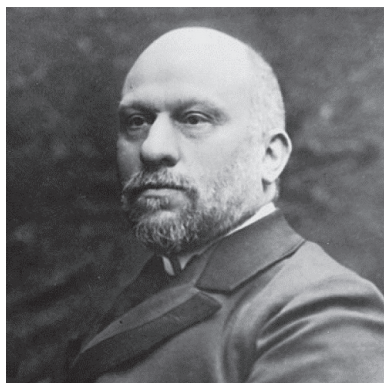


Fig. 2. Angelo Mosso

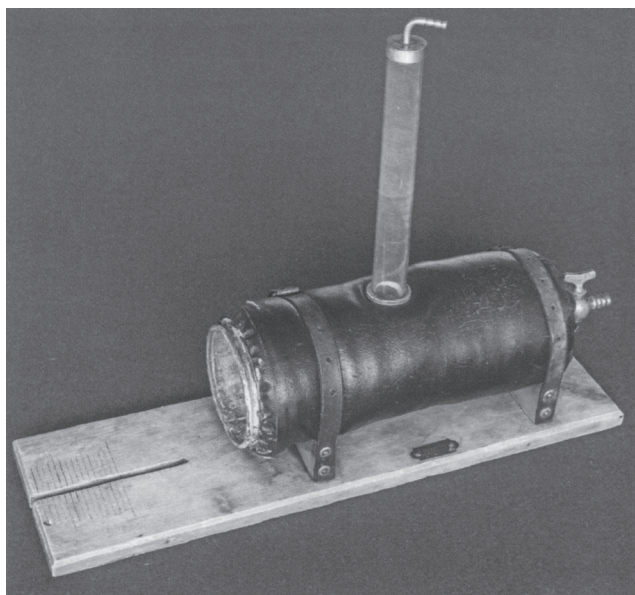


Fig. 3. Hydroplethysmograph (Jagiellonian University Museum)

Should one believe Lombroso's daughter, Gina L. Ferrero, in March 1902 Lombroso interrogated, or perhaps just questioned, a suspect and observed his reactions with hydroplethysmograph in a case concerning the killing of a six-year-old girl. Gina claims that Lombroso used a plethysmograph to observe the suspect's reactions while being shown a photograph of the victim. On these grounds, Lombroso is believed to pass a judgement about the suspect's innocence. Gina Ferrero quotes this information in the introduction to the English translation of Lombroso's fundamental work *The Criminal*

Man. Lombroso himself mentioned the use of the hydroplethysmograph in another case, which concerned the forced entry and stealing of 20,000 francs (Ferrero 1911). Still, the date of that case remains unknown. The information was publicised in the work of P.V. Trovillo entitled *History of Lie-Detection* and is most often mentioned in the context of that work. I have found no other published sources quoting more detailed information on the subject, and especially corroborating the information given by Gina Ferrero.

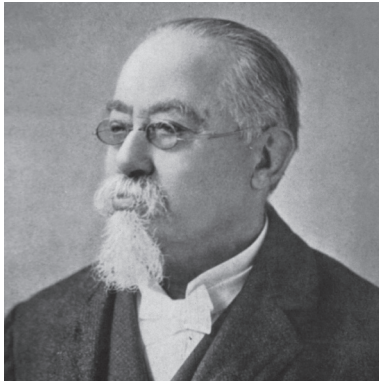


Fig. 4. Cesary Lombroso

2.2. Attempts at detecting lies based on changes in the breath

Beginning from the 19th century two methods of recording the breathing functions have been known. The first consists in the measuring of the volume of the inhaled and exhaled air, and the latter on the measuring of changes in the circumference of the chest or diaphragm. The volume of the exhaled air is measured with spirometers, and in turn the measurements of the changes in the circumference of the chest or diaphragm are performed with pneumographs.

The first are primarily used for medical diagnosing, as they allow observation and recording of the volumes of the air going in and out (inhaled and exhaled) and also the breathing rate. Pneumographs found application primarily in psychophysiological examinations. Moreover, in the latter half of the 19th century, pneumograph was connected with a kymograph, which allowed to obtain complete recordings of breathing functions. Such a recording reflected the breathing rate (the number of breathing cycles: inhalation – exhalation per unit of time) and the depth of breathing measured with the amplitude of breathing, and made it possible to compare the duration of the inhalation and exhalation.

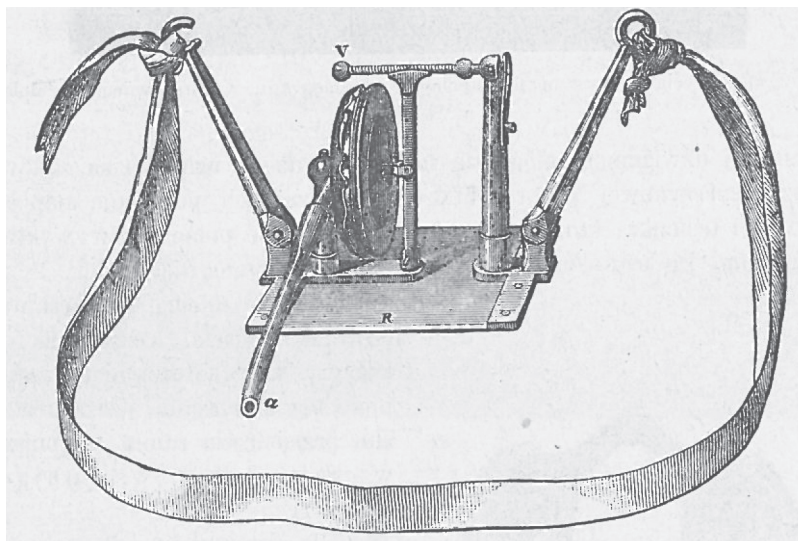


Fig. 5. Pneumograph (N. Cybulski, 1891)

Experimental studies, conducted by physiologists and psychologists (among others Angelo Mosso in Torino, Vittorio Benussi in Graz, and Edward Abramowski in Warsaw) in the late 19th and early 20th centuries proved a link between changes in the activity of an organism and the changes in the process of breathing captured in the recording. Today, knowing the physiological mechanism of emotions, we can explain and justify this link. The first observations of changes of the pneumographic recording under the influence of strong emotions (fear) were observed and described by Mosso (Mosso 1891, 100). He believes that the first breath after receiving the stimulus as a rule becomes deeper (Mosso, 1891, 100). This is followed by an intermission in breathing, after which the breath speeds up.

Abramowski found recurring changes following such stimuli as noise, touch, sudden flash of light, and sound, while similar changes were present when the subject solved tasks or “strained imagination” (Abramowski 1913, 89). In turn, Rehvoltd described the speeding up and deepening of breathing in excitement. Other researchers operating later also discovered changes in the course of breathing caused by the impact of various stimuli (Rehvoltd 1911).

The studies by E.E. Blatz (Blatz 1925) proved that the emotion of fear slows down the pace of breathing from the average 14 cycles a minute to 11. He also noted that if the fear-inducing stimulus occurred at inhalation, it was extended, yet if it occurred during exhalation, the egress of air was interrupted to allow inhalation to begin. The recording

of breathing functions made it possible to determine not only their qualitative shape of the curve but also its quantitative assessment. Besides the frequency of breathing, it also made it possible to measure its amplitude, duration of the inhalation and duration of the exhalation, and in consequence, to count the ratio between the inhalation and exhalation. That proportion is known as the “Störing’s breathing ratio” (Störing 1906). If I denotes the duration of an inhalation and E – the duration of exhalation then Q (breathing ratio) equals I/E .

Vittorio Benussi, an Italian working at the University of Graz, was the first to try to use the assessment of the recording of the breath for lie detection (Benussi 1914).



Fig. 6. Vittorio Benussi

His experiment consisted in presenting the subject with multiple sheets of paper with letters and numbers written on them in certain special positions. There was also a sheet with a drawing of a generally known object. Every other sheet also featured a red star. If the subject received a sheet without a star, the task was to describe the placement of the elements on the sheet, informing whether they are numbers or digits, and also stating the number of the elements. The following task of the subject was to read out all the elements according to a predefined order. If there was a drawing on the sheet, the subject was to describe it. If, however, the subject received a sheet with a star, his task was to make up the content of the sheet, and the description was to be entirely false. While the subjects described the contents of their sheets, Benussi used Marey’s pneumograph to register their breathing.

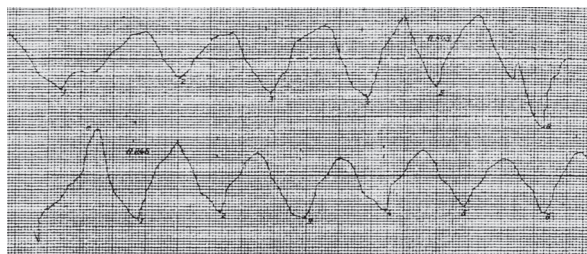


Fig. 7. Recording of the breath performed by Benussi (based on H.P. Huber, *Die Vermessung der Seele*. Psychologische Laborgeräte, UniGraz Museum 2013, p. 28)

The researcher conducted his experiment on 160 people altogether, and was capable of discerning honest answers in 100% and deceptive ones in 97.5% of cases. Benussi discovered that while telling the truth, $Q_v > Q_n$ where Q_v – is the averaged breath coefficient for 3–5 breaths before the statement, and Q_n – an identical coefficient for the breaths following the completion of the statement. In turn, in case of untrue statements $Q_v < Q_n$.

To test whether the changes observed in the breathing functions were caused by insincerity (lie) or perhaps a mental effort caused by the need to change elements of the description, Benussi complemented his studies by repeating the experiment, this time, however, agreeing with the subjects whether they will tell the truth or lie. Even though the mental effort was identical as in the first experiment, the subjects knew that they did not deceive anyone and did not experience the tension whether the lie will out or not. In this experiment, the ratio of Q_v to Q_n ended up as identical with the results in non-deceptive utterances.

Encouraged with his results, Benussi expressed the conviction that his method would be useful in investigative practice. However, the results of other authors who repeated his experiments were far less encouraging (Burt 1921). Only his student, Mussatti, obtained results close to Benussi's (Mussatti 1930). Eager to avoid the artificial quality of the situation developed in Benussi's experiments, Mussatti agreed with the subjects that he would ask them personal questions, and they can answer truthfully or deceptively (i.e. tell the truth or lie). Then the subjects wrote introspective testimonies in which they admitted when they told the truth and when they lied. In 19 series of the experiment, Mussatti was capable of answering correctly when the subjects told the truth and when they lied in 15 cases. Thus, the correct results were obtained in 78.9% of cases. A result still worse than obtained by Benussi, even though the questions which the subjects answered were certainly far more emotion-genic than in Benussi's experiment.

2.3. Attempts at lie detection based on the assessment of changes in the cardiovascular system

Changes in the work of the heart, and the ensuing changes in the entire circulatory system, have long been considered a good indicator of emotional changes. It is not a coincidence that heart was portrayed as the home of all the feelings. Initially, the operation of the cardiovascular system was primarily observed through changes in the pulse, which was the effect and at the same time the indicator of contractions of the heart. The first devices capable of objective observation and registration of the phenomenon were sphygmographs.

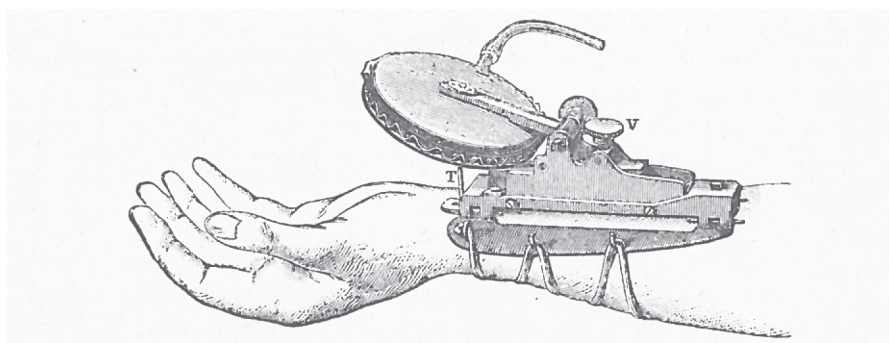


Fig. 8. Sphygmograph (N. Cybulski, 1891)

Changes in blood pressure were another way to observe the work of the cardiovascular system. Measurements of blood pressure began early in the second half of the 19th century. Around 1896 Luigi Riva-Rocci constructed the first device for measuring blood pressure, the so-called sphygmomanometer. The concept of examination with sphygmomanometer is based on balancing the blood pressure with the external pressure of the cuff of the device connected to a mercury-based manometer (or aneroid; today usually digital). When the external pressure, caused by the pressure of the cuff into which air is pumped through a rubber pump matches and slightly exceeds the pressure of the blood in the artery, pulse measured below the cuff disappears. The pressure of air inside the cuff, necessary to offset arterial blood pressure, can be measured with the manometer. The electrocardiograph, constructed by Walter in 1887 to assess the condition of the heart and study its operation, was subsequently enhanced by Einthoven in 1903 (string galvanometer), and later repeatedly perfected (with amplifier tubes and moving mirror introduced in the 1920s). (Kwoczyński 1972). It allows to observe the electric activity of the heart muscle, which has it used for medical diagnostic purposes. However, for psychophysiological purposes, and especially for researching emotions,

sphygmographs were, however, still in use as they registered the pulse (using the sphygmograph), relative oscillations of blood pressure (with the sphygmomanometer), and optionally also changes in blood supply and consequently in volumes of the organs (with the use of plethysmograph).

The first attempts at detecting lies by observing changes in the cardiovascular system were conducted early in the 20th century by an American, William Moulton Marston (1893–1947), a graduate of Harvard University (BA in 1915 and LLB in 1918) awarded a doctorate in psychology (PhD) in 1921.



Fig. 9. William Marston

It is worth remembering that, as a student of Münsterberg, Marston both studied and worked under his guidance in the laboratory of psychology of Harvard University (Krapohl, Shaw 2015). Interested in the issues of lie detection, Marston conducted an experiment with ten students. Their role consisted in playing witnesses asked to defend a friend, who was agreed to have been accused of certain perpetrated crimes. In the experiment, the witness (subject) was to provide the defendant with an alibi, selecting either a true or a made up one. In the experiment, both during the examination and during the breaks in the examination, Marston measured the blood pressure of all the subjects. Out of his 107 indications of “true accounts” and “false accounts” no fewer than 103 were correct, which corresponds to approx. 96% accuracy. Marston realised that the arterial blood pressure of people telling the truth during the examination, i.e. giving true accounts, increased by no more than 5mm Hg. In people who made untrue accounts, the increase in the blood pressure was significantly higher, as on average it amounted to 16mm Hg. (Marston 1917). In controlled experiments, in which Marston had his subjects count, tell stories, etc., no increase in blood pressure was detected. Using this premise, Marston concluded that Münsterberg was right to claim that detection of a lie actually means detection of emotions accompanying it. Emotions, and

not for example, the straining of the mind (Marston 1917). Marston's experiment convinced him and other researchers that changes in the operation of the cardiovascular system are a good indicator of emotional changes accompanying lie, and through this, they are indirectly a good indicator of lie. He also emphasised that a regular blood pressure device is unsuitable for such purpose, yet what could make greater sense is one that would continuously record blood pressure. Beyond doubt Marston's experiments were the proverbial milestone in the instrumental detection of lie.

In 1929 Marston's experiment was repeated by Chappell, yet, with only 87% of correct indications, the results he obtained were slightly poorer. Chappell also made a somewhat different description of symptomatic changes in the blood pressure. In his studies, the arterial blood pressure in people telling the truth during the examination, increased on average by approximately 5mm Hg, and only in some it exceeded 12mm Hg. In the case of liars, the average increase in blood pressure was 19mm Hg, remaining below 18mm Hg only in some individuals. Moreover, Chappell's studies confirmed that changes of pressure were not connected to the lie itself but only to agitation (emotion) accompanying it (Chappell 1929). The researcher recorded no increase in blood pressure whenever the subject lied in circumstances in that his lie caused no agitation (I.e. the subject uttered false sentences without fearing consequences of his lies being uncovered.) as the fact that the subject lied was known to the researcher. Today, this goes without saying: a lie can only be detected when there are consequences for the liar connected to its detection, which is the reason why lies are accompanied by emotions (Burt 1921, 1965, Woodworth, Schlosberg 1966, Widacki, Dukala 2015).

2.4. Attempts at lie detection based on observation of muscular tension and body tremors

Muscular tension and the possible tremors are known to be symptoms of emotions. A special complex device was constructed to observe and measure them.

Early in the 20th century, the University of Graz (Karl-Franzens-Universität Graz) was certainly one of Europe's key academic hubs in what was broadly construed as criminological sciences. The contemporary Graz is often referred to in literature as "the criminological capital of Europe" (Mueller 1957). Enough to recall that the world's first the Institute of Criminalistics (Kriminalistische Institut, Karl-Franz-Universität in Graz) set up by Professor Hans Gross and the psychological laboratory founded by Professor Alexius Meinong (1853–1920), a pioneer of experimental psychology, operated here. One of Meinong's students was Vittorio Benussi, who conducted above-mentioned studies in lie detection with the new pneumograph. In the 1920s, Professor Ernst Seelig

(1895–1955), successor to Hans Gross in his chair of the University of Graz, tested Benussi's method and modified it to suit his needs, recognising it hardly useful for court practice, however (Seelig 1927). It must be remembered that Seelig was a lawyer, holder of a doctorate in criminal law, criminology and criminalistics at the University of Graz (Mueller, 1957), little wonder therefore that he tried to fit Benussi's method to the binding criminal procedure. Aware of its requirements, he decided to develop such a lie detection technique that would be consistent with it.

Seelig proposed his lie detection technique, and tried to use an improved device of a German psychiatrist and neurologist, Otto Lowenstein (1889–1965) for that purpose. Lowenstein was a physician, a doctor of medicine (with doctorate from the University of Bonn obtained in 1914), and a military doctor during the First World War. To investigate psychological shock in soldiers, he constructed among others a special device helpful in distinguishing tremors caused by organic changes from ones caused by psychological trauma resulting from wartime experiences.

The machine simultaneously recorded a number of functions that Lowenstein believed to be manifestations of expression, and therefore helpful in psychiatric diagnosing. Seelig, who had critically examined Benussi's experiment even earlier, decided to use Lowenstein's device in an experiment of his design. For his criminalistic purposes, he adapted both Lowenstein's technique and method. The intended purpose for his device was the registration of the involuntary expressions of experiences, gleaned from the charts of no fewer than six curves (records) drawn in parallel by the kymograph: chest breathing, diaphragmatic breathing, and the relative changes in the position and movement of arms, feet, and head (Seelig 1927).

The subject set on a tall chair with arms suspended by leather belts, with pneumograph sensors girdling the chest and the abdomen at the diaphragm, also recording the movements of the subject's head, arms and feet, and transferring all their movements to the markers of the kymograph. The kymograph itself was placed behind the back of the subject. The styluses of the kymograph drew altogether seven curves on a smoke-blackened sheet of paper stretched on a drum, allowing the experimenter to follow the course of "expression" of the subject.

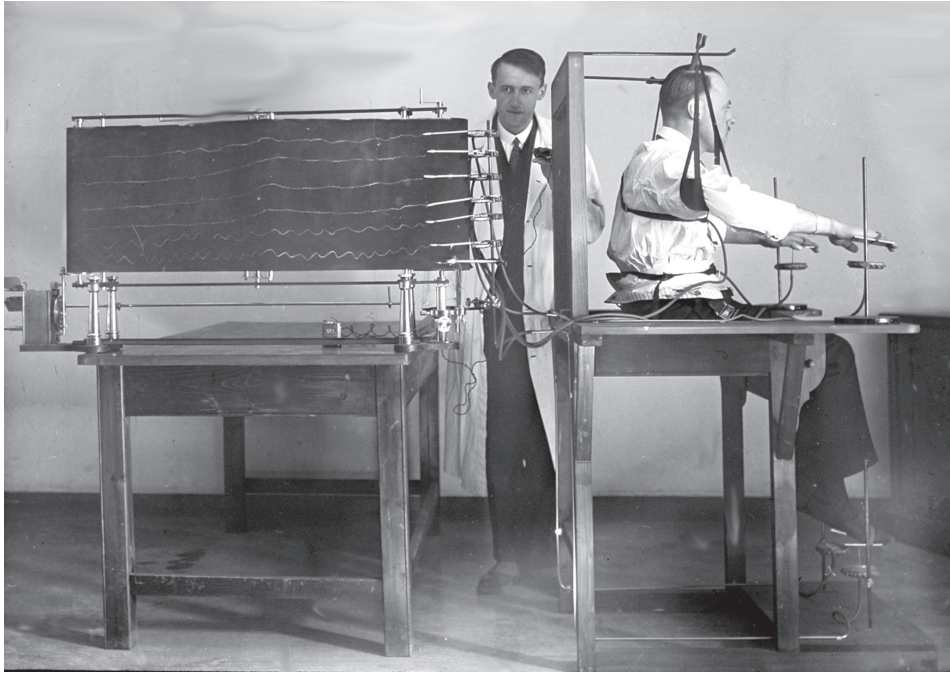


Fig. 10. Lowenstein's device (based on Ch. Bachhiesl, *The Search for Truth by "Registration of Expression". Polygraph Experiments in Graz in the 1920s*, *European Polygraph* 2013, 7, 2(24), p. 61)

Seelig wanted to check whether the subject still holds experiences of emotions from the past. In other words, the examination was to provide a proof whether there are mental traces (whether related to memory or emotions) of crime retained in the consciousness (subconsciousness) of the subject. Therefore, it can be said that, like Lykken would do several decades later, Seelig rather than try to detect lie or deception, ascertained whether the subject has the knowledge of a deed, and knows details of the crime, despite denying it. Lykken mentioned above used the term "guilty knowledge" to refer to such a state (Lykken, 1960).

Christian Bachhiesl (Bachhiesl 2013) reminds that the paths of Lowenstein and Seelig parted suddenly. After Hitler grabbed power, Lowenstein first emigrated to Switzerland and then to the US, where he died in 1965, never continuing his European studies. He became primarily involved in the physiology of the eye, including studies of the change of pupil diameter in different lighting conditions and measurements of the pupillary reflex. Today he is considered the pioneer of pupillography. A year before his death, Lowenstein was granted an honorary doctorate of the University of Bonn. Seelig did not continue studies on lie detection either. He was busy with various aspects of crimi-

nology, criminal sciences, and law of evidence. After the annexation of Austria, Seelig joined the NSDAP and transformed his chair, founded earlier by Hans Gross, into the Institute of Forensic Biology, developed even further by Adolf Lenz into a Nazi hotbed of racism. After the war, Seelig left Austria for Germany, where he opened the Institute of Criminology at the University of Saarbrücken (Bachhiesl, 2005).

Although the experiments of Lowenstein and Seelig had no direct continuators, David T. Lykken might have, perhaps quite unaware, made a reference to Seelig's concept. However, none of his works mentions the Austrian.

The observations of the movements of the head and extremities, and the tremors registered by Lowenstein were advanced, and the devices used for the purpose were significantly modernised in attempts to discover conscious disruptions of polygraph examinations recordings.

2.5. Attempts at lie detection by observing changes in electroencephalograms

Electroencephalography (EEG), that is a method of monitoring electric activity of the brain has been routinely used in psychiatry and neurologic diagnosing at least since the 1940s. The electroencephalograph uses the electrodes installed on the head of the subject, to capture the rhythmical bioelectrical discharges in the brain, amplified and recorded on the recording device. Independent of diagnostic purposes in neurology and psychiatry, the electroencephalographic is used for research purposes in both these sciences as well as in experimental psychology as such. It allows direct monitoring of the brain's electric activity, and uses it to assess the level of activity of the organism and its reaction to stimuli. Therefore, it also allows to follow emotions. When the brain is resting, the alpha waves are the fundamental rhythm of its activity. They have a relatively high amplitude and small frequency of around 10 Hz. As soon as a stimulus, whether internal or external, is received, the alpha rhythm is blocked, and the alpha waves yield to ones of lower amplitude and higher frequency (Hilgard 1967). The changes in the EEG are correlated with the changes in the electrocardiogram (ECG), the galvanic skin response (GSR), and other indicators of emotional changes (Lindsley 1951).

Obermann used EEG for experimental lie detection, and that with good results, as early as in the 1930s (Oberman, 1939). Nonetheless, experiments using the electroencephalogram for lie detection were discontinued for a long time. It was only early in the 1970s that Orne at al. (Orne at al. 1972) realised that an electroencephalogram can be useful in lie detection.

Moreover, the electroencephalograph was used in parallel with the polygraph (recording changes in breathing, blood circulation, and GSR) in experiments conducted by Dufek and co-authors in Czechoslovakia in the 1960s and 70s (Dufek, Richter 1970).

Description of Dufek's experiments is fairly limited, as he only concludes that the EEG can be as useful in lie detection as the physiological correlates of emotions recorded by the polygraph.

Soviet authors, Gulyayev and Bykhovskiy, describe using a 15-channel electroencephalogram "Alvar-2" for experimental lie detection (number and similar tests). Unfortunately, there is no precise description of the experiment, and the description of the changes in the EEG curves (records) when the subject lied is missing (Guljajew, Bychowskij 1972).

It seems that the EEG is more useful for researching the mechanisms of emotions than for detecting them as such. Should one even assume that emotions, coupled with the intellectual effort accompanying lie trigger reactions visible in the electroencephalogram, as it happens in the recordings performed with a classical polygraph (functions of the respiratory and cardiovascular systems, the GSR) it has to be remembered that electroencephalographic examinations suffer from plenty of specific limitations. First, it is a highly sensitive method and as such is vulnerable to both external and internal (e.g. thinking processes) stimuli, which makes it difficult to differentiate between reactions caused purposefully by the researcher (e.g. by asking the test questions) from reactions caused by other stimuli of both endogenous and exogenous nature that can be purposefully triggered by the subject who is keen on corrupting the results, as well as on the subject's will and even consciousness. Moreover, despite the development of devices used in encephalography, recording of action currents in the brain is fairly complicated and cumbersome for the subject. Hence the conviction that electroencephalographic examination is useful only to a limited degree in lie detection, and is not fit for routine application (Widacki 1981).

Recently, the interest in using EEG examinations for lie detection (see below) has been on the rise again in the wake of the discovery of the P - 300 wave (Wojciechowski 2014).

2.6. Attempts at using the galvanic skin response for lie detection

It is noteworthy that the galvanic skin response (GSR, aka electrodermal activity) discovered and described in the 19 century by Fere and by Tarkhanoff (Féré 1883, Tarkha-

noff 1890) and considered a perfect indicator of emotional changes unanimously in Europe and the US was long not used for attempts at lie detection.

In 1907 Charles Richter and Carl Jung, at the time still a *Privatdozent* lecturer of psychiatry in Zürich, jointly announced a study entitled *Further investigation on the galvanic phenomenon and respiration in normal and insane individuals* (Richter, Jung 1907).

The phenomenon of the galvanic skin response was also the object of studies and descriptions of his contemporary Polish researchers (see: Hortyński 1907, Abramowski 1913, Ochorowicz 1914).

Unlike in the West, many Japanese researchers investigated the galvanic skin response already in the 1920s, as they found it an indicator of emotions (Matte 1996), and suggested the possibility of using it for lie detection. Early in the 1930s Akamatsu, Uchida, and Togawa (Fukumoto 1982), and later Akamatsu and Togawa (Akamatsu, Togawa 1938), Akamatsu, Uchida, Togawa, and Miyata (Akamatsu et al. 1939) suggested the possibility of using the indicator for lie detection. In 1937 Akamatsu, Uchida, and Togawa (Akamatsu et al. 1939) announced that they successfully used the psychogalvanometer for lie detection. In 1938 and 1939, they announced the positive results of the successive experiments in lie detection. Fukumoto informed that Togawa was probably the first to use the observation of the galvanic skin response (electrodermal activity, EDA), while examining spies (Fukumoto 1982).

A “lie detector” with the psychogalvanometer being its key part was constructed in Japan in the 1930s, and Yokokawa Denki Company marketed the Denki Psychogalvanometer during the Second World War. The device was used by Tokyo Metropolitan Police since 1947, and later also by majority of departmental police forces (Matte 1996) Psychogalvanometers were used by the Japanese police until the introduction of the American Keeler polygraph (model 302) in 1953, and later the development of proprietary polygraphs manufactured by Takei Kikikogyo Company and Yamakoshi Seisakusho Company (Fukumoto 1982).

References

- Abramowski, E. (1913), 'Oddech jako czynnik życia duchowego', *Prace z Psychologii Doświadczalnej*, t. 1.
- Abramowski, E. (1913), 'Wpływ woli na reakcję galwanometryczną', *Prace z Psychologii Doświadczalnej*, t. 1.
- Akamatsu, P. et al. (1939), 'The measurement of PGR (5)', *Phylosophia*, 9, 195–211.
- Akamatsu, P., Togawa, Y. (1938), 'The application of PGR', *Journal of Educational Psychology*, 13, 4, 311–314.
- Bachhiesl, Ch. (2013), 'The Search for Truth by "Registration of Expression". Polygraph Experiments in Graz in the 1920s', *European Polygraph*, 7, 2(24), 61.
- Bachhiesl, Ch. (2005), *Zur Konstruktion der kriminellen Persönlichkeit. Die Kriminalbiologie an der Karl_Franzes-Universität Graz*, Hamburg, 180–222.
- Benussi, V. (1914), *Die Atmungssymptome der Lüge*, Leipzig und Berlin.
- Blatz, E.E. (1925), 'The cardiac respiratory and electric al. phenomena involved in the fear', *Journal of Experimental Psychology*, 8, 109–132.
- Burt, H.E. (1965), *Psychologia stosowana*, PWN, Warszawa, 251.
- Burt, H.E. (1921), 'The inspiration-expiration ratios Turing truth and falsehood', *Journal of Experimental Psychology*, 4, 2, 1–33.
- Chappell, W.M. (1929), 'Blood pressure ranges in Deception', *Archiv Psycholo. N.J.*, 17, 105, 1–39.
- Cybulski, N. (1891), *Fizjologia człowieka*, Warszawa, p. 260–288.
- Dufek, M., Richter, L. (1972), K problematyce polygrafického vysetrovani w kriminalistice, [in:] *Doplinkove studyjní materialy pro kryminalistický smer právnického studia*, Universita Karlova, Praha.
- Féré, Ch. (1888), Note sur des modifications de la resistance electrique sous l'influence des excitations sensoriales et des emotions, *Comptes rendues de Societe de Biologie*, 3 March.
- Ferrero, G. (1911), Introduction, [in:] C. Lombroso, *The criminal Man*, Putnam's Sons, New York.
- Fukumoto, J. (1982), 'Psychophysiological detection of Deception in Japan. The Past and the Present', *Polygraph*, 11, 3, p. 235.

Guljajew, P.J., Bychowski J.E. (1972), 'Issledovanije emocionalnowo sostajanija czielowika w prociesie prizwodstwa sledstwiennowo diejstwa', *Kriminalistika i Sudiebnaja Ekspertiza*, 9.

Hilgard, E. (1967), *Wprowadzenie do psychologii*, PWN, Warszawa.

Hortyński, F. (1907), 'Galwanometr strunowy Einthovena i jego zastosowanie do badań fizjologicznych', *Kosmos*, 9–11.

Huber, H.P. (2013), *Die Vermessung der Seele. Psychologische Laborgeräte*, UniGraz Museum.

Jung, C.G., Rilkin, F. (1905), *Experimentelle Untersuchungen über die Assoziationen Gesunder*.

Krapohl, D., Shaw, P.K. (2015), *Fundamentals of polygraph practice*, Elsevier, Academic Press.

Kwoczyński, J. (1972), *Elektrokardiografia*, PZWL, Warszawa.

Lindsley, D.B. (1951), Emotion, [in:] *Handbook of experimental psychology*, ed. S.S. Stevens, Wiley.

Luria, A. (1932), *The nature of human conflicts*, N.Y. Liveright.

Lykken, D.T. (1960), 'The validity of the guilty knowledge technique – The effects of faking', *Journal of Applied Psychology*, t. 44, 4.

Marston, W. (1917), 'Systolic blood pressure symptoms of deception', *Journal of Experimental Psychology*, vol. 216, 1.

Matte, J.A. (1996), *Forensic Psychophysiology Using Polygraph. Scientific Truth Verification – Lie Detection*, Williamsville.

Mosso, A. (1891), *Strach*, Warszawa.

Mueller, G.O.W. (1957), 'To the memory of Ernst Seelig', *Journal of Criminal Law and Criminology*, 47, 5.

Mussatti, C. (1930), 'Ricerche Sulla pneumografica delle testimonianze col metodo Benussi', *Arch. Italiano di Psychol.*, 8, 1.

Obermann, C.E., 'The effect on the Berger rhythm of mild affective states', *Journal of Abnormal and Social Psychology*, 1939

Ochorowicz, J. (1914), 'Badania doświadczalne nad zasadniczym znaczeniem reakcji psychogalwanicznej', *Prace z Psychologii Doświadczalnej*, red. E. Abramowski, t. 3, Warszawa.

Orne, M.T., Thackray, R.J., Paskewitz, D.A., On the detection of deception – a model for the study of physiological effects of psychological stimuli, [in:] *Handbook of Psychophysiology*, eds. N.S. Greenfield., R.A. Sternbach, Rinehart and Winston 1972.

Rehboldt, F. (1911), 'Über respiratorische Affektsymptome', *Psychologische Stud.*, 7, 141–195.

Richter, Ch., Jung, C.G. (1907), 'Further investigation on the galvanic phenomenon and respiration in normal and insane individuals', *Journal of Abnormal Psychology*, 2.

Seelig, E. (1927), 'Die Registrierung unwillkürlicher Ausdrucksbewegungen als forensisch-psychodiagnostische Methode', *Zeitschrift für angewandte Psychologie*, 28, p. 45–84.

Störing, G. (1906), 'Experimentelle Beiträge zur Lehre vom Gefühl', *Arch. Ges. Psychologie*.

Tarkhanoff, J. (1890), 'Ueber die galvanischen Erscheinungen in der Haut des Menschen bei Reizungen der Sinnersorgane und bei verschiedenen Formen der psychischen Thätigkeit', *Pflüg Arch ges Phys*, 46, 46–55.

Trevillo, V. (1938/39), 'A history of Lie-Detection', *The Journal of Criminal Law and Criminology*, XXIX, 6.

Undeutsch, U. (2007), 'The actual use of investigative physiological examination in Germany', *European Polygraph*, 1/1.

Widacki, J., Dukała, K. (2015), 'Detekcja kłamstwa – czyli czego?', *Problemy kryminalistyki*, 287 (1), p. 3–16.

Widacki, J., Dukała, K. (2015), 'Lie detection – of what?', *Problemy kryminalistyki*, 287 (1), p. 61–74.

Widacki, J. (1981), *Wprowadzenie do problematyki badań poligraficznych*, Warszawa.

Wojciechowski, J. (2014), 'Detection of concealed information with of the p-300 potential amplitude analysis', *European Polygraph*, 8, 4 (30), s. 167–188.

Woodworth, R.S., Schlosberg H. (1966), *Psychologia eksperymentalna*, t. I, PWN, Warszawa, p. 210, 281–282.