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The European Roots of Instrumental Lie Detection

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It is generally assumed that polygraphy originated in America. Yet the first attempts at instrumental lie detection were performed in Europe earlier than in America, still in the 19th century.

Positivism sought experimental pursuits for establishing methods of examining spiritual life. Subjects formerly described by poets and considered by philosophers were now to be measured, described in scientific language, and explained in the same language.

The pioneer of empirical – including experimental – methods intended to permit investigation of spiritual life, simultaneously rejecting metaphysics

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and embracing physiology, was the German scientist Wilhelm Wundt (1834–1920).

In 1885, Hugo Munsterberg (1863–1916), who arrived at the University of Leipzig from Danzig (now Gdańsk – a German city at the time), defended his doctoral thesis in philosophy (actually: psychology) under the supervision of Wundt. Two years later, the same scientist was conferred another doctorate, this time in medicine at the University of Heidelberg (D.P. Schulz, S.E. Schulz 2008, p. 241). With two doctorates in hand, and even more importantly, a meticulous grounding in psychology and physiology, Munsterberg began working at Freiburg University, where he established his own laboratory for psychophysical examinations (Schulz & Schulz, 2008). Encouraged by William James (today remembered primarily as a philosopher, as his authorship of the fundamental *Principles of Psychology*, published in 1890, is generally forgotten), Munsterberg moved from Freiburg to the United States, where he headed the laboratory of psychology at Harvard University. In America, he skilfully combined his experience in experimental and applied psychology. The fruit of his labours in combining these two fields of psychology was the fundamental work in investigation psychology, pioneering in all its aspects, namely *On the Witness Stand*. Published originally in 1908, it has many editions, with the last (a reprint) being dated 1978!

Fig. 1. Hugo Munsterberg (1863–1916)

In his work, Munsterberg presented a court trial from the point of view of psychology. He described psychological processes that may influence the course and result of court procedures. Most important among these factors, according to Munsterberg, were false, or simply erroneous, testimonies of the witnesses. He believed that the latter were significantly influenced by suggestion. Most important for our considerations was the chapter entitled "The Traces of Emotion". Munsterberg rightly remarked that lies must be accompanied by emotions. They can be discerned by observing physiological changes as they are symptomatic for emotions; here he rightly observed that an uttered lie is accompanied by emotions. Among the three physiological correlates of emotions he listed, and whose assessment he believed to be sufficient to decide whether the subject was lying, were: an increase in blood pressure, quickened heartbeat, changes in breathing, and changes in the skin galvanic reflex.

A few years after Munsterberg's death, the American William Moulton Marston (1893–1947) conducted his first experiments with lie detection based on assessment of changes in blood pressure in his students at the psychological laboratory of Harvard University (Marston 1917).

Marston did not value the diagnostic significance of the GSR and changes in breathing. He did not make full use of the theoretical grounds that Munsterberg left for him, yet in his experiments he went a step further, verifying Munsterberg's empirical hypothesis. In experimental studies, his method allowed correct indication of approximately 96% cases of lying (Marston 1917).

Marston's method was modified and used for the first time in actual police practice in Berkeley, California, by John A. Larson in 1921.

Two facts must be realised here. First, as Udo Undeutsch (2007) rightly remarked, forensic sciences owe the claim that a lie is accompanied by emotional changes and the idea of using observation (and registration) of the physiological correlates of emotions (including blood pressure changes, heart rate, changes in GSR, and breathing patterns) to Hugo Munsterberg, a German who went to America. Secondly, the first application of the instrumental method of lie detection did not take place in America until 1921 (Larson 1989). This is how the practice of using a polygraph for investigation that continues to this day began.

In Europe, the first use of instrument-enabled measuring of physiological correlates of emotions in lie detection in a criminal case recorded in literature took place many years earlier. There, attempts at lie detection by observation (and registration) of physiological correlates of emotions were preceded by studies on the physiological mechanism of emotions.

The most notable studies we can mention were those conducted by the Italian physiologist Angelo Mosso (1846–1910).

Fig. 2. Angelo Mosso (1846–1910)

Studying patients with cranium bone losses resulting from neurosurgical procedures, Mosso discovered pulsations of the human cortex. He believed the pulsations to be linked to mental activity and blood flow surges in various parts of the brain. He also conducted experimental studies investigating the flows of blood in the human organism during sleep, mental activity, and experiencing of emotions. For that purpose, he constructed special scales, sometimes also in today's literature referred to as "Mosso scales" (see: Fig. 3). It corroborated his hypothesis that "even with the weakest emotion, blood flows into the head" (Mosso 1891, p. 106). Moreover, Mosso observed another phenomenon, a change in the heart rate, to accompany blood flows.

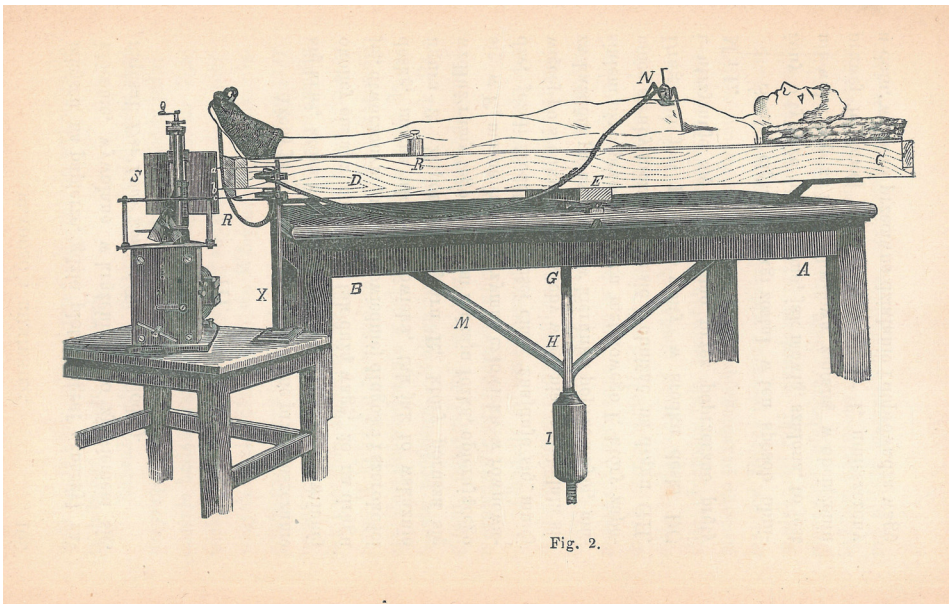

Fig. 3. Mosso's scale (according: A. Mosso, *Strach*, Polish edition, Warszawa 1891, 104)

This is how Mosso explained the phenomena: "the more lively the life processes, the greater the speed of blood circulation in the body. Yet for the movement of blood to become faster, necessary is constriction of vessels. Our blood circulation works much like a river: the current becomes quicker where the riverbed is narrower. When a danger approaches, when we feel anxiety or emotion, the organism must provide plenty of resources. For that reason, if it comes to such a state, vessels automatically narrow, due to which the movement of blood in nerve centres becomes augmented. That is why, in anxiety and strong emotions, the vessels on the surface of the body shrink, and our face becomes pale" (Mosso 1891, p. 108).

Mosso also constructed the first plethysmograph (hydroplethysmograph). As he himself admitted (Mosso 1891, p. 101), the idea of constructing such a device was suggested to him by Carl Ludwig, professor of physiology in Leipzig.

This is how Mosso described it himself: "I took a long and narrow bottle and cut off the bottom. Then I put into it my hand and a good section of my forearm, and sealed the bottle off around the elbow with quality glazer's putty.

I closed the neck off with a cork through which a long and narrow glass tube went, and subsequently filled the bottle and the tube with lukewarm water. My reasoning was: when there is a more profuse inflow of blood into the hand, when the arteries, veins, and capillary vessels fill up, a corresponding amount of water will have to leave the bottle. And vice versa: whenever vessels shrink and the hand decreases in this volume, the water in the cannula going through the cork should flow down into the bottle" (Mosso 1891, pp. 100–101).

Mosso believed all the physiological changes accompanying emotions to have their source in the operation of the heart and the circulatory system. The remaining ones (the pattern of breathing and plethysmographic action) were secondary.

Using the cardiograph of his own construction, Mosso obtained recordings of the operation of a dog's heart (Fig. 4).

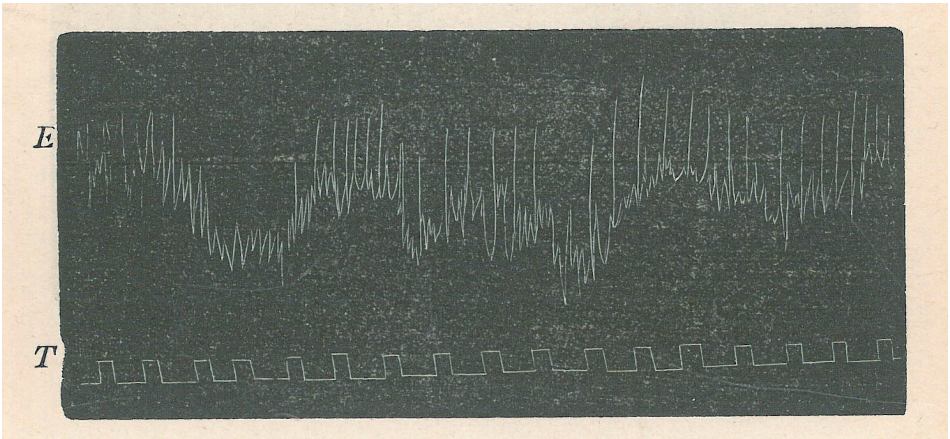

Fig. 4. Sphygmogram by Mosso (according: A. Mosso, *op. cit.*, 120)

In one of his experiments, Mosso showed a hunting rifle to a dog, and operated it. In a hunting dog, this resulted in acceleration of the heart rate. A dog that had never seen a hunting rifle did not react (Mosso 1891, p. 122).

The chemical mechanism of psychophysical changes observed by Mosso and his contemporary physiologists became explainable. This was thanks to the discoveries of, among others, a Polish physiologist, professor of the Jagiellonian University in Kraków, Napoleon Cybulski (1854–1919), who in 1895

acquired an extract from the adrenal cortex known as "*nadnerczyna*, which contained catecholamines, adrenaline included" (Szymonowicz, Cybulski: *O funkcji nadnercza*, Kraków 1895). It is worth mentioning in passing that Cybulski was one of the world's first researchers to obtain an EEG of the cortex.

Fig. 5. Napoleon Cybulski (1854–1919)

Napoleon Cybulski was a student of, and in his youth also an assistant to, Ivan Tarchanoff (Tarkhanov 1846–1908), professor at the Imperial Medico-Surgical Academy in St Petersburg. In 1890, Tarchanoff discovered the phenomenon that skin changes its electrical properties as a reaction to stress or anxiety (Tarchanoff phenomenon). The mechanism of the Tarchanoff phenomenon is identical to that of Fere's phenomenon (Jeffers 1928).

Fig. 6. Ivan Tarchanoff (1846–1908)

The only difference was in the methods of measurement. Tarchanoff applied an endosomatic method, based on using a psychogalvanometer to measure the difference between the potentials on any two points on the skin. The volume of the difference changed with the stimuli. The French psychiatrist and neurologist Charles Ferre (1852–1907) discovered two years earlier that, having attached two electrodes connected in a series to a weak source of electricity and a galvanometer to the body of the patient, the pointer of the galvanometer moves when the patient is exposed to various stimuli (Woodworth, Schlosberg p. 209, Fere 1888). The phenomenon proved by Fere and Tarchanoff is known today as the galvanic skin response (GSR).

Fig. 7. Charles Fere (1852–1907)

It can therefore be stated categorically that towards the end of the 19th century, European science prepared the grounds for instrumental lie detection, laying down the foundations for future polygraph examinations. For form's sake, one must add that the first device that simultaneously recorded heart rate and breathing functions, that is actually the first "polygraph", was constructed by the British cardiologist James Mackenzie, who demonstrated his machine at the Cardiology Congress in Toronto in 1906 (Mackenzie 1908, Inbau 1953). The device not only registered in parallel two functions of the organism, but did it with the use of ink pens. Previously, such recordings were made on blackened paper, on which dry pens rubbed out the light lines of the curves.

There are also many reasons to believe that the first attempts at instrumental lie detection performed for forensic reasons in Europe preceded what Larson did in America by over a decade.

While Angelo Mosso was a professor of physiology in Turin, the father of contemporary criminology, Cesare Lombroso (1835–1909) was a professor of forensic medicine and hygiene at the same university. Both the academics assumed their university positions in 1878. (Lombroso had not received his chair of psychiatry until 1896 and his chair of criminal anthropology, i.e. criminology, until 1906).

Fig. 8. Cesare Lombroso (1835–1909)

Searching for the anthropological and physiological identity of criminals, Lombroso not only performed anthropological measurements of such, but also studied emotional qualities, sensitivity to pain, etc. In these studies, Lombroso used the devices constructed by Mosso, including the plethysmograph (hydroplethysmograph) and sphygmomanometer (which he called "the heartbeat gauge"). Moreover, he consulted his experiments with Mosso (Lombroso 1891, vol. III, p. 6).

One of Lombroso's experiments entailed his assistant pulling away a curtain to show the subject various objects, whose sight was meant to stimulate the subject emotionally. The objects were wine, cigars, delicacies, money, photographs of women, and a gun (Lombroso 1891, vol. III, p. 6). The reactions

of the subjects were measured with a plethysmograph and sphygmomanometer and registered on a revolving drum of blackened paper, on which a pen rubbed out a line (Fig. 3).

In the course of these experiments, Lombroso made extremely valuable remarks on the possibility of using this method to discover deception. Moreover, he noticed that the reactions accompanying deception are stronger when the subject's attitude to such a deception is not indifferent, that is when he judges it negatively or approves. In other words, reactions are clearer the more the subject does not want the deception to be discovered. Lombroso believed the plethysmograph to be more useful in detection of deception than the sphygmomanometer (Lombroso,1891, p. 16).

What was to serve the corroboration of psychophysical identity of criminals, whom Lombroso believed to account for a separate type of human being, backward in moral and physical evolution, was the study of heart rate and breath rate. To record breathing, Lombroso used the pneumograph, which charted the course of breathing functions on blackened paper (Fig. 9).

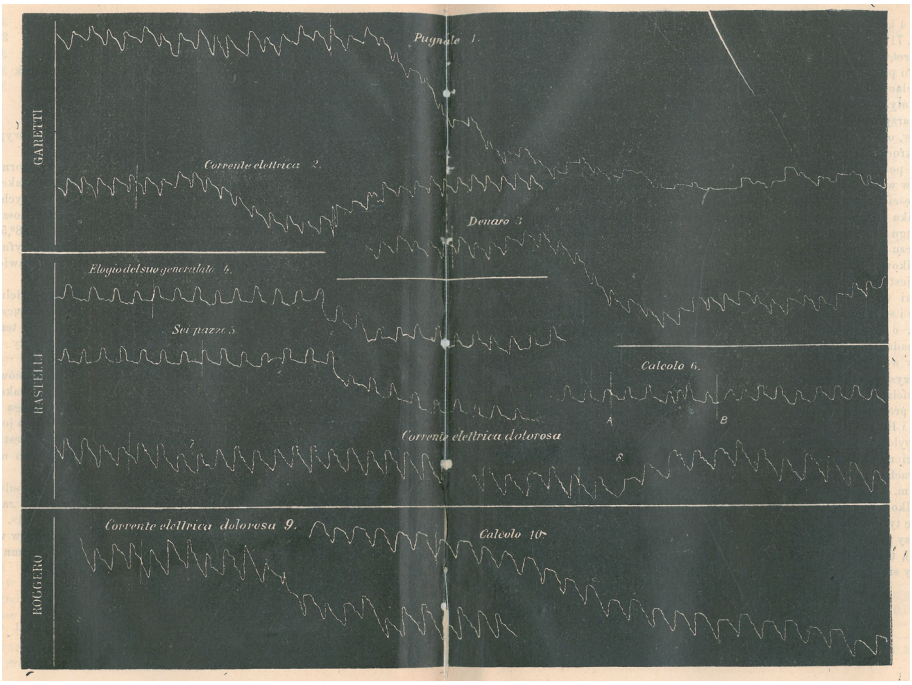

Fig. 9. Sphygmographs by Lombroso (according: C. Lombroso, *Człowiek zbrodniarz*, Polish edition, Warszawa 1892, 134)

In fact, the attempt to seek the untroubled logical, physiological, and psychological idiosyncrasy of the criminal ended in failure, and the whole theory put forth by Lombroso was finally disproved by Charles Goring, who in his work entitled *The English Convict* proved that from the anthropological (and also any other, physiological included) point of view, a British criminal is simply a reflection of the British population (Vold 1986).

Nevertheless, in the course of these pursuits, the ways of observing and recording the activity of the heart, respiratory activity, and plethysmographic reaction were improved, and an array of valuable conclusions were obtained, not least the fact that deceit or "insincerity" is accompanied by changes in the observed activity of the organism, and even that these changes are clearer when combined with motivation stimulated by the attitude of the subject, his praise or reprimand.

The experiments mentioned above were later described by Lombroso in his fundamental *L'uomo delinquente*, a work published in Turin in 1878.* [In this paper I followed the Polish translation of the book, published in Warsaw in 1891–1892. The first English translation of the book was published in 1900.] Lombroso must have been the first to realise that the method of observing physiological changes accompanying emotions allows efficient lie detection in an actual criminal case.

As Lombroso's daughter, Gina Ferrero, stated in the introduction to the English version of *The Criminal Men* in 1911, i.e. already after his death, he used the plethysmograph as soon as 1902 to detect lies in an investigation into the murder of a six-year-old girl (Ferrero 1911). In a book entitled *Crime, its Causes and Remedies* Lombroso himself mentioned that he had used the plethysmograph to detect lies in the investigation into a robbery of 20,000 francs (Trovillo 1938/1939). Even though detailed descriptions of these studies and the results are missing, nevertheless, the very fact of Lombroso conducting them raises no doubts. It remains unknown when the investigation into the case of robbery took place, yet there are grounds to believe that it was chronologically the first. Nevertheless, the second of Lombroso's known examinations, conducted in 1902, preceded the one performed by Larson in America by 19 years.

Similarly, later experimental examinations and attempts at lie detection based on the analysis of pneumograph recordings conducted in Graz by the Italian scientist Vittorio Benussi even before the first world war helped to deepen

the knowledge on which contemporary polygraph examinations are based, and paid attention to the application of recording breathing functions in assessing deception (Benussi 1914) .

What is significant, however, is that Larson's studies were continued and improved. As such, they ushered in the regular practice of polygraph examinations. Lombroso's experiments were not continued in Europe. They returned to Europe from America only after the second world war, and in many European countries are still treated with distrust.

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