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From forensic psychophisiology to forensic neurophysiology. New trends in examinations in the detection of deception

1. Introduction

Developed and perfected for years, polygraph examination techniques have probably reached the limits of their capabilities. Their diagnostic value is comparable to that of other techniques routinely used in investigations (Widacki 1977, Widacki & Horvath 1978). Neither new examination techniques nor new kinds of tests are likely substantially to affect this conclusion. Granted, whereas whether it is possible to improve the diagnostic value by another 1 % and increase the number of conclusive results may be of significance for practice, this remains more an issue of perfecting practice rather than a scientific problem.

Classical detection of deception, recently more often referred to as forensic psychophysiology, has become – just as fpr example fingerprint identification

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– a routine method, albeit continuously perfected, but no longer presenting a principal research issue for science.

2. Remote polygraph examinations

A new situation – undoubtedly due to the threat of terrorism – has trigged significant interest in the possibility of developing a detection of deception technique that would enable the test to be performed remotely without the examinee's knowledge. Therefore, attention has been brought to the physiological correlates of emotions that can be observed and registered remotely, without placing sensors on the examinee's body. Such physiological correlates of emotions are, inter alia, changes in facial temperature (discernible with a thermovison camera), emotional changes in the voice, and the pupillary reflex (Hilgard 1972). All of these were taken into consideration separately as diagnostic indicators in the detection of deception.

Undoubtedly, the most extensive literature deals with emotional changes in the voice as an indicator of deception. In general, this indicator and the devices that register it, such as the Psychological Stress Evaluator (PSE) and the Voice Stress Analyzer (VSE), have been tested and as a result deemed useless, since their diagnostic value found experimentally was significantly lower than the diagnostic value of examinations with the traditional polygraph that simultaneously registers changes in breathing, the circulatory system, and the galvanic skin response (Barland 2002, Horvath 2002, Lynch, Henry 2002).

Attention was brought to the possibility of remote observation of another physiological correlate of emotion – changes in facial temperature using a thermovision camera (e.g., Kołecki 1979) – already over 30 years ago. Yet, no research has in any way standardized these changes or, in particular, attempted to apply them in the detection of deception. The pupillary reflex and eye movement has also been known to be a symptom of emotion for some time (Bender 1933, Woodworth, Schlosberg 1966).

These last three methods have recently attracted attention again in the hope that they could be used for the remote detection of deception, including without the examinee's knowledge (Povildis, Eberhardt, Levine 2002).

Several years ago, in the development of the classical polygraph, three basic correlates of emotion – breathing, cardiac function, and galvanic skin response – were selected from among several known to science based on the relative ease of their registration.

It is highly probable that it is currently possible to select three other indicators of physiological correlates of emotion from among myriad physiological indicators that are also diagnostic, observable, and possible to register remotely; thus, in theory without the examinee's knowledge. It is also theoretically feasible.

At the same time, it would be necessary to construct tests in such a way that fragments of them could be integrated into a dialogue with the examinee such that it is possible to conduct the test while conversing with the examinee in a manner indiscernible to him or her. While a difficult task, it is nevertheless theoretically possible.

Constructing a "remote polygraph" and the technique of administering an examination without the subject's knowledge, or more importantly without the examinee's consent, also has certain ethical and legal ramifications. During a classical polygraph examination, the rule is that the examinee must give consent because without this declared cooperation in the examination, the test becomes technically impossible – for legal and moral reasons as well. Thus, from a legal and ethical standpoint, the "remote" polygraph examination would create a new standard that would also require debate from these perspectives.

3. Examination of processes in the brain

A lie, understood as the intentional stating of a falsehood or the conscious concealment of the truth, is a function of thought. A lie combined with the awareness that its detection will bring consequences gives rise to emotions. The classical polygraph examination detected, registered, and interpreted the emotions accompanying the lie, and more precisely the physiological symptoms of emotion (physiological correlates of emotion). Based thereon, it became possible to conclude that a lie or, put more cautiously, an insincerity had occurred.

The examination of the brain and observation of neural processes may aim both at the detection of emotion, as well as the monitoring of thought processes. The involvement of the brain in both thinking and the formation of emotion is obvious.

At the end of the 1920s, Walter Cannon and a few years later Philip Bard developed the thalamus theory of emotion (Cannon 1927, Bard 1934), according to which the arousal of a receptor with a stimulus is conveyed to the thalamus, which plays an activating role. According to this theory, the cerebral cortex only plays a secondary role in the emergence of the emotion, namely, when the stimulus reaches the thalamus, the cortex stops exerting an inhibiting effect over it. According to a competing theory developed over a dozen years later by M. Arnold and D.B. Lindsley, termed the cerebral cortex theory of emotion (Arnold 1950, Lindsley 1951), the cerebral cortex – and not the thalamus – plays the activating role in the appearance of emotion.

At any rate, it is beyond dispute that emotional processes originate in the brain. Emotional states are experienced and expressed in response to events occurring in our surroundings and in ourselves. The brain undoubtedly mediates in the experiencing and expression of responses to the aforementioned events, identifies signals of these events, and triggers emotional processes (Łosiak 2007).

Electroencephalograph (EEG) examinations, involving the registration of the brain's electrical activity, have been conducted since the 1920s. Since the 1940s, EEG examinations have routinely been applied in psychiatric and neurological diagnostics. They have also been used in research on central nervous system activity (e.g., to test the functional connections between the sub-thalamus, thalamus, and the cerebral cortex) (Woodwoth, Schlosberg 1966). It was also noted that changes in an EEG reading could be indicators of emotional changes (Gallhorn 1943, Haogland, et al. 1938), and further that as such they correlate with changes in GSR readings and other indicators of emotional changes (Lindley 1951). Obermann (Obermann 1939) made successful use of EEG readings in the experimental detection of deception. In the 1970s, numerous authors, among others Orne and co-researchers (Orne, et al. 1972), wrote on the application of the EEG in the detection of deception.

M. Dufek and co-researchers (Dufek, Richter 1972; Dufek 1970) used the EEG reading, along with GSR readings, pneumograph and pulse-rate readings,

and blood pressure fluctuations in the experimental detection of deception. Guliajew and Bychovskij (Guljajew, Bychovskij 1972) also applied the 15-channel electroencephalograph "Alvar-2" in the experimental detection of deception by conducting the test with the chart. Detailed descriptions of Dufek's or Guljajew and Bychovskij's experiments, however, do not exist.
The literature points out that EEG exams probably may have greater importance for the analysis of the origin of emotion and its physiological correlates than just for ascertaining that emotion occurs (Widacki 1981). Finding the existence of emotional changes and the record of physiological correlates of emotion can be done in a much less complicated manner.

The discovery of nuclear magnetic resonance (MNR) by F. Bloch and E. M. Purcel (Nobel Prize in physics 1952), the possibility of magnetic resonance imaging (MRI), and finally since the 1980s their medical application in examining living humans (Nobel Prize in medicine for P.C. Lauterbur and P. Mansfield in 2003) enabled the monitoring of brain activity at a previously unknown scale.

fig. 1: Apparatus for MRI Edge Eclipse 1, 5 T (1999)

Apart from medical diagnostics, MRI can be used to examine the brain itself and its functioning. This gave rise to hope that not only would it be possible to locate the part of the brain responsible for moral choices (Green 2003, Green et al. 2001, Green et al. 2004), but that it would even be possible to attempt mind-reading (Haynes, Rees 2006). Attempts have also been made to use this method in the detection of deception. In experimental research, Hira (Hira 1998) achieved slightly better results with this method than by using the classical polygraph.

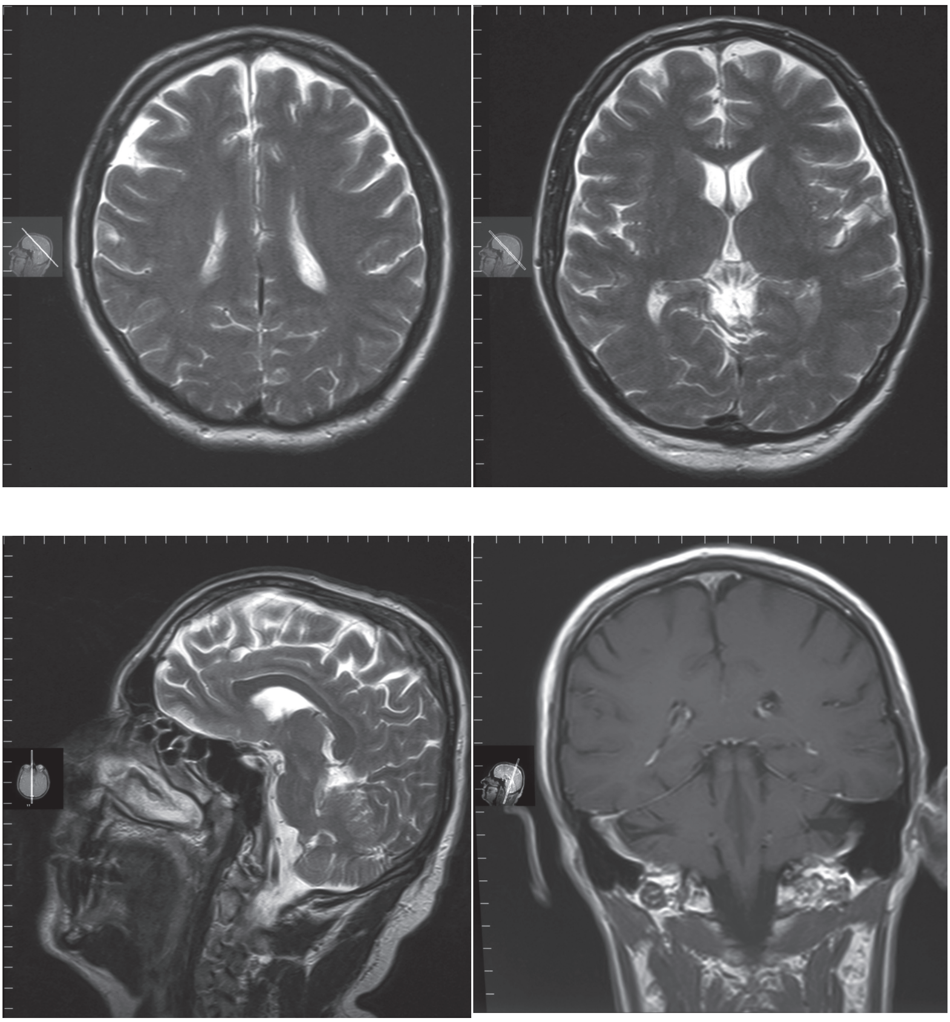

fig. 2: Pictures of human brain by MRI

Other experimental research has also yielded promising results. Loughead and co-researchers (Loughead et al. 2004), after conducting an experiment involving the tracking of brain activity in 18 volunteers examined using the Guilty Knowledge Test (GKT), found that telling a lie and telling the truth required different brain activity. In giving untrue responses, brain activity increased in regions associated with inhibition and control. The authors concluded that using the fMRI is a more exact method of examining brain activity and is superior to previously used methods of detecting deception, that is, to classical polygraph examinations.

Other authors, having conducted similar experimental research on a group of 10 volunteers, reached identical conclusions (Kozel, et. al. 2004, Kozel, et. al. 2004a). The conclusion from another experiment on a group of 11 volunteers (Mohamed, et, al. 2006) was that the method is more effective than classical polygraph examination because the specific areas of the brain associated with telling the truth or telling a lie are identifiable using the fMRI. Other researchers investigating the application of fMRI in the detection of deception have also obtained interesting results (J.M.C. Vendemia 2001, 2001 a, 2002; Langleben et al. 2002, 2005, 2006; Wolpe et al. 2005, Lee et al. 2002).

Whereas all of the experiments were conducted on small groups (from 10 to 18 persons), all appear to confirm the assumption that detection of deception using brain observation with the fMRI method can produce more certain results than those obtained in classical polygraph examinations. At any rate, such research will certainly deepen knowledge of the mechanisms of emotion and enrich theoretical knowledge upon which to base the detection of deception.

Thus, the possibility of increasingly thorough penetration of brain processes enables the increasingly deeper delving into the private sphere of humans, which, as Happel (Happel 2005) noted, gives rise to new ethical and legal problems. What is more, it may entail consequences for our entire civilization.

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