

Review on Polygraph Testing in Clinical Forensic Psychology

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Abstract

Polygraph tests are widely employed as forensic tests in investigations and in legal proceedings. The aim of this study is to demonstrate how physiology and psychological techniques operate in lie detection or Polygraph provides a contribution to scientific methods of criminal investigation. Lie detector tests use a polygraph machine that consists of different parts to measure the changes in the physiological aspects (usually respiration, electro dermal activity, relative blood pressure, and often peripheral vasomotor activity) of a person while answering questions or reacting to statements. Polygraph testing is still used in certain contexts, its validity and reliability are matters of ongoing debate within the scientific community. Many experts argue that it should not be the sole basis for making high-stakes decisions. Polygraph tests are used frequently in many fields, such as law enforcement, national security, and private investigations etc. The constitutional validity of Polygraph Test is still unanswered. Thus, government should enact new legislation regarding application of lie detectors in criminal justice. So that, our legal system take better advantage of rapid advances in scientific tools which work as judicial aids.

Keywords: Polygraph, Lie Detection and Legal admissibility.

Introduction

Catching liar is important issue in criminal and forensic area. Polygraph test is one of the investigating an interrogating tool to solve the crime in scientific way. It provides new lines of inquiry. In India, Central Forensic Science Laboratory, C. B.I, New Delhi, first of all providing the facility of polygraph for crime investigation. A number of other institutions have since introduced this facility Forensic Science Laboratory, Bihar, Patna is also one of them. The first modern commercially usable polygraph test was developed by John Larson a forensic psychiatrist(U.S) in 1921(Grubin and Madsen ,2005).Polygraph test is also referred to as a Psychological Detection of Deception or PDD examination. The literal meaning of the term “polygraph” is multiple pens writing on moving paper (i.e., many writings) that characterized the original instruments, but data are now digitized and presented on a computer screen (Don Grubin, MD, 2010).The polygraph is an instrument which is commonly called lie detector, but it does not recognize lies. The term ‘polygraph’ refers only to the recording device that is used for registering different physiological parameters. The primary purpose of a polygraph test is to detect deception or confirm honesty. The test works on a psychological principle known as the “Psychosomatic interaction”. The principle deals with the minor changes occur in a human body.

Whenever a person lies or fake a statement, that person will have fear of getting caught and he holds his emotions which leads a mental disturbance within that person. The polygraph test records physiological activity associated with arousal in the autonomic nervous system i.e respiration, heart rate, blood pressure, and electro dermal response or electrical conductance at the skin surface of the suspect who is being questioned. (National Research Council 2003). Polygraph tests are psychological tests that are used worldwide. The largest professional association of Polygraph examiners, the American Polygraph Association (APA), shows more than 2800 members from 58 countries (APA, 2019a). Estimates indicate that there are more than 8000 polygraph examiners operating in China alone (Zhang, 2011). The aim of this study is to demonstrate how physiology and psychological techniques operate in lie detection or polygraph provides a contribution to scientific methods of criminal investigation.

Polygraph Components -Several painless components fasten to and around the examinee's body for connecting him or her to the polygraph instrument (David 1983). Measurements are recorded simultaneously in the form of traces on a graph paper individually. These recordings on a graph paper, collectively, are known as PolyGram.

Different Polygraph Components are as follows-

Pneumographs - The pneumo graph measures the rate of respiration, thereby revealing the subject's breathing pattern. Two convoluted rubber tubes that are fastened around the examinee's chest and abdominal area for the purpose of obtaining a continuous tracing of his or her respiratory activity (i.e., breathing pattern). Expansion of the subject's chest and stomach during breathing causes stretching of the tubes, the movements of which are transmitted through bellows and recorded by pens on moving graph paper (the chart).

Cardiosphygmograph (A blood pressure cuff)-The cardiosphygmograph measures changes in the subject's blood pressure and pulse. That is secured around the examinee's upper arm and centered over the brachial artery or occasionally around the thumb or wrist for the purpose of obtaining a continuous tracing of his or her cardiovascular activity (i.e., heart rate and blood pressure) recorded by a single pen on the polygraph.

Galvanometers-The galvanometer measures variations in skin resistance to electricity because of electrodermal activity called as galvanic skin response (GSR) or psycho galvanic reflex (PGR). Two protruding electrodes each with an insulated seating that are attached to the examinee's fingers for the purpose of obtaining a continuous tracing of his or her electrodermal activity (i.e., sweat gland activity). When a small amount of electrical current passes through these fingers, any variation in perspiration, a routine sympathetic response to stress, is measured and recorded by another pen on the polygraph.

Plethysmograph (Transducer)-It is connected to the thumb to measure blood volume reflecting the pulse rate.

Types of polygraph Test and Techniques-

Control Question Test (CQT)-This test takes a direct approach to forensic credibility assessment by asking simple accusatory questions. There are three sets of questions included in the CQT (Ben-Shakhar, Bar-Hillel and Lieblich 1986).

Control questions-These questions are based on an assumed lie, related to the general truthfulness of the past of the test candidates. They are unrelated to the matter under investigation but of a similar, though less serious nature.

Irrelevant questions– These questions are not related to crime such as subject's name, age, address, or recent meals. It is designed primarily to establish the subject's normal physiological baseline for truthful responses under test conditions. They are asked for the purpose of making the subjects familiar with the testing situation and procedures.

Relevant questions- Relevant questions are semantically simple questions that directly address the matters under investigation.

Comparison Question Test -Built on the R/I paradigm by adding a third type of questions: comparison questions regarding moral character (Synnott et al., 2015). It helps to differentiate guilty suspects from innocent suspects whose physiological responses indicated high stress toward relevant questions (Meijer and Verschuere, 2015).

Symptomatic question–Such questions are utilized by followers of the Backster school, gauges whether an unrecognized outside factor may be distorting test results.

Guilt complex question-In special situations additional types of questions are used. Whenever a subject exhibits a strong specific response to all relevant and control questions. It determines whether the subject will respond to accusatory questions about a fictitious incident similar in nature to the one being investigated (D. Lykken 1977).

Guilty Knowledge Test (GKT) or Concealed Information Test (CIT)-In this test more “relevant questions” are included and each question is provided with four alternative answers which help to reduce the probability of “false positive” misclassification. It is based on the Orienting Response involving changes to heart rate and skin conductance to a significant stimulus. It is expected that the guilty person would react strongly when presented with information that is significant to the crime whereas an innocent person would have no change in reaction between the correct answer and the insignificant alternatives (Lykken, 1974). A person answers multiple-choice test that contains answers that only a person who committed the crime would know. That means a correct answer out of a line up would cause a greater reaction from a person who was guilty, whereas an innocent person’s response would not differ. These tests have good psychometric qualities and have been shown to be accurate in experimental settings.

Symptom Validity Testing (SVT)-This test is used in combination with the GKT to produce better results in detecting liars.

Neuroscience-Based Advanced Polygraph Tests-

This is advanced version of polygraph tests. In this test, the pattern of brain waves in response to the test questions are measured in order to relate the truthfulness or dishonesty of subjects. These methods assume that a special kind of brain wave is linked to the act lying. Human brain tends to produce a unique type of wave called P300 wave when exposed to familiar information or images. Therefore, by comparing the verbal responses of a test subject and his/her brain waves, one can understand whether the person is lying or not. Brain Finger Printing is the specific technique employed in the neuroscience-based polygraph tests. The subjects are fitted with an electroencephalogram (EEG) to record their brain waves and are presented with images or information relevant to the crime. If a crime suspect falsely reports that he/she is not aware or does not recognize the image, a P300 wave will appear on the machine revealing that the person is lying. (Metzinger2006).

Phases of Polygraph test-

Initial Interrogation and Pre-Test Phase-In this phase the examiner informs the specific issue that is being investigated. They are also given opportunity to clarify their doubts at this phase. Explain about his or her constitutional rights, of their right to an attorney and of the voluntary action of submitting to a polygraph examination. Draft the question that is going to be asked. Review and formulate all the questions to him or her that asked in test. During this conversation, verbal and non-verbal reactions will be observed, and a picture of honest and dishonest behaviour such as fidgeting, sweating, eye movement, etc. will be compiled. The response and behavioural indicators will be used to build the questions for the in-test phase. No measurements of physiological data are taken during this phase. After pre-test explain about polygraph instrumentation. Then examinee have to sign a declaration form to state that he/she is agreeing to take the polygraph and understand the procedure. The pre-test interview may last several hours but generally takes from thirty to forty minutes.

In -test phase (Polygraph exam or Chart-collection Phase)-In this phase the sensors attached to the body, which measure physiological responses such as blood pressure, pulse, respiration, and sweat gland activity. These sensors are attached to the fingers, chest, and abdomen. The examinee's physiological data continuously collected, measured and recorded, onto polygraph charts, as he or she answers the set of questions that were formulated and reviewed during the pre-test phase it may include "crime-related" and "non-crime related" questions. The test usually consists of a series of ten questions at twenty second intervals, covering a time span of five minutes or less while the physiological indices are simultaneously recorded with 'yes' or 'no' replies given by the examinee. Examiner ask each question multiple times to ensure accurate readings and may also ask follow-up questions to clarify the response, a significant change in these responses may indicate deception or stress which is monitored by sensor. This phase typically lasts between 30 minutes and 3 hours and is divided into several smaller parts. Minimum three separate tests each lasting approximately 5 minutes — and a maximum six tests administered. The examinee have a two-minute relaxation period between each test. Then examinee's physiological data collected during the polygraph examination evaluated as DI / SR (Deception Indicated /Significant Response) The examinee was found

deceptive in one or more of the pertinent questions asked during the test. NDI / NSR (No Deception Indicated/ No Significant Response) Often referred to as the examinee was found truthful. INC (Inconclusive) The examiner could not reach a conclusive decision based on analysing the polygraph charts. PNC (Purposely Non Cooperative) The examinee did not comply with the examiner's instructions and/or was detected trying to deploy some counter-measures during the test.

Post-test phase or Chart analysis-When post-test phase is finished, the examiner discusses the results of the polygraph examination with the client which is based on the analysis, interpretation and evaluation of the polygraph data. If the physiological data recorded on the charts shows reactions on the part of the examinee to the relevant questions that were asked, he or she will be given the opportunity to explain these reactions. In criminal investigations, this interview may be transformed into an interrogation if the results clearly indicate that the subject is being untruthful.

Polygraph Applications-Application of polygraph test is extremely significant in such fields as criminal investigation, sexual harassment accusations, national security, and employee recruitment, employee theft and proof of truth etc.

Scientific Validity of Polygraph Testing or Controversy Over Polygraph Testing Validity-Reliability and validity are core aspects of measurement (Hammersley 1987). Reliability is the extent to which an experiment, test, or any measuring procedure yields the same results on repeated trials and validity is the extent to which an indicator “measures what it purports to measure”. (Carminesetal 1979). The polygraph test cannot differentiate between the changes that have taken place in the body whether it is by way of a lie or something else. If a person is in control of their emotions then that can also lead to false results as they can manipulate the test results hence these types of tests are not completely reliable. The success of polygraph testing will depend heavily on its ability to minimize misclassification of subjects. The biggest danger is “false positives” that declare innocent suspects as guilty and “false negative” that declaring the dishonest crime suspects as innocent reveals that these instruments are not valid (aka Polygraph tests),’ 2004). So test developers and researchers may pay more attention to innovate the methodology or develop measures to prevent the occurrence of “false negatives” and “false positives” so that polygraph tests could be effectively and widely employed in detecting lies(Kaste2015).The accuracy of the test can be influenced by a variety of factors like the skill of the examiner, type of questions asked, and the respondent’s physiological response to stress also. Two meta-analyses suggest polygraph accuracy is in the region of 81-91% (NRC, 2003) and 89% (American Polygraph Association, 2011).

Polygraph legal admissibility worldwide-There are a number of countries that allow for the admission of polygraph test results as evidence in their courts of law. In the United States, polygraph tests are admissible in courts of law in about half the states under stipulation (Iacono& Ben-Shakhar, 2019). Belgium (Philippe, 2020) has determined that the results of CQT polygraph examinations may be used as evidence in criminal cases. Japan is the only country were the CIT is widely applied in criminal investigations (Matsudaet al., 2019). Polygraph tests results have been admissible in Poland since 1976 (Widacki, 2007). In Europe, it is also noted that in a few cases polygraph results were presented in courts in Finland, Norway, Sweden (Meijer & von Koppen, 2008) and Lithuania (Kraujalis et al., 2007).

In Asia, polygraph test results are admissible in China in civil but not criminal cases (Guodong, 2020). In South America, polygraph test results are admissible in Colombia (Bermudez & Arias, 2011). The only other countries where polygraph has been put no extensive use in criminal justice system are Japan and Israel. In Japan some of the courts have accepted the polygraph test results. The use of polygraph in Canada or in European countries, e.g., U.K., France, Germany, etc. is not extensive. But it is on the increase.

Legal Status of Polygraph Test in India-

National Human Rights Commission in 2000- NHRC has suggested that at the time of polygraph test a forensic psychologist, a psychiatrist and an anesthetist should remain present. NHRC published asset of guidelines relating to the administration of the Polygraph Test which included-

- No Lie Detector Tests should be administered except on the basis of consent of the accused. An option should be given to the accused whether he wishes to avail such test.
- If the accused volunteers for a Lie Detector Test, he should be given access to a lawyer and the physical, emotional and legal implication of such a test should be explained to him by the police and his lawyer.
- The consent should be recorded before a Judicial Magistrate.
- During the hearing before the Magistrate, the person alleged to have agreed should be duly represented by a lawyer.

Legal provisions related with the protection of the accused

Article 20(3) Right against self-incrimination-No person accused of any offence shall be compelled to be a witness against himself. An accused person cannot be forced to undergo scientific tests like Narco-analysis, Polygraph, Brain-finger Printing etc. as it amounts to self-incrimination of the accused.

Article 21 Right to life and personal liberty-It means no person shall be deprived of his life or personal liberty except according to procedures established by law. It also traditionally known as 'natural right'.

Section 161(2) of the Criminal Procedure Code, 1973, Right to remain silent- It mandatory for every individual to truthfully answer every question posed to them by the police, except those that would make them liable to a criminal investigation.

Section 45 and 45A of the Indian Evidence Act- Polygraphy test cannot be considered as an evidence. According to the Section 45 the opinions of persons who have special skill in foreign laws, science or art, and on handwriting and finger impressions are relevant. Under certain circumstances the evidence of opinions of persons who are called 'experts' have become relevant. An opinion evidence of an expert after its acceptance by the court becomes the decision of the court and causes to be a opinion evidence of the expert. Polygraphy test cannot be considered as an evidence but the court can consider it as an expert opinion under Section 45A of evidence act.

Section 27 of the Evidence Act : Voluntary test of polygraph admissible in evidence-If certain safeguards like the one recommended by the National Human Rights Commission in the case of

polygraph test are observed, then such test results may be admissible in evidence for a limited purpose (Smt. Selvi Vs. State of Karnataka, (2010) 7 SCC 263 (Three-Judge Bench)).

S Vs. State and Others CRL. REV.P.788/2023 and CRL.M.A. 19745/2023-

In the present case by the learned Judge who passed orders that the IO should get conducted polygraph tests of accused and prosecutrix as per law and later the learned Trial Court relying on the polygraph test and discharging the accused while making an observation that the victim was lying whereas the accused was truthful. But according to Honourable High Court, Delhi further discharging an accused primarily on the basis of outcome of the polygraph test at the stage of charge was equally erroneous. Since the polygraph test result by itself is not a piece of independent evidence. So, Polygraph test along with proper trail is helpful.

Discussion

The polygraph (Reid and Inbau, 1977) is a device that indirectly assesses psychological processes, such as lying, through analyses of changes in the ANS (Raskin, 1979, 1986; Lykken, 1998). Lying is thought to produce a natural stress reaction (Wilcox, 2000) activating the autonomic nervous system, a part of the central nervous system that is largely outside of conscious, volitional control. The polygraph uses such physiological measurements such as ElectroCardioGraphy (ECG) and Galvanic Skin Response (GSR) to determine pulse and skin conductivity changes that correspond with deception. American National Research Council (2003) determined polygraph accuracy to be in the region of 80 to 90 per cent when undertaken by properly trained polygraphists. Researchers, with regard to employing the polygraph more as a truth facilitator than a lie detector (Gannon et al, 2014; Grubin, 2006; Heil & English, 2009; Wilcox et al, 2005). Polygraph is well established in the United States in the assessment, treatment, and management of people who have committed sexual offences, both in prison and community settings. Encouraged by the American experience, studies in the UK, have examined the utility of Post Conviction Sex Offender Testing (PCSOT), employing the polygraph in the community (Gannon et al, 2014; Grubin, 2010; Wilcox, & Sosnowski, 2005) and in a mental health setting (Collins, 2019). Collins (2019) referred to the additional utility of polygraph with adults and juveniles, as well as value of polygraph to professionals and participants. In addition, 90% of probation officers in Grubin's (2010) study rated the impact of polygraph on testing and supervision, as being 'somewhat' or 'very' helpful. The results of the polygraph findings prompted the widespread enforcement of the Offender Management ACT (2007) section 28 in the UK, in which mandatory polygraph testing is arranged for sex offenders identified as high risk according to the Risk Matrix 2000 (RM2000, Thornton, 2010) and have a sentence of 12 months or longer. A 2009 survey reported that nearly 80 percent of adult community treatment programs in the United States and over half of institutionally based ones incorporated polygraph into treatment. (Burchard BL, *et al*: 2010.) But the constitutional validity of Polygraph Test is still unanswered. These tests overall are violation of personal liberty and intrusion of one's mind and thoughts, as in some tests the person is not in a conscious state of mind and cannot control their brain, this is not considered as evidence in the court. So, government should enact new legislation regarding application of lie detectors in criminal justice. Due to their limited reliability and scientific proofs these methods cannot be used as incriminating evidence. However, they can be used as useful tools to solve complicated cases as investigative tools. The polygraph test cannot take place of a thorough investigation. Before making request for polygraph test, the investigating officer must exhaust all

avenues of investigation. The polygraph test can check truthfulness of witnesses' statement, it can induce criminals to confess to crimes committed by them, it replaces third degree methods used during police interrogations. So, it can help in discriminating the innocent from the guilty. Study conducted on the polygraph and its role in the administration of criminal justice by Chicago Bar Association Committee of Criminal Law concluded that Polygraph has a place in the detection of crime because of psychological effect on persons, who are in fact guilty of crime. There may be 5-30% errors in the test results, depending upon the ability of the examiner and other factors. Unqualified operators could cause unnecessary injury to innocent persons. A 'expert' witness is one who has devoted time and study to a special branch of learning, and thus is specially skilled on those points on which he is asked to state his opinion. Section 45 clearly deals with the opinion of persons who are called experts. There are matters mentioned in the section in which help is required from witnesses having experiences and skill and the opinion given by such witness is expert opinion. Section 45 of the Indian Evidence Act is wide enough to accept the polygraph evidence. The opinion of such experts is admissible in evidence as relevant facts. Thus, The lie-detectors are in providing useful assistance in criminal investigations in thousands of cases. As per Indian Law no person accused of any offence can be forcefully compelled to be a witness against himself, it is a violation of fundamental rights but within the narrow confinement of law it can be done.

Conclusion

Thus, the simple way of assessing honesty and truthfulness using polygraph tests might be more appropriate because it appears to be better lie detection methods compared to the conventional methods of interrogation. Hence, Polygraphs tests play important role in maintaining peace, national security, social stability. Additional research is needed to explore this scientific techniques. Polygraph tests must receive more attention in academic psychology also. The constitutional validity of Polygraph Test is still unanswered. Thus, government should enact new legislation regarding application of lie detectors in criminal justice. So, that our legal system take better advantage of rapid advances in scientific tools which work as judicial aids.

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References-

1. American Polygraph Association. (2019a). Find a member. Retrieved from <https://apoa.memberclicks.net/find-a-member#/>.
2. American Polygraph Association. (2011). Meta-analytic survey of criterion accuracy of validated polygraph techniques. Retrieved from https://apoa.memberclicks.net/assets/docs/polygraph_404.pdf.
3. Bermudez M. N., & Arias S. W. (2011). Polygraph testing in Colombia. *Polygraph*, 40(2), 124–130.
4. Ben-Shakhar, G., Bar-Hillel, M., & Lieblich, I. (1986). Trial by polygraph: Scientific and juridical issues in lie detection. *Behavioral Sciences & the Law*, 4(4), 459- 479. Retrieved from Academic Search Premier Collins, N. (2019), *The Utility of the Polygraph with Mentally Disordered Offenders*. Unpublished Doctoral Dissertation, University of Birmingham.

5. Carmines EG, Zeller RA.. Reliability and Validity Assessment. Vol. 17 Thousand Oaks, CA: Sage; 1979.
6. D. Lykken, supra note 6, at 32; J. REID & F. INBAU, supra note 1, at 48-49; see also Abrams, A Survey of Attitudes on the Guilt Complex Technique, 6 POLYGRAPH 123 (1977).
7. Don Grubin, MD(2010), The Polygraph and Forensic Psychiatry, The Journal of the American Academy of Psychiatry and the Law;38:446–51.
8. David E. Nagle,*The Polygraph in the Workplace*, 18 U. Rich. L. Rev. 43 (1983).
9. Gannon, T.A., Wood, J.L., Pina, A., Tyler, N., Barnoux, M.F.L., & Vasquez, E.A.(2014), An evaluation of mandatory polygraph testing for sexual off enders in the United Kingdom. *Sexual Abuse: Journal of Research and Treatment*, 26 (2), 178–203.
10. Grubin, D., & Madsen, L. (2005). Lie detection and the polygraph: A historical review. *Journal of Forensic Psychiatry & Psychology*, 16(2), 357-369. doi:10.1080/14789940412331337353.
11. Grubin, D. (2006), *Polygraph pilot report: Final report*. London: Home Office.
12. Grubin, D. (2010), A trial of voluntary polygraphy testing in 10 English probation areas. *Sexual Abuse: Journal of Research and Treatment*, 22 (3), 266–278.
13. Guodong, D. (2020) Is a polygraph test admissible as evidence in China? China Justice Observer. Retrieved from <https://www.chinajusticeobserver.com/a/is-a-polygraph-test-admissible-as-evidence-in-china>
14. Hammersley M. Some notes on the terms ‘validity’ and ‘reliability’. *Br Educ Res J* 1987; 131: 73–82.
15. Heil, P., & English, K. (2009), Sex off ender polygraph testing in the United States:Trends and controversies. in: D.T. Wilcox (ed.), *The use of the polygraph in assessing, treating, and supervising sex off enders: A practitioner’s guide* (pp. 181–216). New York, NY: Wiley.
16. Kaste, M. (2015). Trial of polygraph critic renews debate over tests’ accuracy. Retrieved from <http://www.npr.org/2015/01/02/371925732/trial-of-polygraph-critic-renews-debate-over-tests-accuracy>.
17. Kraujalis, L., Kovalenko, A., & Saldziunas, V. (2007). Legal and practical aspects of using the polygraph in the Republic of Lithuania. *European Polygraph*, 1(1), 17–23.
18. Lykken, D. T. (1974). Psychology and the lie detector industry. *Am. Psychol.* 29, 725–739. doi: 10.1037/h0037441.
19. Lykken, D. T. (1998). *A Tremor in the Blood: Uses and Abuses of Lie Detection*, 2nd Edn. New York, NY: Plenum.
20. Matsuda, I., Ogawa, T., & Tsuneoka, M. (2019). Broadening the use of the concealed information test in the field. *Frontiers in Psychiatry*, 10, 24. <https://doi.org/10.3389/fpsy.2019.00024>.
21. Meijer, E. H., and Verschuere, B. (2015). “The Polygraph: Current Practice and New Approaches,” in *Detecting Deception: Current Challenges and Cognitive Approaches*, eds P. A. Granhag, A. Vrij, and B. Verschuere (Chichester: John Wiley & Sons, Ltd).
22. Metzinger, T. (2006). Exposing LIES. *Scientific American Mind*, 17(5), 32-37. Retrieved from Academic Search Premier.
23. Meijer, E. H., & von Koppen, P. J. (2008). Lie detectors and the law: The use of polygraph in Europe. In D. Canter & R. Zukauskienė (Eds.), *Psychology and the law: Bridging the gap* (pp. 31–50). Taylor and Francis.

24. National Research Council (2003). *The Polygraph and Lie Detection*. Committee to review the scientific evidence on the polygraph. Washington, DC: The National Academies Press. Offender Management Act (2007), Her Majesty's Stationary Office, Office of Public Sector Information.
25. Philippe, R des B, (2020). *Loimodifiant le Code d'instruction criminelle qui concerne l'utilisation du polygraphe (1)*, Belgisch Staatsblad, February 21, 2020, MontieurBelge, p. 10239–10240.
26. Raskin, D. C. (1979). "Orienting and defensive reflexes in the detection of deception," in *The Orienting Reflex in Humans*, eds H. D. Kimmel, E. H. van Olst, and J. F. Orlebeke (Hillsdale, NJ: L. Erlbaum Associates), 587–605.
27. Raskin, D. C. (1986). *The polygraph in 1986: scientific, professional and legal issues surrounding application and acceptance of polygraph evidence*. *Utah Law Rev.* 29, 29–74.
28. Reid, J. E., and Inbau, F. E. (1977). *Truth and Deception: The Polygraph (Lie-Detector) Technique*. Philadelphia: Williams & Wilkins Company.
29. Synnott, J., Dietzel, D., and Ioannou, M. (2015). *A review of the polygraph: history, methodology and current status*. *Crime Psychology Review* 1, 59–83. doi: 10.1080/23744006.2015.1060080.
30. Thornton, D. (2010). *Scoring guide for Risk Matrix 2000.10/svc*. Unpublished document.
31. Widacki, J. (2007). *Polygraph examinations in Poland*. *European Polygraph*, 1(1), 24–34.
32. Meijer, E. H., & von Koppen, P. J. (2008). *Lie detectors and the law: The use of polygraph in Europe*. In D. Canter & R. Zukauskienė (Eds.), *Psychology and the law: Bridging the gap* (pp. 31–50). Taylor and Francis.
33. McGrath RJ, Cumming GF, Burchard BL, *et al*: *Current Practices and Trends in Sexual Abuser Management: The Safer Society 2009 North American Survey*. Brandon, VT: Safer Society Press, 2010.
34. Wilcox, D.T. (2000). *Application of the clinical polygraph examination to the assessment, treatment and monitoring of sex offenders*. *Journal of Sexual Aggression*, 5, 134–152.
35. Wilcox, D.T., & Sosnowski, D.E. (2005). *Polygraph examination of British sexual offenders: A pilot study on sexual history disclosure testing*. *Journal of Sexual Aggression*, 11 (1), 3–23.
36. Zhang, X. (2011). *The evolution of polygraph testing in the People's Republic of China*. *Polygraph*, 40(3), 181–193.