

LIE Detection in the Field of Crime Investigation

[¹] Bhuvanesh.K [²] Vishnu Shanmughan [³]Vrinda Thampi
[¹] Assistant Professor [²][³] 2nd Year B.Sc. Computer Science
Department of Computer Science
Sri Krishna Adithya College of Arts and Science

Abstract: -- The ability to detect when someone is lying is a skill that fascinates us all. On the quiet, many of us like to think of ourselves as amateur lie detectors. A polygraph popularly referred to as a lie detector. The polygraph was invented in 1921 by John Augustus Larson, a medical student at the University of California at Berkeley and a police officer of the Berkeley Police Department in Berkeley, California. It is commonly used by law enforcement and has historically been an inexact science. There are a wide variety of technologies available for this purpose. The most common and long used measure is the polygraph, which is considered by the U.S. National Academy of Sciences to be unreliable. A polygraph, popularly referred to as a lie detector, measures and records several physiological indices such as blood pressure, pulse, respiration, and skin conductivity while the subject is asked and answers a series of questions. The belief underpinning the use of the polygraph is that deceptive answers will produce physiological responses that can be differentiated from those associated with non-deceptive answers. This document study on lie detection.

Keywords:— Polygraph, Cognitive Polygraph, Erp, Eeg, Facial Emg, Eye Tracking, Voice Risk Analysis, Fmri- Fnirs, Brain Observations.

I. INTRODUCTION

Lie detection, also referred to as deception detection, uses questioning techniques along with technology that record physiological functions to ascertain truth and falsehood in response. It is commonly used by law enforcement and has historically been an inexact science. There are a wide variety of technologies available for this purpose. The most common and long used measure is the polygraph, which the U.S. National Academy of Sciences states, in populations untrained in countermeasures, can discriminate lying from truth telling at rates above chance, though below perfection. They added that the results apply only to specific events and not to screening, where it is assumed that the polygraph works less well.

A polygraph, popularly referred to as a lie detector, measures and records several physiological indices such as blood pressure, pulse, respiration, and skin conductivity while the subject is asked and answers a series of questions. The belief underpinning the use of the polygraph is that deceptive answers will produce physiological responses that can be differentiated from those associated with non-deceptive answers; the polygraph is one of several devices used for lie detection.

The polygraph was invented in 1921 by John Augustus Larson, a medical student at the Berkeley and a police officer of the Berkeley Police Department in Berkeley, California. The polygraph was on the Encyclopædia Britannica 2003 list of greatest inventions, described as inventions that "have had profound effects on human life for better or worse.

The efficacy of polygraphs is debated in the scientific community. In 2001, a significant fraction of the scientific community considered polygraph to be pseudoscience. IN 2002, a review by the National Academies of Science found that in populations untrained in countermeasures, polygraph testing can discriminate lying from truth telling at rates above chance, though below perfection. These results apply only to specific events and not to screening where it is assumed that polygraph would work less well. Effectiveness may also be worsened by countermeasures.

In some countries polygraphs are used as an interrogation tool with criminal suspects or candidates for sensitive public or private sector employment. US law enforcement and federal government agencies such as the FBI and the CIA and many police departments such as the LAPD use polygraph examinations to interrogate suspects and screen new employees. Within the US federal government, a polygraph examination is

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)

Vol 3, Issue 12, December 2016

also referred to as a psychophysiological detection of deception (PDD) examination. [1][2][3][4]

II. FEATURES OF LIE DETECTOR

For more than 15 years, Robert Hanssen led a double life. In one life he was a 25-year veteran with the Federal (FBI) who had access to some of the nation's most-classified information. In his other life, he allegedly was spying for the Russian government. Hanssen's deception was finally discovered, and in February 2001 he was arrested and later pled guilty to 15 espionage-related charges. Spies are probably the world's best liars, because they have to be, but most of us practice deception on some level in our daily lives, even if it's just telling a friend that his horrible haircut "doesn't look that bad."

People tell lies and deceive others for many reasons. Most often, lying is a defence mechanism used to avoid trouble with the law, bosses or authority figures. Sometimes, you can tell when someone's lying, but other times it may not be so easy. Polygraphs, commonly called "lie detectors," are instruments that monitor a person's physiological reactions. These instruments do not, as their nickname suggests, detect lies. They can only detect whether deceptive behaviour is being displayed.

Polygraph exams are most often associated with criminal investigations, but there are other instances in which they are used. You may one day be subject to a polygraph exam before being hired for a job: Many government entities, and some private-sector employers, will require or ask you to undergo a polygraph exam prior to employment.

Polygraph examinations are designed to look for significant involuntary responses going on in a person's body when that person is subjected to stress, such as the stress associated with deception. The exams are not able to specifically detect if a person is lying, according to polygraphed Dr Bob Lee, former executive director of operations at Auction, a manufacturer of polygraph instruments. But there are certain physiological responses that most of us undergo when attempting to deceive another person. By asking questions about a particular issue under investigation and

examining a subject's physiological reactions to those questions, a polygraph examiner can determine if deceptive behaviour is being demonstrated. [5]

III. HISTORY OF LIE DETECTOR

A. 1900s

The study of physiological methods for deception tests measuring emotional disturbances began in the early 1900s. Benussi was the first to work on practical deception tests based on physiological changes. He detected changes in inspiration-expiration ratio—findings confirmed by N.E. Burtt. Burtt conducted studies that emphasized the changes in quantitative systolic blood-pressure. William Moulton Marston studied blood-pressure and noted increase in systolic blood pressure of 10 mm Hg or over indicated guilt through using the tycos sphygmomanometer, with which he reported 90-100% accuracy. His studies used students and actual court cases. Then in 1913 W.M. Marston determined systolic blood-pressure by oscillatory methods and his findings cite definite changes in blood pressure during the deception of criminal suspects. In 1921, Larson criticized Marston's intermittent blood pressure method because emotional changes were so brief they could be lost. To adjust for this he modified the Erlanger sphygmograph to give a continuous blood pressure and pulse curve and used it to study 4,000 criminals.

B. 21st century

A meta-analysis study from DePaulo and Morris found an "association between lying and increased pupil size, an indicator of tension and concentration." Additionally, those lying are perceived to appear more nervous than those telling the truth (which may be because the voices of those lying are higher pitched), while they also do not appear to be more fidgety, blink more, or have a less-relaxed posture but "are more likely than truth-tellers to press their lips together." However, highly motivated liars (those with higher stakes) "seem unusually still and make notably less eye contact with listeners."

Paul Ekman has used the Facial Action Coding System (FACS) and "when combined with voice and speech measures, [it] reaches detection accuracy rates of up to 90 percent." However, there is currently no evidence to support such a claim. It is currently being

**International Journal of Engineering Research in Computer Science and Engineering
(IJERCSE)**
Vol 3, Issue 12, December 2016

automated for use in law enforcement and is still being improved to increase accuracy. His studies use micro-expressions, which last less than one-fifth of a second, and "may leak emotions someone wants to conceal, such as anger or guilt." However, "signs of emotion aren't necessarily signs of guilt. An innocent person may be apprehensive and appear guilty" Ekman reminds us. With regard to his studies, lies about emotions at the moment have the biggest payoff from face and voice cues while lies about beliefs and actions, such as crimes use cues from gestures and words are added. Ekman and his associates have validated many signs of deception, but do not publish all of them as not to educate criminals.

DePaul and her graduate student Morris have been studying the verbal and written output of liars to find distinctive patterns. They have found that "liars take longer to start answering questions than truth-tellers--but when they have time to plan, liars actually start their answers more quickly than truth-tellers. And they talk less." When considering the perception of others, "liars seem more negative--more nervous and complaining, and less cooperative--than truth-tellers" and they additionally seem to withhold more information. Individuals lying sound "more discrepant and ambivalent, the structure of their stories is less logical, and their stories sound less plausible." Additionally, it has been observed that they are more likely than those telling the truth to repeat words and phrases, but they also use fewer hand movements to aid in the description of their actions.

James Pennebaker uses the method of Linguistic Inquiry and Word Count (LIWC), published by Lawrence Erlbaum, to conduct an analysis of written content. He claims it has accuracy in predicting lying. Pennebaker cites his method as "significantly more effective than human judges in correctly identifying deceptive or truthful writing samples"; there is a 67% accuracy rate with his method, while trained people have 52% accuracy. There were five experimental procedures used in this study. Study 1-3 asked participants to speak, hand write or type a true or false statement about abortion. The participants were randomly assigned to tell a true or false statement. Study 4 focused on feelings about friends and study 5 had the students involved in a mock crime and asked to lie. Human judges were asked

to rate the truthfulness of the 400 communications dealing with abortion. The judges read or watched the statement and gave it a yes or no answer about if this statement was false or not. LIWC correctly classified 67% of the abortion communications and the judges correctly classified 52%. His studies have identified that deception carries three primary written markers. The first is fewer first-person pronouns. Those lying "avoid statements of ownership, distance themselves from their stories and avoid taking responsibility for their behaviour" while also using more negative emotion words such as "hate, worthless and sad." Second, they use "few exclusionary words such as except, but or nor" when "distinguishing what they did from what they did not do."^{[6][7]}

IV. COMPONENTS IN LIE DETECTION

A. *Polygraph*

Lie detection commonly involves the polygraph; however, it is not considered reliable by some. It detects autonomic reactions. These changes in body functions are not easily controlled by the conscious mind and include bodily reactions like skin conductivity and rate. They also may consider respiration rate, blood pressure, capillary dilation, and muscular movement. While taking a polygraph test the subject wears a blood pressure device to measure blood pressure fluctuations. Respiration is measured by wearing pneumographs around the chest, and finally electrodes are placed on the subject's fingers to measure skin conductivity. To determine truth, it is assumed the subject will show more signs of fear when answering the control questions compared with the relevant questions. If a person is showing a deception, there will be changes in the autonomic arousal responses to the relevant questions. Results are considered inconclusive if there is no fluctuation in any of the questions. These measures are supposed to indicate a short-term stress response which can be from lying or significance to the subject. The problem becomes that they are also associated with mental effort and emotional state, so they can be influenced by fear, anger, and surprise for example. This technique may also be used with CQT and GKT. There are many issues with polygraph tests because many people have found ways to try and cheat the system. Some people have been known to take sedatives to reduce anxiety; using antiperspirant to prevent sweating;

International Journal of Engineering Research in Computer Science and Engineering (IJERCSE)

Vol 3, Issue 12, December 2016

and positioning pins or biting parts of the mouth after each question to demonstrate a constant physiological response.

B. Erp

Event-related potentials assess recognition, and therefore may or may not be effective in assessing deception. In ERP studies P3 amplitude waves are assessed, with these waves being large when an item is recognized. However, P100 amplitudes have been observed to have significant correlation to trustworthiness ratings, which the importance of will be discussed in the EEG section. This, along with other studies leads some to purport that because ERP studies rely on quick perceptual processes they "are integral to the detection of deception."

C. Erg

Electroencephalography, or EEG, measures brain activity through electrodes attached to the scalp of a subject. The object is to identify the recognition of meaningful data through this activity. Images or objects are shown to the subject while questioning techniques are implemented to determine recognition. This can include crime scene images, for example. Perceived trustworthiness is interpreted by the individual from looking at a face, and this decreases when someone is lying. Such observations are "too subtle to be explicitly processed by observers, but does affect implicit cognitive and affective processes." These results, in a study by Heussen, Binkofski, and Jolij, were obtained through a study with an N400 paradigm including two conditions within the experiment: truthful faces and lying faces. Faces flashed for 100ms and then the participants rated them. However, the limitations of this study would be that it only had 15 participants and the mean age was 24.

D. Eye-Tracking

John Kircher, Doug Hacker, Anne Cook, Dan Woltz and David Raskin have developed eye-tracking technology at the University of Utah that they consider a polygraph alternative. This is not an emotional reaction like the polygraph and other methods but rather a cognitive reaction. This technology measures pupil dilation, response time, reading and rereading time, and errors. Data is recorded while subjects answer true false questions on a computer.

They have found that more effort is required by lying than giving the truth and thus their aim to find indications of hard work. Individuals not telling the truth might, for instance, have dilated pupils while also taking longer to answer the question.

E. Voice Risk Analysis

Voice risk analysis or Voice stress analysis uses computers to compare pitch, frequency, intensity and micro tremors. In this way voice analysis "detect minute variations in the voice thought to signal lying." It can even be used covertly over the phone, and has been used by banking and insurance companies as well as the government of the United Kingdom. Customers are assessed for truth in certain situations by banks and insurance companies where computers are used to record responses. Software then compares control questions to relevant questions assessed for deception. However, its reliability has been debated by peer-reviewed journals. "When a person lies, an involuntary interference of the nerves causes the vocal cords to produce a distorted sound wave, namely a frequency level which is different from the one produced by the same person when telling the truth."

Recently conducted studies have however, identified that the detection of deception is possible with the use of voice stress analysis software loaded onto a laptop computer. In a study published December 7, 2013, the International Journal of Electrical, Electronics and Computer Engineering (IJEECE) found that Voice Stress Analysis (VSA) technology can identify emotional stress better than polygraph.

F. Fmri

Functional magnetic resonance imaging is a technique used for multiple purposes which shows the uses of oxygen by the brain, allowing for the identification of which portions of the brain are using more oxygen, and thus being used during a specific task. This is called the Blood Oxygen Level Dependent or BOLD response. The first model of the magnetic resonance imaging (MRI) was built by Raymond Damadian and his colleagues in 1976. It revolutionized the field of anatomical study by providing images in real-time and 3-D models of human parts. The technique is also used in drug development, a wide-variety of research efforts, and diagnostically. [6][7][8][9] [10] [11] [12] [13] [14] [15]

**International Journal of Engineering Research in Computer Science and Engineering
(IJERCSE)**
Vol 3, Issue 12, December 2016

V. DRAWBACKS OF LIE DETECTOR

Lie detector are not reliable and they do not tell the examiner whether the subject is telling the truth or lying as they can only indicate a lie based on the physiological reactions to the questions asked. The examiner can be swayed by the individual's physiology or he could be bias. Some people are very nervous while others are unshakable. Some people can control their physical reactions which all makes for a less reliable result. Polygraph tests are used to test whether an employer can trust an employee but these tests can damage the trust an employee has with an employer. Even if an employee passes a polygraph test, the fact that he was asked to do the test can cause great resentment, discomfort and anger. Employees sometimes feel their employers do not trust them. This can make employees decrease their performance and overall production.

A polygraph test may produce a mixed result. An honest employee may have failed answers to the test because she was afraid of the test and her physical reactions to the fear were misread by the machine. The company could waste time on a false investigation and wrongly accuse an honest person of misconduct as a result of false positives on the test. False accusations can damage moral and give the employee a right to take the employer to court. Charlie Hodgson has worked with private detectives as a private investigator. During his many years of experience working on investigations and carrying out detective work he has witnessed the need for numerous polygraph tests. Having worked alongside many highly trained polygraph examiners he has gained the knowledge of how the polygraph machine works and the expert way the examiner carries out the test. [16]

VI. FUTURE OF LIE DETECTION

Although the scientific base for detecting deception remains weak, scientific analysis remains the best way for government agencies to assess techniques that are presented as useful for detecting and deterring criminals and national security threats and to develop improved methods. This section suggests ways that federal agencies should evaluate purported techniques for detection of deception or of concealed information. The next section recommends a program of research aimed at improving the capability for detection and

deterrence. Government agencies will continue to seek accurate ways to detect deception by criminals, spies, terrorists, and others who threaten public safety and security interests.[17]

VII. CONCLUSION

Claims that a technique is valid for the detection of deception should be accompanied by evidence of accuracy. The broader the range of examinees, examiners, situations, and social contexts in which accuracy is demonstrated, the greater the confidence that a technique will perform well across various applications. Agencies assessing claims of accuracy should consider the degree to which the studies offered to support the claims embody a number of features shared by good validation research in this area. Polygraph testing, though exhibiting accuracy considerably better than chance under a variety of conditions, has characteristics that leave it far short of what would be desirable for screening programs to distinguish individuals who pose threats to national security from innocent examinees. The research base for precisely quantifying the accuracy of polygraph testing is also far from what would be desirable. During our deliberations we repeatedly discussed how polygraph research might have been done better, what alternatives to the current instruments and tests would most sensibly take modern psychophysiological understanding into account, and what evidence we ourselves would find compelling as support for a technique for the physiological detection of deception. We also asked ourselves whether there would be much practical or scientific gain from incremental research on polygraph testing and scoring techniques and on the other detection techniques discussed throughout this report.

REFERENCES

- [1] The polygraph and lie detection. Washington, D.C: National Academies Press. 2003. pp. 4–5. ISBN 0-309-08436-9.
- [2] Adelson, Rachel (July 2004). "Detecting Deception". Monitor on Psychology (American Psychological Association) 37 (7): 70. Retrieved 26 April 2012.

**International Journal of Engineering Research in Computer Science and Engineering
(IJERCSE)**
Vol 3, Issue 12, December 2016

- [3] "Detecting Deception". Parliamentary Office of Science and Technology (UK). Retrieved 26 April 2012.
- [4] The polygraph and lie detection. Washington, D.C: National Academies Press. 2003. pp. 4–5. ISBN 0-309-08436-9.
- [5] <http://people.howstuffworks.com/lie-detector.htm>
- [6] Keeler, Leonarde (January 1930). "A Method for Detecting Deception". American Journal of Police Science 1 (1): 38–51. doi:10.2307/1147254. Retrieved 26 April 2012.
- [7] "Guide to Washington Post Fact Checker Rating Scale". Voices.washingtonpost.com. December 29, 2011. Retrieved January 3, 2012.
- [8] American Psychological Association (2004). The Truth About Lie Detectors(akaPolygraphTests). <http://www.apa.org/research/action/polygraph.aspx>
- [9] Electronic Privacy Information Centre. Polygraph Testing.<https://epic.org/privacy/polygraph/>.
- [10] "Education psychologists use eye0tracking method for detecting lies". psychologalscience.org. Retrieved 26 April 2012.
- [11] Njemanze, P. C. (2005). Cerebral lateralization and general intelligence: Gender differences in a transcranial Doppler study. *Brain and Language*, 92, 234–239.
- [12] Simpson JR (2008). "Functional MRI lie detection: too good to be true?". *J. Am. Acad. Psychiatry Law* 36 (4): 491–8. PMID 19092066.
- [13] Spence SA, et al. Behavioural and functional anatomical correlates of deception in humans. *Neuroreport*. 2001 Sep 17;12(13):2849-53.
- [14] Langleben DD, et al. Brain activity during simulated deception: an event-related functional magnetic resonance study. *Neuroimage*. 2002 Mar;15(3):727-32.
- [15] Lee TM, et al. Lie detection by functional magnetic resonance imaging. *Hum Brain Mapp*. 2002 Mar;15(3):157-64.
- [16]<http://people.howstuffworks.com/lie-detector.htm>
- [17] <http://www.nap.edu/read/10420/chapter/10>