

Facial psychophysiology in forensic investigation: A novel idea for deception detection

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Abstract

Background: Polygraph or lie detection test has been used since early 90s as an effective method in forensic investigations. However, polygraph does not have a stand-alone value in legal forums. Any novel scientific addition can strengthen the credibility of the polygraph. **Aim:** This study aims to determine whether the deception could be detected with the help of polygraph where electromyography (EMG) readings of the masseter muscle, along with electrocardiography and galvanic skin response, were considered. **Materials and Methods:** The study was conducted on 14 participants in a well-established research setup. Card Test and Affirmative Test were performed on participants and the readings were critically analyzed. **Results:** In both the tests performed, the deceptions were easily detected once and rarely detected twice. In some cases, the deceptions were undetected. **Conclusion:** The result indicated with minimal credence that EMG helps in detecting deception. The accuracy of detection however can be confirmed only after an extensive research.

Key words: Deception, electrocardiography, electromyography, galvanic skin response, lying, polygraph


Introduction

Deception is “an act that is intended to foster in another person a belief or understanding which the deceiver considers to be false.”^[1] For example, a boy who mistakenly claims the pencil as his own is not lying, whereas a boy who claims that the pencil is his, despite knowing that it is not, is lying. One must be attentive to such a misconception to learn to differentiate truth from a lie. False beliefs can be detected from an individual's behavior, speech content, or physiological responses. People can remember emotional

events that never took place. In a study,^[2] the results indicated that the participants recovered the complete memory of a false event, which cannot be considered lying. Lying is an intentional act, and if two individuals contradict each other it is not called as lying. Two individuals who witnessed a crime will recall the event differently and will have their own individual version of the crime. Their sentences might contradict each other. This does not mean

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that one of them is lying but would mean that either of them misremembered the event.

Another aspect of deception is the statement made by the individual. If an individual makes a statement and believes that whatever he or she said is untrue, it is a lie. According to Ekman, people are assumed to be lying when they do not inform others about their intentions to lie.^[3] The act by magicians is not deception because audiences expect to be deceived by him. Many times, people do not try to unearth the truth so very often lies can remain detected.^[4] Aldert Vrij said, “a successful or unsuccessful deliberate attempt, without forewarning, to create in another a belief which the communicator considers to be untrue.”^[5]

There is yet another type of deception, known as self-deception. Self-deception has both negative and positive features. First, people can ignore several bodily symptoms, for example, pain in the chest. This can be life-threatening. Second, self-deception is used to help to protect the self-esteem of an individual.

Lying arouses certain emotions in individuals when they lie, but these emotions are “leakages,” that is, they are in the form of observable characteristics.^[6] Ekman gave a list of clues to be examined to see if someone is lying. They are:

1. Frequent swallowing, faster or slower breathing, sweating, increased blinking, and pupil dilation
2. Loud speech
3. Pauses and speech errors – suggest a lack of preparation of the story or strong negative emotions, such as fear
4. Whitening of the face due to anger or fear
5. Increased pitch of the voice.

This is due to the influence of the autonomic nervous system on intellectual and emotional acts of an individual. While speaking, the autonomic nervous system causes a significant effect on sympathetic and parasympathetic pathways, leading to definite physiological manifestations.^[7] Ekman also gave clues for facial expressions. They are:

1. Asymmetrical facial expressions
2. The onset of the emotion should not be too abrupt, as this a sign of falseness
3. The negative emotion that does not involve sweating or changes in breathing pattern
4. Fear and sadness involve characteristics of forehead expression involving eyebrows. If this is missing, the emotion is false.

On the flip side, the speech patterns also stand as effective indicators of deception. The modulation of speech has an inherent variation while uttering truth or lie.^[8] This scientific truth can be effectively utilized for discerning veracity and falsity.

The polygraph is a device which records changes in a individual’s blood pressure and pulse, rate of inspiration,

expiration and depth of respiration, and galvanic skin response (GSR) (resistance of the skin to electric current) all at a time. The polygraph or lie detector records physiological responses to support the individual’s notion of lying. The instrument, which is a computerized recording system, typically used to measure the physiological changes which indicates autonomic arousal such as heart rate, blood pressure, respiration, and skin conductivity. Various accessories are attached to the individual to measure the aforementioned physiological parameters.

A typical polygraph usually contains the recording of instrument and questioning techniques as a part. A typical examination includes:

- A pretest phase interview, which is designed to ensure that individuals understand the questions and to induce an individual’s concern about being deceptive
- Polygraph examinations are then followed by a “stimulation test,” which is an evaluation of the instrument’s precision in spotting deception. Even for screening tests, questions are custom made as per the given solution.^[9]

The polygraph can also measure false-positives; meaning stating that the individual is lying when he/she is actually telling the truth.

Many techniques of questioning are commonly used in these tests. Control Question Test (CQT) is the one widespread test format for individuals in criminal incident investigations. The CQT equates answers to “relevant” questions (e.g., “Were you present at the crime scene?”), with those of “control” questions. The control questions are designed to control for the effect of the generally threatening nature of relevant questions.

It is an assumption that even though one is telling the truth, he/she might fear controlled questions more than relevant questions. This may be because even if relevant questions ultimately lead to the detection of deception, the controlled questions are the ones which arouse a person’s concern about their past truthfulness. This comparison between responses of an individual to relevant questions and controlled questions leads to the detection of “deception.” If a person’s responses are more to “relevant questions,” it can be inferred that he/she may be lying. If there is more response to “controlled questions,” it leads to a judgment of nondeception. It may happen that there is no difference in responses to relevant and controlled questions. At such instances, the test is considered as “inconclusive.”^[10]

A similar procedure called the Guilty Knowledge Test (GKT) is a questioning test that can be used as part of a polygraph examination which is employed to assess whether suspects reveal “guilty knowledge” by measuring their physiological responses while they respond to a series of multiple-choice questions.^[11] One limitation of the GKT is that it can be used

only when investigators have information that only a guilty individual would know.^[10] Therefore, a study was planned to investigate the deceptive patterns in male and female participants using research polygraph, which comprised electromyography (EMG), electrocardiography (ECG), and GSR.

Materials and Methods

The study was carried out at our polygraph laboratory, equipped with high-quality research facilities for neuropsychological and forensic studies. A group of 14 voluntary individuals (7 males and 7 females) of similar anthropometric variables was chosen for the study. Individuals who had facial trauma or grew beards and those who were uninterested and apprehensive were excluded from the study.

The participants were informed about the study and requested to follow the given instructions. The EMG electrodes were placed along the course of the superficial belly of the masseter muscle, bilaterally, approximately 2 cm superior and 1.5 cm anterior to the angle of the mandible. Concurrently, the ECG and GSR recordings of a routine polygraph examination were made. A card test and an affirmative test were administered by a single examiner, on each participant, twice, to avoid intraexaminer errors. ECG readings, GSR readings, and the questions for which the patients were honestly supposed to say yes/no were taken as controls. The questions which contained deception were noted with reference to the timings in the recording process and correlated with the obtained graphical recordings. All the deceptions recorded in the graph were noted and were qualitatively measured by calculating the percentage of accuracy derived from the study.

The polygraph profiling was carried out by the polygraph instrument of Limestone Technologies supplied by Axxonet Solutions India. It consists of Limestone DataPac (data acquisition system), two respiration pneumatic transducers, electrodermal activity electrodes, pneumatic blood pressure cuff and electronic countermeasures cushion. The data acquisition system consists of a headbox which houses all other parameters in it and is connected to the system [Figure 1].

Results

The statistical analysis of the acquired data shows that overall in 14 participants, the card test shows 57.14% deception, whereas in the affirmative test, 31.43% shows deception the first time. When the tests were conducted again, 14.29% deception was detected in the card test and 1.43% deception was detected in the affirmative test. The analysis also shows that about 28.57% data in the card test were undetected and 67.14% in the affirmative test were undetected [Figures 2 and 3].

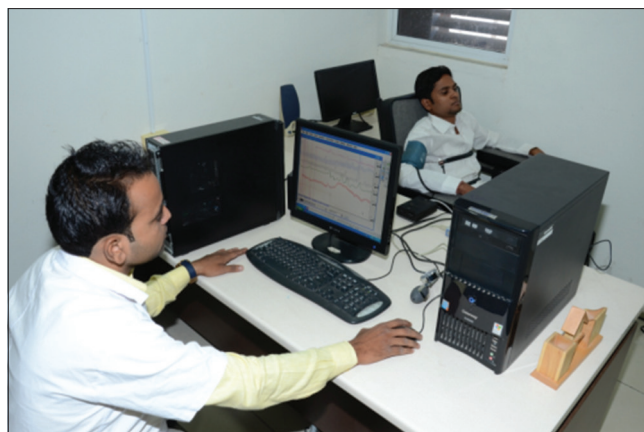


Figure 1: A participant during the study with all attachments of a research polygraph

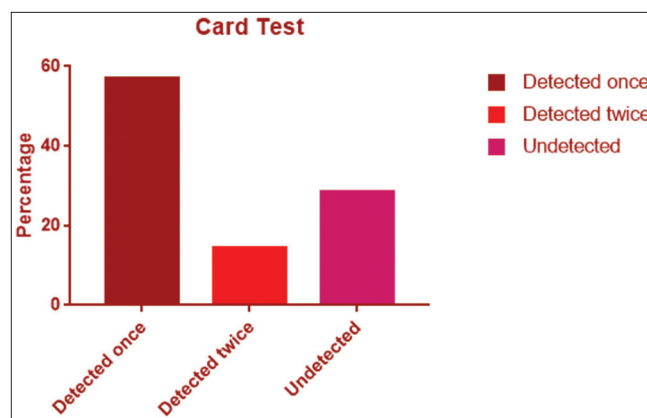


Figure 2: Results of the “Card Test” employed in the study

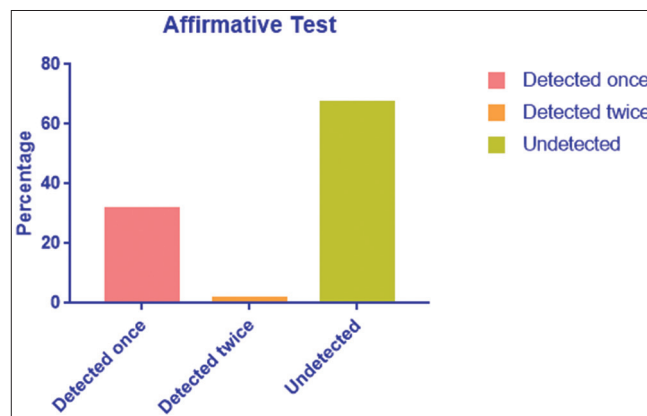


Figure 3: Results of the “Affirmative Test” employed in the study

Discussion

Deception is a premeditated attempt to convince someone of something that the liar believes are untrue, is a fact of regular life.^[12] Deception is not always an outward-facing act. There are also the lies people tell themselves for reasons ranging from healthy maintenance of self-esteem to serious delusions beyond their control. While lying to oneself is generally perceived as harmful, some experts argue that

there are certain kinds of self-deception – like believing one can accomplish a difficult goal even if evidence exists to the contrary – that can have a positive effect on overall well-being.

Heart rate, blood pressure, and other cardiovascular processes can be affected by perceived threats, the anticipation of a threat or activity, increased physical or mental activity, and/or any form of specific or general arousal. They may be distinct among different individuals (more so in individuals with active mental illnesses) and may even differ for the same individual under different circumstances.^[13] Quite a few examiners use written statements about a crime as the focus of the polygraph test. On the polygraph test, examinees are not asked directly if they committed some crime or not, but they are asked if they falsified their statement about the illicit act.^[14]

Experts neither claim nor have they proved that the polygraph measures deception directly. Some polygraph theories also state that an indicator if the examinee is being deceptive would be to compare the physiological responses to questions relevant to the issue being investigated to those responses to comparison questions. If the responses to relevant questions are more, the examinee may be deceptive.^[15]

The aim of this study was to determine whether the deception could be detected with the help of a polygraph where EMG readings of the masseter muscle, along with ECG and GSR, were considered. Cognitive appraisal plays a significant role in triggering emotion and physiological reactions. These reactions should be interpreted with caution as it is not clear which emotion has elicited which pattern of response.^[16]

The participants were informed about the study and requested to follow the given instructions. The EMG electrodes were placed along the course of the superficial belly of the masseter muscle, bilaterally, approximately 2 cm superior and 1.5 cm anterior to the angle of the mandible. Concurrently, the ECG and GSR recordings of a routine polygraph examination were made. A card test and an affirmative test were administered by a single examiner, on each participant, twice, to avoid intraexaminer errors.

From the statistical analysis, we can conclude that the electrodes on the masseter muscles can detect mild physiological responses to deception. The readings from the EMG indicate that EMG can support the data from GSR and ECG to furthermore prove the deception and EMG could be a good addition to the polygraph instrument.

Conclusion

The results obtained from the present study indicate that the masseter muscle where the EMG electrodes were placed

helps in detecting deception along with GSR and ECG. The differences in the amplitude and variations in the reading were clearly visible while deception during data recording. Furthermore, the statistical analysis reveals the same, suggesting that when lying, the muscle of masseter, skin conductance, and cardiac rhythm undergo apparent changes compared to when an individual is not deceiving. However, this study is limited to 14 participants. This study could be applied to larger populations, and further results could be studied. In this study, false positives were not noted, and this could also be a part of further research. Along with the recordings on masseter muscles, other physiological changes that could be recorded could be looked into, which could also be an addition to the polygraph instrument.

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Conflicts of interest

There are no conflicts of interest.

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