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Combined Use of Polygraph and Layered Voice Analysis in a Homicide Investigation: A Case Study

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ABSTRACT

In criminal investigations that offer little direct physical evidence, psychological and behavioural tools assist investigators in identifying an offender and establishing motive. This paper presents a case study of an eight-year-old boy's homicide, initially reported as a missing-person matter, in which polygraph examination and Layered Voice Analysis (LVA) were applied in tandem to test the veracity of a suspect's statements. The suspect, a family acquaintance, confessed to the killing and led investigators to the disposal site, but the possible involvement of the victim's mother warranted further verification. Following the consent requirements laid down by the Supreme Court of India, the suspect underwent a Modified General Question Test on the polygraph and a subsequent LVA session. The polygraph indicated truthfulness on the act of murder but deception on questions of motive and the mother's involvement, while the LVA session recorded an absence of cognitive and emotional stress after the suspect elaborated on both the crime and its motive. The convergence of results from the two techniques helped elicit a fuller account and illustrates the practical, corroborative value of combining deception-detection methods, subject to their acknowledged evidentiary and reliability limitations.

Keywords: Deception detection, polygraph, Layered Voice Analysis, forensic psychology, criminal investigation, homicide.

I. INTRODUCTION

In complex criminal investigations, especially those with limited physical or material evidence, psychological tools play a critical role in identifying the offender and establishing motive. Deception-detection technologies have evolved to support this endeavour. Deception has been defined as a deliberate act intended to foster in another person a belief or understanding that the deceiver considers false.¹ It involves motive, the delivery of false information, and an effort to

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¹ Miron Zuckerman, Bella M. DePaulo & Robert Rosenthal, *Verbal and Nonverbal Communication of Deception*, 14 ADVANCES IN EXPERIMENTAL SOCIAL PSYCHOLOGY 1, 3 (1981).

mislead. In any crime scenario it is therefore important to identify deception and intention in order to hold a person accountable through the justice-delivery process.

A range of tools has been developed to detect deception, extending from verbal and non-verbal cues, such as facial expressions and voice analysis, to physiological measures such as the polygraph and neural techniques such as functional magnetic resonance imaging and electroencephalography.² Among these, the polygraph and LVA stand out for their applicability in field investigations. A comparison between the polygraph and Layered Voice Analysis is set out in the table below.

Parameter	Polygraph	Layered Voice Analysis (LVA)
Primary Principle	Measures physiological changes (e.g., heart rate, respiration, skin conductance) associated with stress and deception	Based on changes in voice associated with emotional and cognitive load
Measured Parameters	- Galvanic Skin Response (GSR) - Cardiovascular activity (blood pressure, heart rate) - Respiratory patterns	- amplitude - stress levels, cognitive dissonance
Data Collection Method	Uses multiple physiological sensors attached to the subject	Uses microphone or recorded speech samples
Test Environment	Controlled setting with pre-test, in-test, and post-test phases	Can be conducted in controlled or field environments; even via phone calls
Time Requirement	1–3 hours including pre-test interview and analysis	Minutes to hours depending on speech length
Subject Preparation	Requires cooperation, consent, and minimal movement	Minimal preparation
Scoring/Analysis Method	Numerical scoring (e.g., Empirical Scoring System), examiner interpretation, sometimes computer-assisted	Proprietary algorithms (e.g., Nemesysco model) analyze speech parameters
Scientific Validation	Relatively more studied; accuracy estimates vary but subject to countermeasures	Limited peer-reviewed validation
Best Use Case	Structured, formal deception detection during investigations	Rapid screening, remote monitoring, and supplemental

² Nina Lisofsky et al., *Investigating Socio-Cognitive Processes in Deception: A Quantitative Meta-Analysis of Neuroimaging Studies*, 61 NEUROPSYCHOLOGIA 113 (2014); Giorgio Ganis et al., *Neural Correlates of Different Types of Deception: An fMRI Investigation*, 13 CEREBRAL CORTEX 830 (2003); Ronald P. Fisher, R. Edward Geiselman & David S. Raymond, *Critical Analysis of Police Interviewing Techniques*, 8 J. POLICE & CRIM. PSYCHOL. 2 (1992).

Parameter	Polygraph	Layered Voice Analysis (LVA)
		analysis, motive or intention identification
Limitations	Requires controlled environment, susceptible to anxiety unrelated to deception, Questioning techniques	Sensitive to background noise, health of vocal cords, and emotional states unrelated to deception

Comparison between Polygraph and Layered Voice Analysis (LVA)

Despite criticism regarding its limitations,³ the polygraph continues to play a significant role in investigative psychology.⁴ Polygraph testing has shown accuracy rates ranging from roughly 70 to 90 per cent under controlled conditions.⁵ LVA, by contrast, is a newer technique that evaluates vocal stress by reference to the cognitive-dissonance framework, identifying inconsistencies and deception through voice parameters such as cognitive stress and emotional stress.⁶ Studies have reported that voice analysis is able to detect cognitive dissonance and emotional and psychological stress.⁷

II. CASE DESCRIPTION

This case concerns the murder of an eight-year-old boy, initially reported as a missing person. Investigation revealed that the boy was last seen with Mr. D, a forty-one-year-old married male, educated up to the twelfth standard, a farmer by profession and a family acquaintance. Mr. D later confessed to the murder and led investigators to the disposal site. In his statement, Mr. D disclosed that he had been in an illicit relationship with the victim's mother for four years. The boy had reportedly witnessed their physical intimacy, which alarmed his mother. Mr. D alleged

³ NATIONAL RESEARCH COUNCIL, *THE POLYGRAPH AND LIE DETECTION* (2003); ALDERT VRIJ, *DETECTING LIES AND DECEIT: PITFALLS AND OPPORTUNITIES* (2d ed. 2008).

⁴ John Synnott, David Dietzel & Maria Ioannou, *A Review of the Polygraph: History, Methodology and Current Status*, in *REVIEWING CRIME PSYCHOLOGY* 50 (David Canter & Donna Youngs eds., 2021); Raymond Nelson, *Scientific Basis for Polygraph Testing: Field Studies and Accuracy Rates*, 44 *POLYGRAPH* 1 (2015).

⁵ John C. Kircher & David C. Raskin, *Human Versus Computerized Evaluations of Polygraph Data in Field Examinations*, 73 *J. APPLIED PSYCHOL.* 291 (1988); Gershon Ben-Shakhar & Eitan Elaad, *The Validity of Psychophysiological Detection of Information with the Guilty Knowledge Test: A Meta-Analytic Review*, 88 *J. APPLIED PSYCHOL.* 131 (2003); David C. Raskin & Charles R. Honts, *The Comparison Question Test*, in *HANDBOOK OF POLYGRAPH TESTING* 1 (Murray Kleiner ed., 2002). The estimated accuracy of laboratory studies is widely regarded as higher than field accuracy: see NATIONAL RESEARCH COUNCIL, *THE POLYGRAPH AND LIE DETECTION* (2003).

⁶ Leon Festinger, *A Theory of Cognitive Dissonance* (1957); see also LVA Technology, NEMESYSO, <https://www.nemesysco.com/lva-technology/>.

⁷ Frank Horvath et al., *The Accuracy of Auditors' and Layered Voice Analysis (LVA) Operators' Judgments of Truth and Deception During Police Questioning*, 58 *J. FORENSIC SCI.* 385 (2013); William J. Mayew, Christopher A. Parsons & Mohan Venkatachalam, *Voice Pitch and Managerial Dishonesty*, 106 *J. FIN. ECON.* 673 (2012); Michael Jessen, Sushant K. Sharma & Tobias Bocklet, *Voice Analysis for Detection of Deception*, 17 *INT'L J. SPEECH LANGUAGE & L.* 37 (2010); Norihide Kitaoka, Keiichi Hirose & Keiichi Tokuda, *Speech-Based Deception Detection Using Support Vector Machines*, 50 *SPEECH COMM.* 738 (2008).

that the mother, fearing exposure, instructed him to eliminate her son and guided him on how and where to dispose of the body.

The murder occurred during a family gathering. Mr. D took the boy to a secluded lakeside area, strangled him, and concealed the body under bushes before returning to the gathering and signalling the mother.

Mr. D was charged with abduction, murder, and destruction of evidence under the Indian Penal Code.⁸ Because of the implications for the boy's mother, further investigation was warranted to establish the veracity of Mr. D's claims. As part of the inquiry, psychological assessments, including polygraph and LVA, were authorised by the court.

III. METHODS

Mr. D was informed of his right to refuse to undergo any psychological examination or test. He gave his consent, in accordance with the guidelines of the Supreme Court of India, to undergo psychological examinations and testing.⁹

A. Phase 1: Interview and psychological screening

Mr. D was found to be mentally sound and cooperative. He initially denied involvement, contradicting his earlier confession. During the polygraph examination, he admitted to the murder but did not mention any motive and answered in the negative to questions relating to motive. In the LVA session, conducted on the same day as a separate session after a break, he elaborated on both the crime and his motive, implicating the mother.

Four key issues were identified for verification. These were finalised on the basis of the investigation and the information provided by the investigating agency and the subject: first, whether the murder was due to enmity, financial dispute, or black magic; second, whether Mr. D had a sexual relationship with the victim's mother; third, whether the mother instigated Mr. D to kill the boy; and fourth, whether the mother guided the disposal of the body.

After the issues were finalised, a Modified General Question Test (MGQT) questionnaire was prepared, containing relevant questions related to the crime under investigation, general questions eliciting personal information, and control questions used for comparison. Studies

⁸ INDIAN PENAL CODE, No. 45 of 1860, §§ 302 (murder), 364 (kidnapping or abducting in order to murder), 201 (causing disappearance of evidence).

⁹ *Selvi v. State of Karnataka*, (2010) 7 SCC 263 (holding that narco-analysis, polygraph, and brain-mapping tests may not be administered without the subject's consent).

have shown the effectiveness of this question method in the detection of deception and the reduction of examiner bias.¹⁰

B. Phase 2: Polygraph and LVA testing

For the polygraph procedure, the process was first explained to Mr. D, who was then fitted with sensors measuring electrodermal activity (galvanic skin response), cardiovascular activity (heart rate and blood pressure), and respiratory patterns to monitor physiological responses. A baseline recording was taken first. He was then asked questions based on the four issues, to each of which he answered 'yes' or 'no'. The questionnaire was repeated three times during the examination and his answers were recorded. After the three runs, a two-minute post-recording was taken, and he was then released from the instrument.

For the LVA procedure, a verbal interview was recorded digitally and analysed using LVA software. Mr. D was asked open-ended questions focusing on the four issues. His responses were analysed using the proprietary system of Nemesysco, an Israel-based developer, applying algorithms across cognitive, emotional, and stress parameters.

IV. RESULTS

On the polygraph test, scoring was based on physiological responses across all three charts to the relevant issues pertinent to the crime, compared with responses to control questions. A positive score indicated truthfulness and a negative score indicated deception, with each response scored between -3 and +3. The polygraph test scores are set out in Table 1.

Sr. no.	Issues	Answers	Score
1	He killed the boy	yes	+
2	He killed the boy for black magic	no	+
3	He attempted to molest the boy in anyways	no	+
4	He killed the boy because boy's family did not allow him to adopt	no	+
5	He killed the boy for human sacrifice	no	+
6	Boy's family did not returned money to Mr. D he owed	no	+
7	He killed the boy because he had illicit relation with boy's mother	no	-
8	Boy's mother asked him to kill her son	no	-
9	Boy's mother refused to have physical relations with him	no	-

Table 1: Test scores on polygraph

¹⁰ Kircher & Raskin, *supra* note 5; Raskin & Honts, *supra* note 5; ALDERT VRIJ, DETECTING LIES AND DECEIT: PITFALLS AND OPPORTUNITIES (2d ed. 2008).

On interpretation, and based on the numerical scoring, Mr. D was truthful about the act of murder but showed deception on questions relating to motive and the mother's involvement.

The LVA findings indicated an absence of cognitive and emotional stress on all relevant issues. The LVA responses are set out in Table 2.

Issue	Response	Cognitive conflict	Stress level associated with deception	Risk level
Illicit relation with boy's mother	accepted	absent	absent	low risk
Boy saw them in compromising position	accepted	absent	absent	low risk
Boy's mother pressurized him to kill	accepted	absent	absent	low risk
Disposal location suggested by mother.	corroborated with crime scene identification	absent	absent	low risk
He killed the boy	accepted	absent	absent	low risk

Table 2: LVA Responses

On interpretation, the voice segments showed an absence of cognitive and emotional stress, a lack of anticipation, and no high-risk indicators in the segments of speech relating to the crime under investigation. As he had confessed to the crime and the intention behind it, there was psychological relief, and no conflict or dissonance was present.

Taken together, the deception recorded in the polygraph examination and the truthfulness recorded in the LVA analysis combine to indicate that Mr. D killed the boy and that the boy's mother also had a role in the act. Their illicit relationship appears to have been the main motive behind the killing, and the findings suggest that there was no reason to kill the boy other than that unlawful relationship.

V. DISCUSSION

One of the key challenges in criminal investigations is the lack of direct evidence linking a suspect to a crime. In such situations, investigators must rely heavily on circumstantial evidence and behavioural indicators to draw meaningful inferences. This is where forensic psychology and investigative tools such as the polygraph and LVA become relevant. Bearing in mind the limitations of the polygraph and LVA, in this case the issues were considerably clearer and required verification rather than identification through these techniques.

This case study examines a homicide investigation in which both polygraph and LVA were used to evaluate the veracity of a suspect's statements. The convergence of results from the two techniques played a pivotal role in eliciting a fuller account, thereby underscoring their potential value in real-world investigative settings. The question of the reliability and validity of these techniques was of less significance here because the subject confessed to the crime and the motive; the aim was to cross-check across different instruments while giving the subject an opportunity to respond. The anxiety of being caught, on the part of the mother, and her probable refusal to continue the relationship with Mr. D may have precipitated the murder of the boy. Ultimately, the subject's confessions led to the uncovering of the events.

As this study involves a single case, its findings cannot be generalised. There is a pressing need for more systematic research and controlled studies, particularly on the forensic applicability of LVA. Admissibility in a court of law may vary, but the results can be useful to the investigating agency. It bears emphasis that a confession made to a police officer, or while in police custody, is not admissible against the accused, subject to the narrow exception permitting proof of information distinctly relating to a fact thereby discovered.¹¹

VI. CONCLUSION

In any investigation, the use of a combination of psychological and behavioural techniques is a practical and evidence-informed strategy that can improve the consistency and credibility of deception-detection efforts.

¹¹ INDIAN EVIDENCE ACT, No. 1 of 1872, §§ 25-27.

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