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ANDRZEJ FRYCZ MODRZEWSKI KRAKOW UNIVERSITY

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From the Editors

Courtesy of the American Polygraph Association, we had the privilege, to publish the "Terminology Reference for the Science of Psychophysiological Detection of Deception, 4th Edition, 2022" in the previous issue of *European Polygraph* (2023, volume 17, No. 2 (58)).

The work has been, and continues to be, profoundly valuable for all those engaged in polygraph examinations and who use the results of such examinations, including judges, prosecutors, and law enforcement officers. It is also of great use for researchers conducting scientific inquiries in the field of psychophysiological detection of deception. Undoubtedly, it will contribute to the standardisation of terminology in the extensive scientific and professional literature. The authors, Donald Krapohl, Mark Handler, and Michael Lynch, are globally recognised authorities in this domain. Their "Terminology Reference..." merits profound respect and commendation.

The realisation that clarification and unification of terminology is a continuous process that, furthermore, must be pursued in parallel with the development of the field (science) it pertains to, and has to keep pace with such development, makes it evident that universally accepted terminology can only be adopted through consensus, preceded by open discussion within the professional community. Which is why the Editorial Board of *European Polygraph* initiates this discussion and kindly invites participation.

We begin by publishing two texts. The first is "A Handful of Remarks on the 'Terminology Reference for the Science of Psychophysiological Detection of Deception'" by Jan Widacki, and the other, titled "A Letter to the Editor Regarding the APA's Terminology Reference for the Science of Psychophysiological Detection of Deception" comprises comments presented by James Allen Matte in a letter to the authors of the "Terminology Reference...".

The Editorial Board commits to publishing texts that may contribute to the refinement of subsequent editions of the "Terminology Reference...". The published texts solely reflect the views of their respective authors and do not necessarily align with the views of the Editorial Board, whose position is articulated in the text by Jan Widacki, published in this issue.

Articles

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From Ancient Oracles to Modern Techniques: The Evolution of Deception Detection and the Benefits of Investigative Interviewing

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Abstract

Throughout history, different methods and instrumental designs have been used to identify and obtain the truth. Some of the methods described in this work are based on myths that have remained over time, but due to this legacy are unlikely to be applied, such as the Osiris judgment. In this study, we analyzed the characteristics of these methods, such as the period in which they were used, their scientific validation, and their passive or active approach according to the literature. Some approaches have established the theoretical foundations for the development of more precise technologies that are currently used, such as the Bisha Bedouin Court System (ordeal by fire), which is based on arousal theory (response). This work also includes innovative

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applications such as the use of interview techniques to detect deception, which stands out for their wide spectrum of use in different contexts. Finally, we mention elements of investigative interview models and highlight the benefits of using verbal approaches to detect deception.

Key words: history, evolution, deception detection, investigative interviewing

Background

Over time, different techniques and technologies have been used to detect deception, from the undercover Salem witch trials in Massachusetts (Ford, 2006) to the use of the brain fingerprint identification system in the XXI century (Wolpe et al., 2005) or Functional Magnetic Resonance (Kozel et al., 2005). This work, in addition to informing the reader about the various techniques used to detect deception, offers a classification of each technique, according to its type, application viability context, and degree of certainty. Not all the techniques presented in this text can be used in all scenarios; therefore, in our experience, the interview is the best way to assess deception in most situations. The main objective of the interview is to acquire information and assess its credibility. We will focus on the techniques that stand out for their operability and scientific support, such as information-gathering interviews, also known as ethical interviews or investigative interview techniques. Amongst the most notable is the Cognitive Interview (CI), which allows the use of cognitive approaches to detect deceit (Vrij et al., 2017), as well as the Strategic Use of Evidence (SUE) (Hartwig, 2005). We leave aside techniques not validated by the scientific community or those that are considered third-degree interrogation methodologies, consisting of emotional, physical, and cognitive coercive tactics (Leo, 2004).

History and evolution of deception detection

Ancient history

For many centuries, knowledge has equaled power. The employment of trustworthy information has served to win battles and money, as well as create religious, economic, and cultural empires. In a current context, the importance of using relevant and trusty information increases exponentially when talking about legal matters, it is crucial for the success of a product, service, or judgment about an act or person.

For thousands of years, attempts have been made to define the reliability of information from human sources. One of the oldest records addressing this type of cred-

ibility assessment practice can be seen in the myth of the trial of Osiris, 3500 B.C.E. (Assmann, 1989), in which Anubis, the grave keeper, removes the heart of a deceased person and places it on a scale to counterbalance a feather: the symbol of truth. From this, a jury of 42 judges questions the spirit of the deceased regarding the sins committed in life, the truth is determined from the weight of the heart in the postmortem trial.

A very creative way to detect deception was used in India (500 B.C.E.). In the sacred ass/donkey test, suspects were told that the animal would bray when a guilty subject grabbed its tail. Before the test, the investigator covered the animal's tail with soot. Due to the belief in the animal's supernatural powers, when the guilty suspect was sent alone into the chamber with the guilt-detecting ass, he passed by without grasping its tail, while the innocent subject grasped the tail as instructed, thus covering his hand with soot. The guilty subject, therefore, came from the chamber with clean hands (Keeler, 1938). In this example, the donkey, imbued with sacredness, acts as a supposed agent of a just world order, reinforcing the idea that the guilty will be exposed and punished, thus maintaining the illusion of a just world. The ritual plays on the suspect's fear and his own belief in a just world system (Lerner & Lerner, 1980).

The Odyssey, written in 800 B.C.E. by Homer (Vidal-Naquet, 2000), records the first use of social engineering to manipulate and deceive people. "The cyclops Polyphemus traps Odysseus and his men in a cave behind an enormous rock. Only the Cyclops is strong enough to move the rock, so Odysseus cannot escape. Instead, Odysseus hatches a plan. While the Cyclops is out with his sheep, Odysseus sharpens a piece of wood into a stake and hardens it in the fire. Then, he gives the Cyclops wine to get him drunk, and he tells the Cyclops that his name is "Nobody." When the Cyclops falls asleep, Odysseus blinds him with the hardened stake. Polyphemus' screams summon the other Cyclopes, but when he screams "Nobody's killing me!" they go away again" (Schein, 1970).

Physical behavior has also been considered important throughout the history of credibility assessment. For example, in Egyptian culture in 900 B.C.E., signs of stress from lying down were perceived as playing with hair, facial paleness, evasive behavior, and rubbing the big toe on the floor (Hocking et al., 1979; Trovillo, 1939). The same characteristics were observed in the sacred Hindu Yajurveda, written around 1000 B.C.E (Chand, 1980, p. 54).

The year 970 B.C.E., witnessed the trial of King Salomon (Francisco, 1953). To discover the truth in the dispute between two women who declared themselves to be the authentic mother of a child, the king decided that the best way to confirm it would be to suggest taking the child's life. After asking each woman for her opinion, one replied that it was fine to do so, however, the other, with tears in her eyes, cried out "Let her keep it!" (Giovanazzi & Linares, 2007). These words allowed the king to identify the true mother by probing instincts, observing emotional authenticity, and offering a forced choice that allowed the women's responses to be compared and contrasted. Salomon trial could be explained through the Social Cognitive Theory (Bandura & Walters, 1977), which emphasizes observational learning and social modelling. It could be argued that Salomon used his understanding of typical maternal behavior to identify the real mother, based on how most mothers would react in this heightened situation.

Middle Ages

The trial of Pontius Pilate occurred between 30–33 Common Era (C.E). During the trial, Pilate asked Jesus, 'So you are a king, are you not?', Jesus replied, 'You say that I am a king. For this reason, I was born and came into the world, to bear witness to the truth. Everyone who belongs to the truth listens to my voice.' When Pilate asked, 'What is truth?', Jesus did not answer. After this, he returned to the Jews and informed them that he found no guilt in Jesus (Agamben, 2015). During the trial, the crowd posed the question of who was to be crucified, Jesus or Barabbas. This exemplifies a trial conducted without physical evidence, which carries the risk of personal bias or crowd pressure in high-stakes situations. Such factors can lead to a subjective interpretation of the truth or social conformity (Mallinson & Hatemi, 2018). In this case, the crowd's decision resulted in the acceptance of a falsehood as the answer.

One way of assessing credibility, carried out by the Rajmahal tribes in North Bengal, was to put a burning iron on the accused's tongue nine times and, if burn injuries occurred, they were considered guilty (Segrave, 2003; Trovillo, 1939). Nowadays, Bedouin tribes (North Africa, Arabian Peninsula, Egypt, Israel, Iraq, Syria, and Jordan) still practice the hot iron lie detector applied to the tongue (Adrian, 2014; Houck, 2018).

In China, suspects were instructed to chew rice and spit it out a few minutes later; those who spit out dry rice, that is, rice without saliva, were considered guilty (Grubin & Madsen, 2005; Sullivan, 2001; Trovillo, 1939).

In the year 49 C.E., a Roman tale recounts the story of Empress Agrippina, who ordered the assassination of Lollia Paulina, her perceived rival for the imperial throne. Soldiers were sent to kill Lollia Paulina and were instructed to return with her head to confirm her death. However, the delay in returning Lollia Paulina's head resulted in the decomposition of tissues, rendering her face unidentifiable. Undeterred, Agrippina identified Lollia Paulina's head by examining her teeth, as she was known to have distinctive dental characteristics (Bowers, 2010). This exemplifies the comparison of the oldest records of a testimony (soldiers) with evidence, as in the Strategic Use of Evidence (SUE) technique, used to uncover false information during interviews in modern times.

Another mythical example is the Bocca della Verità mask (Underwood, 1995), one of the most famous attractions in Rome, situated on a wall inside the Cosmedin church in Santa María since the beginning of the 17th century. Legend says that it was used to obtain confessions from adulterers during medieval times (476 C.E.), i.e., the "mouth of truth" bit those who lied. A similar example is described in the work "Das Gottesurteil" (The Judgement of God) (Hepworth & Rahde, 1964), in which the subjects were obligated to put their hands into the mouth of a stone lion, in which lay a venomous serpent that only bit those who were guilty, and they died shortly after.

During the Inquisition and the witch trials (1478–1808 C.E.), the credibility test for identifying those who practiced witchcraft in Great Britain was mediated by signs, marks, or scars that appeared on the body. Once the suspects were identified, their hands and feet were tied and they were thrown into a lake or river. The final decision of guilt or innocence was determined by whether they "floated" or not. Those who were considered innocent sank and drowned during the trial, while the survivors were believed to be witches (Kramer & Sprenger, 1971).

In Mexico, the last Aztec Emperor Cuauhtémoc ruled Tenochtitlan from 1520 to 1521. During the battle for Tenochtitlan, Hernan Cortes questioned him about the hidden treasure of Moctezuma; Cuauhtémoc responded that it was just a myth. Cortes did not believe him; thus, he dipped his hands and feet in oil and set them on fire to discover the truth (foot roasting). Only then did the emperor

confess that the treasure had been thrown into the lagoon. This is an example of coerced confession (Kassin & Wrightsman, 1981; Rajagopalan, 2018).

In the 1850s, French forensic pathologist Augusto Ambrosio Tardieu stated that to distinguish truth or lie in allegations related to sexual abuse, the number of details in the statements should be observed. In 1886, Dr. Jerome Walker indicated that "the way in which children tell their stories, in their own words and expressions," was indicative of the authenticity of sexual abuse cases (Lamers-Winkelman, 2000). Both examples reveal one of the first attempts to detect deception through verbal approaches.

Other practices, such as instructions to identify poisoners by their conduct, claimed: "A poisoner can be identified. They do not answer questions or give evasive answers, they speak without meaning, rub the big toe on the ground and shake, their face loses color, they play with their hair, and they try to leave the building by all means..." (Wise, 1860).

Cesare Lombroso (1895) thought that psychophysiological measurement could be recorded with some type of instrumentation. This led to the creation of the polygraph in 1921 by John A. Larson (Synnott et al., 2015).

More recently, the use of "science" has become present, in the early 1900's, the so-called "truth serum" was used. It was believed that a combination of barbiturates administered to a suspect would cause him to provide true and accurate information about his actions (Piper, 1993). This technique was used by Sidney Gottlieb ("Mad scientist") in 1953 to get confessions and control the mind (Thomas, 2008).

In 1915, William Marston developed the 'systolic blood pressure deception test,' apparently stimulated by his wife's observation that her blood pressure increased when she became angry or excited (Lamb, 2001). For this reason, some investigators look at an interviewee's neck to try to observe and identify a "jumping vein", which is considered a lie detection clue (Hartley & Karinch, 2012; Morrison et al., 2007). Marston also gained fame under the pseudonym Charles Moulton as the creator of comic strip hero Wonder Woman, whose 'magic lasso' forced everyone caught by it, to tell the truth (Berlatsky, 2015; Grubin & Madsen, 2005). In 1923, he attempted to submit the results of his lie detector test as evidence in the case of James Frye, a 19-year-old man who had been accused of robbery and murder (United States v. Frye, 1924). Marston administered the lie on Frye test and concluded that he was telling the truth, although Frye was convicted. On appeal, the initial decision was upheld and the court decided that Marston's lie detector test had not

gained sufficient acceptance within the scientific community to be considered scientific evidence. Ironically, Frye was later exonerated and set free, suggesting that Marston may have been right all along (Office of Technology Assessment, 1983).

The 'Frye standard,' as it was known, became the test for the admissibility of scientific evidence in the US and remained a significant barrier to the inclusion of polygraph evidence in American courtrooms for the next 70 years. However, the Frye standard was eventually displaced in 1993 in the US Supreme Court's decision in Daubert v. Merrell Dow (Farrel, 1993).

In the 1970s, the UK government attempted to limit the immigration of fiancées from the Indian subcontinent. This was based on the unfounded assumption that these women were using a legal loophole in marriage to migrate. A credibility test was then used to determine whether the women had been previously married, as their word alone was not considered sufficient. The examination conducted was a 'virginity test', which is considered invasive and unscientific (Smith & Marmo, 2011). Female immigrants were frequently subjected to an examination that falsely claimed to determine whether they were virgins or not (Parekh & Datta, 2024). Passing this test was a prerequisite for women to enter the UK and get married. Similar tests are currently used in India, but they are intended to determine whether a woman has been raped or not (Bagcchi, 2017).

In World War II, the Scharff technique began to be used (1939–1949). Hanns Joachim Scharff created a framework with four main tactics (Granhag, 2010): 1) the friendly approach, 2) not pressing for information, 3) the illusion of knowing everything, and 4) the confirmation/disconfirmation tactic (May & Granhag, 2016; Oleszkiewicz et al., 2014). This approach allowed investigators to decrease the frequency of lies by establishing the facts through the disclosure of information.

In 1942, the Reid Interview & Interrogation was developed (Inbau, 1942) to replace "third-degree" interrogation methods (methods that inflict physical or mental suffering on a person to obtain information about a crime) (Keedy, 1936; Leo, 2004; Ortman, 2016). Reid's technique assesses credibility through a Behavior Analysis Interview (BAI). This technique, according to Masip et al. (2011), is based on common sense beliefs to identify guilt or innocence.

In the same decade, the Brain Fingerprint (BF) was developed. The BF detects concealed information stored in the brain by measuring brainwaves (P300) and identifying cognitive information processing with an encephalogram (Farwell, 1992, 1994, 1995a, 1995b, Farwell & Donchin, 1991). The Polygraph Concealed Infor-

mation Test (CIT) technique uses physiological responses to assess whether someone can differentiate crime details from irrelevant control information (Lykken, 1959).

Years later in Mexico (1996), through the attorney general offices of the Mexican Republic, the Federal Government used a psychic named "La Paca" to discover information about a murderer (Olmos, 2012), similar to the psychic (Troy Griffin) used by the FBI to solve cases in 2010 (NY post, 2016). This pseudo-investigation technique "allows investigators to uncover concealed information and validate that acquired by other means".

Another promising technique that has been studied in the twentieth century is Functional Magnetic Resonance Imaging (FMRI). The existence of a prefrontal-parietal-subcortical circuit has been demonstrated to be activated when deceivers produce simulated memory impairment. Brain activation Patterns in feigned memory would provide specific markers for the detection of deception. FMRI serves to investigate the precise nature of brain activation during feigned memory impairment, in particular, to determine whether it is distinguishable from normal recall (Lee et al., 2002).

In the state of Oaxaca, Mexico, in the region of Tehuantepec, there is still a ritual to show if a woman is pure and chaste, since her word is not considered enough. She is submitted to a "rapture", agreed upon by the families concerned, in which the man makes his future spouse show evidence of her virginity to society. He does this by publicly displaying a blood-stained sheet, which is presumed to show the loss of her virginity and purity (Vázquez, 2017).

Contemporary Techniques to Detect Deception

Throughout history, various methods have been employed to determine whether a person is lying or telling the truth. Previous examples have attempted to identify cues that distinguish deception from truthfulness. Many of these methods were based on the arousal theory to detect deception (De Turck & Miller, 1985). For instance, centuries ago, poisoners were identified by observing their behavior during questioning and looking for suspicious behavior. A guilty verdict was based on physiological manifestations derived from adrenergic responses, which influence human behavior, physiology, emotions, and the biochemistry of the body (Rinaman, 2011).

Today, technological advances have allowed investigators to indirectly observe physiological responses, such as with the polygraph. Also, evidence-based interview techniques have been developed that allow the application of verbal approaches to detect deception. In this regard, approaches to detecting deception can be classified into three categories: 1) psychophysiological technology-based techniques, 2) psychophysiological interview and interrogation techniques, and 3) investigative interviewing verbal approaches.

All of these categories involve the use of a stimulus, such as questions, to elicit physiological, nonverbal, or verbal responses. These responses may include an increase in heart rate, a change in posture, or the provision of specific details. The categories can be applied in a variety of settings, including formal or informal interviews, or through the use of technology, such as an oculomotor detection test (ODT), or voice stress analysis (VSA). The first two categories are referred to as arousal approaches. These methods aim to measure physiological changes associated with lying. The principle underlying this approach is that deception often triggers increased arousal in the nervous system, leading to detectable bodily responses (Ambach & Gamer, 2018; Handler & Honts, 2007; Vrij & Fisher, 2016; Vrij & Granhag, 2006).

Arousal approaches
Psychophysiological technology-based techniques, psychophysiological interviews, and interrogation techniques

These approaches are known as arousal-based lie detection tools because they rely on physiological reactions as indicators of deception (Vrij & Fisher, 2016). These indicators can originate in various organs and manifest as signs, which can be observed directly or indirectly (i.e., pupil dilation) (Langham et al., 1971), or symptoms, which are subjective experiences (i.e., emotional intensity or time distortion) (Brosnihan, 2023). Some signs can be observed through simple means, such as blushing, while others require the use of technology; for example, reactions in heart rate, skin color, intestinal movements, salivary gland excretions, pupil movements, smooth and striated muscle contractions, pituitary gland hormone release, etc. Each organ will react differently, releasing hormones or glycogen and increasing or decreasing activity.

These changes can affect verbal, nonverbal, or cognitive behavior, modifying or influencing thoughts, emotions, and cognition such as attention, perception, and

memory. For instance, the secretion of stress hormones (such as amylase and cortisol) in response to a genuine or imaginary threat (such as physical aggression or inquiries about homicide) alters both thoughts and behavior (Engert et al., 2014). Arousal approaches are related to Cannon's theory of emotions (the fight or flight response) (Handler & Honts, 2007), which was used for many years to explain the polygraph or BAI hypothesis (Vrij & Fisher, 2016). Currently, the polygraph test is based on the scientific analytic theory, which states that "polygraph testing does not depend on the false hypothesis that responses are driven by fear, or any other emotion, or any psychological process" (Nelson, 2016). Scientific analytic theory provides an opportunity for polygraph testing to develop protocols that comply with Daubert criteria. The Daubert criteria, also known as the Daubert Standard, are a set of factors used by courts in the US to determine the admissibility of scientific evidence and expert testimony. The Daubert criteria, named after the landmark legal case Daubert v. Merrell Dow Pharmaceuticals (1993) (Farrel, 1993), have a significant impact on how scientific evidence is handled in court.

Some arousal-based techniques do not meet the Daubert criteria and therefore cannot be used as evidence in US criminal courts (confirmatory test) but can be used in operational settings (presumptive test), for example, to profile passengers within an airport through Screening of Passengers by Observation Techniques (SPOT) (Lord, 2010).

Verbal Approaches

Investigative Interviewing Verbal Approaches (IIVA)

IIVA refers to scientifically based methods used to determine whether someone is lying or telling the truth through verbal cues to deception. These methods include the 1) Verifiability approach (Harvey et al., 2018), 2) Cognitive Credibility Assessment (e.g., imposing cognitive load, techniques designed to encourage interviewees to say more, and ask unexpected questions), and 3) The Strategic Use of Evidence.

Investigative Interviews Verbal Approaches are preferred over accusatory or behavior analysis styles because arousal approaches reveal fewer verbal cues to deceit (Vrij et al., 2007).

Table 1. Arousal, verbal, third-degree, and brainwave approaches assessing credibility

Period: 1) Ancient history, 2) Middle Ages, 3) Modern history	Approaches, techniques & myths (legends) of Credibility Assessment	1) Verbal, 2) arousal response, or nonverbal behavior, 3) third-degree-based Lie Detection, and 4) electroencephalographic (EEG) brain responses (brainwaves)	Controlled (interview room, laboratory) or uncontrolled environment (airport, customs, street)	Requires technical equipment or technicians	Has scientific publications listed in SCOPUS or JCR	Investigative interviewing techniques include active and passive approaches to detect deception (Vrij et al., 2014). An investigative interviewing technique typically consists of phases, operating rules, and a specific structure. This box only applies to non-technological techniques	Currently used
Ancient history	Judgment of Osiris	Does not apply	Does not apply	Does not apply	Does not apply	Does not apply because it is not an interview or interrogation technique	Does not apply
	Test of Sacred ass/donkey	Does not apply	Does not apply	Does not apply	Does not apply	Does not apply because it is not an interview or interrogation technique	No longer used
	Odysseus and the Cyclops Polyphemus: Odyssey	Does not apply	Does not apply	Does not apply	Does not apply	Does not apply because it is not an interview or interrogation technique	Does not apply
	Egyptian papyrus, signs of stress from lying	Arousal response, or nonverbal behavior	Does not apply	No	No	Does not apply because it is not an interview or interrogation technique	No longer used
	Judgement of King Salomon	Does not apply	Does not apply	Does not apply	Does not apply	Does not apply because it is not an interview or interrogation technique	No longer used
	Hindi Sacred Writing Yajurveda	Arousal response, or nonverbal behavior.	Does not apply	No	No	Does not apply because it is not an interview or interrogation technique	No longer used
Middle Ages (suffering and torture)	Hot red iron test, Rajmahal tribes	Arousal response, or nonverbal behavior	Uncontrolled environment	No	No	Passive	It is no longer used by the Rajmahal tribes, but it is for the Bedouin tribes. For more information, refer to the following sources: (Adrian, 2014; Houck, 2018)
	China rice test	Arousal response, or nonverbal behavior	Does not apply	Does not apply	Does not apply	Does not apply because it is not an interview or interrogation technique	No data is available on this matter.
	Agrippina legend	Does not apply	Does not apply	Does not apply	Does not apply	Does not apply because it is not an interview or interrogation technique	Does not apply
	Legend of the Bocca della Verità Mask	Does not apply	Does not apply	Does not apply	Does not apply	Does not apply because it is not an interview or interrogation technique interrogation technique	Does not apply

	"The Judgement of God" myth	Does not apply	Does not apply	Does not apply	Does not apply	Does not apply because it is not an interview or interrogation technique	Does not apply
	Inquisition period	Third-degree	Does not apply	Some of them yes, e.g., the chair of the Inquisition (Donnelly & Diehl, 2008)	Does not apply	Does not apply because it is not an interview or interrogation technique	Yes (torture). Refer to Ginbar (2020) for information on torture in modern times
	Forced confession of Cuauhtémoc (Foot roasting)	Third-degree	Does not apply	No	Does not apply	Does not apply because it is not an interview or interrogation technique	Yes (torture). Refer to Wang (2020) for information on foot roasting in modern times
Modern history	Augusto Ambrosio Tardieu, "the number of details within statements"	Currently, it is understood that it belongs to the verbal approach	This information is unknown	This information is unknown	At the time he made the statement, the number of details provided in the testimony was not considered a verbal cue of deception. Nowadays, the number of details in a testimony is considered a verbal cue of deception (Amado et al. 2016)	This information is not available	Not currently used, however, it may be a precursor of the Verifiability approach
	Jerome Walker, "the way in which children tell their story, their own words and expressions"	Currently, it is understood that it belongs to the verbal approach	This information is unknown	This information is unknown	No	This information is unknown	Not currently used, however, it may be a precursor to the linguistic analysis of true and deceptive statements. For more information, refer to the following sources: Hauch et al., 2015; Thompson & Hartwig, 2023; Williams et al., 2014)

	How to identify a poisoner	Arousal response, or nonverbal behavior	This information is unknown	This information is unknown	No.	It can be inferred that a passive approach was adopted	Not currently used, however, evasive responses are still employed to detect deception. For further information, please refer to Masip et al. (2018)
	Polygraph	Arousal response, or nonverbal behavior	Controlled environment	Yes	Yes (Honts et al., 2021)	Does not apply because it is not a perse interview or interrogation technique	Yes
	Hot red iron test, Bedouin tribes	Arousal response, or nonverbal behavior	Uncontrolled environment	No	No	Passive	Yes (Adrian, 2014; Houck, 2018)
	The truth serum	Third-degree lie detection using drugs tends to make subjects chatty and cooperative with investigators (Bimmerle, 1993; Sandhiyadevi, 2021)	Controlled environment	Yes	Does not apply	Does not apply	Yes (Lokaneeta, 2020)
	Scharf technique	Verbal approach	Both	No	Yes (Luke, 2021; Oleszkiewicz et al., 2017)	Active	Yes, for human intelligence gathering (Granhag, 2023)
	Behavior analysis interview (BAI). The BAI is part of the Reid technique	Arousal response, or nonverbal behavior	Controlled environment	No	No	Passive	Yes
	Brain fingerprint	Electroencephalographic (EEG) brain responses (Farwell, 2012)	Controlled environment	Yes	Yes	Does not apply because it is not an interview or interrogation technique	Yes (Budaházi & Fantoly, 2019)
	Functional magnetic resonance imaging	This technique is not applicable in our classification. It displays images of brain activity associated with lying by measuring changes in blood oxygenation levels in different areas of the brain (Shapiro, 2015)	Controlled environment	Yes	Yes (Yu et al., 2019)	Passive	Yes (research only) (Langleben et al., 2016)

	Virginity test (local custom of Tehuantepec, Oaxaca)	Does not apply	Controlled environment (bridal bed)	No	No	Does not apply because it is not an interview or interrogation technique	Yes (Vázquez, 2017)
	Scientific Content Analysis (Scan)	Verbal approach	Controlled environment	No	No	Passive	Yes (Bogaard et al, 2016)
	Micro expressions	Does not apply (leakage theory)	Both	No	No	Does not apply because it is not an interview or interrogation technique	Yes (Matsumoto & Hwang, 2018)
	Morphopsychology	Does not apply	Both	No	No	Does not apply because it is not an interview or interrogation technique	Yes (Crăciun, 2020)
	Criteria Based Content Analysis (CBCA)	Verbal Approach (Nahari et al. 2019)	Controlled	No	Yes (Amado et al., 2016)	Passive (Vrij, 2018). It analyzes the content of a person's statements to discern between memories based on real experiences and those that are fabricated or imagined	Yes (Oberlader et al., 2016)
	Reality Monitoring (RM)	Verbal Approach (Elntib, 2015)	Controlled	No	Yes (Gancedo et al., 2021; Vrij, 2018)	Passive. It analyzes the content of a person's statements to discern between memories based on real experiences and those that are fabricated or imagined	Yes (Logue et al. 2015)
	Screening of Passengers by Observation Techniques (SPOT)	Arousal response, or nonverbal behavior	Both	No	No	Passive	Yes (Vrij & Fisher, 2020)
	Synergology "gesture reading" in France & Quebec	Arousal response, or nonverbal behavior	Both	No	No	Does not apply because it is not an interview or interrogation technique	Yes (Delmas et al. 2016; Denault et al., 2020)
	Strategic Use of Evidence (SUE)	Verbal Approach	Controlled environment	No	Yes	Active	Yes (Clemens et al. 2019)
	The Shift-of-Strategy (SoS) approach, an extension of the SUE	Verbal Approach	Controlled environment	No	Yes	Active	Yes (Luke & Granhag, 2020)
	SCAnS (Six Channel Analysis System)	Arousal response, or nonverbal behavior (Langley, 2017).	Both	No	No	Passive	Yes (Mazziotta, 2019)
	Oculomotor detection test (ODT)	Arousal response, or nonverbal behavior	Controlled	Yes	Yes (Kircher, 2018; klein Selle et al, 2023)	Does not apply because it is not an interview or interrogation technique	Yes (Cook et al. 2012; Pasquali et al. 2020)

	Voice Stress Analysis (VSA)	Arousal response, or nonverbal behavior (Sondhi et al., 2015)	Controlled	Yes	No	Does not apply because it is not an interview or interrogation technique	Yes (Hollien et al. 2014)
	Thermography	Arousal response, or nonverbal behavior (Warmelink et al., 2011)	Controlled	Yes	Yes (Gálvez-García et al., 2021)	Does not apply because it is not an interview or interrogation technique	Yes, only in research (Warmelink et al. 2011)
	Verifiability approach	Verbal Approach	Both	No	Yes (Palena et al., 2021; Vernham et al., 2020)	Active	Yes (Vernham et al,. 2020; Kleinberg et al., 2019)
	Imposing of a cognitive load	Verbal Approach	Both	No	Yes (Vrij et al., 2017)	Active	Yes, only in research (Vrij & Fisher, 2016)
	Psychologically Based Credibility Assessment Tool (PBCAT)	Verbal Approach	Controlled	No	Yes (Evans et al., 2013; Wylie et al., 2022)	Does not apply because it is not an interview or interrogation technique.	Yes, only in research (Evans et al., 2013; Wylie et al., 2022)
	Controlled Cognitive Engagement (CCE) method	Verbal Approach	Both	No	Yes (Dando & Ormerod, 2020 a, b)	Active	Yes, only in research (Dando & Ormerod, 2020 a, b)
	Transdermal Optical Imagin Technology (TOI)	Arousal response, or nonverbal behavior	Both	Yes	Yes (Ahuja, 2024)	Does not apply because it is not an interview or interrogation technique.	Yes, only in research (Ahuja, 2024)
	Interview-Based Connectivity Analysis of Electroencephalogram (EEG) to Detect Deception	Electroencephalographic (EEG) brain responses (brainwaves)	Controlled	Yes	Yes (Kohan et al., 2020; Motie-Nasrabadi et al., 2020)	Does not apply to this category because it uses technology	Yes, only in research (Daneshi Kohan et al. 2020)

Comparative evolution

Table 1 presents techniques for detecting deception during an investigation. These include the behavior analysis interview, which uses behavioral and nonverbal arousal cues to identify deception such as crossing legs during questioning. It also includes techniques based on leakage theory, such as micro expressions (Ekman, 2009), which reveal contradictions between emotions and nonverbal behavior indicating 'deceit' or discomfort. Furthermore, techniques are shown that do not necessarily detect deception such as Brain Fingerprinting (BF), which uses an electro-

encephalogram to search for the P300 memory wave and possibly detect concealed information (Farwell, 2012).

The evolution of detecting deceit

Currently, there are various techniques available to evaluate credibility. Techniques that evaluate credibility during the interview process stand out, such as the Strategic Use of Evidence. When assessing credibility, it is important to consider techniques that rely on verbal signals rather than non-verbal cues. Arousal-based lie detection can lead to misinterpretation of deception cues, which could lead to false confessions and wrongful convictions if psychophysiological interview and interrogation techniques are employed (Vrij et al., 2010; Vrij et al., 2015). Cases of wrongful convictions have been reported in various countries, including the United Kingdom's Birmingham Six case and the United States' NY Central Park Jogger case (Kassin, 2006). In both instances, the determination of the suspect's guilt was based on external evidence, such as eyewitness reports, or the interviewer's judgments during the interview (Kassin, 2004, 2005). The credibility of suspects is often influenced by the training that officers have received to interrogate and interpret their behavior. The use of psychophysiological interview and interrogation techniques presents various challenges, including legality, validity, and operability. For deception detection techniques to be considered useful, they must address the following questions in response to these ideas:

- Can it be used in a wide range of investigation contexts? For example, is its application legal in the public and private sectors?
- Is it useful for investigating all types of crime?
- In the private sector, is it affordable?
- Is the cost of training affordable?
- Does the investigator need special knowledge to be trained in the technique?
- Is the technique validated by the scientific community?
- Is it easy to apply?
- How much time does the investigator need to get results?
- Can it be applied to victims, witnesses, and suspects?
- Can it be applied anywhere, or does it need to be applied in a special room to conduct interviews and observe non-verbal behavior?
- Is the credibility assessment carried out during or after the process?

To respond to the previous questions, Investigative Interviews have been designed to be applied in a wide variety of contexts. In contrast to an Ocular-motor deception test, informed consent is not necessary for the application of this technique. Additionally, this technique is non-intrusive, unlike the use of contrast medium in FMRI, and is legal and ethical in all countries. It can be applied in corporate and public service investigations, as well as for all types of crimes. The training cost is affordable and no specialized prior knowledge is required for learning and application. Investigative interviewing is a validated technique endorsed by the scientific community. It can be applied to witnesses, suspects, and victims, and offers numerous benefits.

Investigative Interview

An investigative interview is a purposeful conversation conducted to elicit information from a person, such as a witness, victim, or suspect during an investigation. The purpose, scope, and content of investigative interviews conducted by investigators can vary greatly. The objective of an investigative interview is to obtain reliable information and assess credibility through verbal approaches to deception detection while reducing the occurrence of false confessions resulting from an accusatory style of questioning. To achieve this, it is important to avoid techniques such as the prisoner's dilemma (Norris & Redlich, 2014).

Verbal Approaches to Deception Detection

Verbal approaches are useful in investigative interviews. Credibility should not be evaluated based on non-verbal behaviors or attitudes, as scientific evidence has shown that the nonverbal cues associated with deception are weak and unreliable. To enhance the interview accuracy, investigators should focus on improving verbal cues. This can be achieved through the application of the Cognitive Credibility Assessment, Verifiability Approach, and Strategic Use of Evidence.

Cognitive Credibility Assessment

The cognitive credibility assessment (CCA) comprises three elements: (1) imposing a cognitive load, (2) asking unexpected questions, and (3) encouraging interviewees to say more.

Imposing a cognitive load

Stating the truth requires less cognitive effort than lying. Investigators can exploit this by introducing a secondary task, such as asking the suspect to remember a number, during the interview. This additional cognitive load disproportionately affects lie-tellers, who are already struggling to maintain their deception. According to Debey et al. (2012), individuals who lie experience a noticeable impairment in their storytelling abilities.

Asking unexpected questions

During interviews, individuals who are not truthful can prepare for anticipated questions and rehearse their answers. To counter this, investigators should ask both anticipated and unanticipated questions. This approach can reveal a key difference between truth-tellers and lie-tellers. Truth-tellers handle both types of questions with relative ease while lie-tellers struggle with unanticipated questions, leading to a noticeable decline in the quality of their responses (Lancaster et al., 2013).

Encouraging interviewees to say more

During interviews, individuals may not always reveal all information due to uncertainty about the investigator's expectations. To address this, a Model Statement (Pérez-Campos Mayoral et al., 2023) can be used as a benchmark for the desired level of detail. It is important to note that the use of a Model Statement should be disclosed to all interviewees. This can encourage both truthful and deceptive individuals to provide more information. The quality of information provided by truth-tellers is crucially different from that of lie-tellers. Truthful stories tend to be more nuanced and include realistic complications that enhance plausibility (Vrij et al., 2017). In contrast, lie-tellers often provide fewer details, resulting in less complex and less believable stories.

Verifiability Approach

The Verifiability Approach (VA) focuses on the challenge that lie-tellers face. They aim to appear convincing by providing enough details, but they also try to avoid including details that can be easily checked and disproven. Consequently, lie-tellers tend to offer fewer verifiable details compared to truth-tellers (Vrij et al., 2016).

Verifiable details include activities carried out with or seen by named individuals, events recorded on cameras or photos, and actions that leave digital or physical traces (such as phone records or receipts) (Nahari et al., 2014).

When an Information Protocol (Harvey et al., 2017) is used, that explicitly requests verifiable details, the difference between lie-tellers and truth-tellers becomes more pronounced. lie-tellers struggle to invent verifiable details, while truth-tellers readily provide them. The VA analyses the presence and ratio of verifiable details within a person's statement to aid in deception detection.

Strategic Use of Evidence

Investigators can use evidence strategically to distinguish between truthful and deceptive individuals. Truthful individuals are usually forthcoming in their free recall, while deceptive individuals may omit key details such as their whereabouts or deny involvement when directly questioned (Granhag & Hartwig, 2008). Presenting evidence to a suspect can further amplify these differences. When discovered, dishonest individuals may alter their story or provide complicated explanations to fit the evidence. When the suspect's statements agree with the evidence in the investigator's possession, it is determined that there is consistency between the statement and the evidence. When the evidence in the investigator's possession contradicts the suspect's statements, it is called inconsistency between the statement and evidence (Hartwig et al., 2006; Hartwig et al., 2014). The SUE technique is an empirically validated investigative interview technique that adheres to science-based methodologies. It has a structured operational methodology that requires the investigator to understand tactical questioning techniques and the strategic use of evidence. SUE is one of the few techniques allowed for use in the criminal justice system nowadays (Vrij & Fisher, 2016).

Therefore, contemporary investigators can benefit greatly from training in verbal approaches to detecting deception and investigative interviewing techniques. These methods have several advantages. For instance, according to the New Zealand Police (2012), the use of investigative interviews can improve the completeness, accuracy, and reliability of police information acquisition, increase conviction rates within the criminal justice system, and identify innocent individuals to prevent wrongful convictions.

The benefits of applying verbal approaches to detect deception within investigative interviewing include:

- Encourage investigators to use science-based investigation techniques.
- Encourage investigators to continue their additional education/training.
- Encourage investigators to develop ethical questioning styles and avoid inquisitive questioning, which decreases interviewees' self-esteem and can produce false confessions.
- Encourage investigators to actively listen to the interviewee.
- Encourage interviewees to say more (model statement). The interviewer can then be able to apply the Verifiable approach or the Strategic Use of Evidence technique once the interviewee commits to their narrative or uses unanticipated questioning.
- Encourage investigators to develop rapport, avoiding psychological or physical defenses and therefore helping the interviewee to say more.
- Encourage investigators to do proper planning for the entire investigation process, including identifying the best time to show evidence.
- Avoid the so-called Othello error, which is when the interviewer fails to consider that a truthful and stressed person may appear to be lying (Kleinberg et al. 2019).

Closing comments

Throughout human history, one of the primary goals has been to distinguish between truth and lies. There has been a marked tendency to identify lies through nonverbal language or behavior assessment, as seen in the poisoner's exemplified instructions. However, current evidence suggests that nonverbal language evaluation lacks scientific support. At the same time, science-based interview techniques, such as the CI, or SUE, are being developed and seem to be more appropriate for information gathering and assessing credibility in legal and forensic contexts.

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A Handful of Remarks on the "Terminology Reference for the Science of Psychophysiological Detection of Deception"

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Key words: "Terminology References", Science of Psychophysiological Detection of Deception, Language of science

I find it appropriate to commence by recalling that the realisation that one of the defining characteristics of a science (or its field) that allows for its recognition as distinct and mature, alongside its subject of study and methods of research, is its language dates back to as early as the mid-19th century (Okasha, 2016).

Contemporary scientific methodology demands that each science must have a specific subject and objective distinct from other sciences, as well as its own unique language so that it makes use of clearly defined and named concepts (Humphreys, 2014).

It must also employ research methods assigned to it, although these as a rule are of a more universal character. The same methods may be applied across various scientific disciplines, possibly undergoing modifications dictated by the subject matter or the objective of the science or field in which they are employed. Numerous scientific fields, such as sociology, ethnology, criminology, as well as psychology, and even medical sciences, use both quantitative and qualitative research methods that are proper to social sciences. Surveying and interviewing, not unlike observation and experimentation, are employed by numerous sciences, both social and natural.

The purpose divides sciences into theoretical and applied. The former, broadly speaking, serve exploring previously unknown reality, describing it, identifying regularities, and articulating them through propositions and theories. The role of latter is to make use of the discoveries and findings of theoretical sciences for practical application. Both types in a crucial degree rely on language and its precision. For it is language that is used to record research problems, formulate hypotheses, and articulate propositions. The key is to have the same concepts named identically. The more developed a scientific discipline, the richer and more precise its language. Such a language creates a conceptual community within which specialists in the field operate. It enables effective communication among them.

As the language of virtually every science is a particular variation of the language a general national community uses, assorted specialist dictionaries are published as a matter of course. For instance, Oxford University Press has produced dictionaries of psychology (Colman, 2015), law (Law, 2015). Peter Collin Publishing has produced dictionary of military terms (Bowyer, 1999), and so on.

Similarly taken for granted are specialist bilingual dictionaries, such as for example English-Polish dictionaries of medical terminology (Jędraszko, 1974).

For several decades, experts in lie detection, also known as forensic psychophysiology, have undertaken efforts to reconcile and standardise terminology, thereby refining the language of their discipline.

This endeavour is by all means highly desirable. Even the device today commonly referred to as the "polygraph" has operated under various names in professional literature, not to mention all the colloquial terms given to it. Larson called his first polygraph "cardio-pneumo psychogram", or "sphygmomanometer", and terms like "Berkeley psychograph", "sphygmomanometer" (or shortly "sphyggy") (Widacki, 2021) were also used, not to mention the widespread "lie detector".

Incidentally, alongside the name *poligraf*, the Polish language also uses the word *wariograf*, which is a peculiar substitution of the Greek prefix *poly-* meaning "multiple" with the Latin *vario* (different), keeping the Greek root *graphos* unchanged. The modification did not make much sense, as the traditional name *poligraf*, used since the 19th century to describe a device recording more than one parameter, was replaced without any real reason by a neologism artificially constructed from two classical languages, Latin and Greek (Widacki, 2016).

Returning to the main discourse, it must be stated that work on the language of a discipline and its terminology does never end. On the contrary, it has to continue as disciplines continue to evolve. New descriptive needs arise with the discovery of new examination techniques, and emergence of new conventions, practices, and facts, while new concepts that arise require new names.

Recognising the efforts of the authors and the value of their work, we ought to strive for further refinement and standardisation of terminology. Suggestions and new proposals should, and have to be made.

Personally, I hold in high regard the "Terminology Reference for the Science of Psychophysiological Detection of Deception" (4th Edition, 2022) by Donald Krapohl, Mark Handler, and Michael Lynch. Nevertheless, I have a few comments concerning their edition for consideration. I question the advisability of including biographical notes on individuals who have contributed to the development of the "Science of Psychophysiological Detection of Deception", to mention Cleve Backster, Vittorio Benussi, Fred Inbau, Leonarde Keeler, John Larson, Cesare Lombroso, Alexander Luria, David T. Lykken, William Marston, Étienne-Jules Marey, Angelo Mosso, and Hugo Münsterberg. These biographical notes do not fit within the scope defined by the title (Terminology Reference) and their inclusion in this context seems somewhat awkward. Additionally, inclusion of the dates of birth and death in biographical notes is a standard practice that has not been followed here.

Another redundancy is the inclusion of entries for well-defined concepts that belong to other fields, notably "chi-square test", "control group", "empirical", "electrocardiogram (ECG)", "functional Magnetic Resonance Imaging (fMRI)", "habituation", "hypnosis", and many others. Furthermore, there is hardly any justification for including the names of legislative acts (such as the Employee Polygraph Protection Act of 1988), well-known landmark court rulings (like Daubert v. Merrell Dow Pharmaceuticals, Inc.), and official names of institutions (such as the Department of Defence Polygraph Institute (DoDPI) and the National Center for Credibility Assessment).

All these, along with biographical entries edited properly according to a single template, should be compiled into a future dictionary, handbook, or encyclopaedia of forensic psychophysiology, rather than being included in a publication whose title makes it a "terminology reference."

Perhaps the creation of such an encyclopaedia for the science of psychophysiological detection of deception could be worthwhile to undertake? It would be a significant further step towards unifying the language of our discipline, elevating it to a higher level, and promoting it both within the scientific community and the legal profession. Especially as encyclopaedias of forensic sciences, forensic psychology, forensic psychiatry, and police sciences have been published for years successfully fulfilling their purpose*.

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* See: for example: Houck, 2022; Morgan, 2019.

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A Letter to the Editor Regarding the APA's Terminology Reference for the Science of Psychophysiological Detection of Deception

James Allan Matte

Dear Editor:

This critique in the form of a letter-to-the-editor is in response to the publication of the fourth edition of the Terminology Reference for the Science of Psychophysiological Detection of Deception, hereafter referred to as *Terminology Reference*, authored by Donald Krapohl, Mark Handler and Michael Lynch published by the American Polygraph Association in 2022.

The following inaccuracies and omissions were noted on the following pages of the Terminology Reference.

Page 35. Confession criterion

A list of published studies and articles concerning the use of confessions as ground truth omitted some studies that support the use confessions.

Corrective Comment

The following studies supporting the use of confessions as ground truth omitted from the Terminology Reference are listed below:

Light, E.D., Schwartz, J. R. (1999). The relative utility of the forensic disciplines. *Polygraph*, 28(3), 240–258.

Mangan, D.J., Armitage, T.E., Adams, G.C. (2008). Rebuttal to objections by Iacono and Verschuere, et al. *Physiology & Behavior*, 95(1–2), 29–31.

Mason, P. (1991). *Association between positive urinalysis drug tests and exculpatory examinations.* Unpublished doctoral dissertation. United States Army Criminal Investigation Command. Baltimore, MD.

Page 46. Directed Lie

The following published articles should be included in the list of publications pertaining to the Directed Lie control question.

"Validation of Potential Response Elements in the Directed-Lie Control Question."

Matte, J.A. & Reuss, R.M. (1999). Published in *Polygraph*, Journal of the American Polygraph Association, Volume 28, Number 2, Pages 124–142.

"An analysis of the Psychodynamics of the Directed Lie Control Question in the Control Question Technique."

Matte, J.A. (1998). Published in *Polygraph*, Journal of the American Polygraph Association Vol. 27, Nr. l, 56–67.

Page 54. Exclusive (exclusionary) comparison question

A list of published studies concerning the description and effectiveness of the exclusive comparison question omitted studies and critiques that challenged the results of some of the listed studies.

Corrective Comment

The following published critiques challenging the results of some of the studies listed in the Terminology Reference are listed below:

Matte, J.A. (November 2011). Commentary Horvath, F., Palmatier, J.J. Critique of Horvath-Palmatier Laboratory Study on Effectiveness of Exclusive v. Non-Exclusive Control Questions in Polygraph Examination. *Journal of Forensic Science* 53(4): 889–99.

Matte, J.A., Backster, C. (2000). A critical analysis of Amsel's comparative study of the exclusive v. nonexclusive comparison question. *Polygraph*, 29(3), 261–268.

Page 58. Fear of Error

The last sentence states "Empirical support for the inside track is not yet available. See Matte (1996); Nelson & Cushman 2011)"

Corrective Comment

Empirical support for the inside track is provided in the following published field studies. Furthermore, the "Nelson & Cushman 2011" citation could not be found in the References section of the Terminology Reference or in the References section of the Meta-Analytic Survey of Criterion Accuracy of Validated Polygraph Techniques (2011).

Mangan, D.J., Armitage, T.E., Adams, G.C. (2008). A field study on the validity of the Quadri-Track Zone Comparison Technique. *Physiology & Behavior*, 95, 17–23.

Matte, J.A., Reuss, R.M. (1989). A field validation study of the Quadri-Zone Comparison Technique. *Polygraph,* 18(4), 187–202.

Matte, J.A., (1990). *Validation study on the polygraph Quadri-Zone Comparison Technique*. *Research Abstract* LD 01452, Vol. 1502, 1989. University Microfilm International (UMI, Ann Arbor, MI.

Shurany, T., Stein, E., Brand, E. (2009). A field study on the validity of the Quadri-Track Zone Comparison Technique. *European Polygraph*, 1, 5–24.

The following is a correct and accurate description of the Fear of Error:

FEAR OF ERROR: A theory developed by James A. Matte after extensive field experiments to resolve false positives which revealed that an innocent examinee may

show a significant response to relevant test questions as a result of his fear that an error will be made on his test regarding the target issue.

The Fear of Error question contains a suffix "regarding the target issue" and is treated as a control (comparison) question that is compared with its neighboring relevant question within the same Track, namely the Hope of Error question "regarding the target issue." The Fear and Hope of Error questions are contained in a Track labeled "Inside Track" within the Quadri-Track Zone Comparison Technique. The innocent examinee's Fear of Error was recognized by Dr. Paul Ekman (1985) who coined the concept as the "Othello Error." The National Research Council of the National Academies of Science's 2003 report (P. 74, 127), cited the innocent examinee's fear of error as a potential for false positives.

Page 67. Hope of Error

As reads in 2022 version of Terminology Reference:

Concept introduced by James Matte, and a central component of his Quadri-Track Technique. Because guilty examinees usually stand to lose something of importance if their deceptions are uncovered by the polygraph, Matte argues that they are hopeful that there will be an error in the outcome. **A challenge to Matte's hypothesis is that truthful subjects are also deceptive during testing – to probable lie comparison questions – and they too might be hopeful for an error to occur.** During testing Matte includes a direct question regarding the examinee's hope of an error and scores the question as a relevant question. See: Matte (1996); Matte & Reuss (1989); Nelson & Cushman, (2011).

Corrective Comment

The above boldfaced sentence is incorrect and misleading inasmuch as it omits the fact that a **suffix** "regarding the target issue (relevant issue) follows both the Fear of Error and the Hope of Error questions. See Matte 1978, 1980, 1993, 1996, 2000, 2007, 2011; Mangan et al 2008; Shurany et al, 2009. Furthermore, the above Nelson Cushman 2011 citation could not be found in the references section of the Terminology Reference or in the Meta-Analytic Survey of Criterion Accuracy of Validated Polygraph techniques (2011).

Page 69. Inclusive (inclusionary, non-exclusionary) comparison question

Cites Amsel (1999); Podlesny & Raskin (1978; Horvath (1988); Horvath & Palmatier (2008).

Corrective Comment

The Terminology Reference omitted the following published critiques of the Amsel 1999 and the Horvath-Palmatier 2008 studies which are listed below:

Matte, J.A. (November 2011). Commentary Horvath, F., Palmatier, J.J. Critique of Horvath-Palmatier Laboratory Study on Effectiveness of Exclusive v. Non-Exclusive Control Questions in Polygraph Examination. *Journal of Forensic Science* 53(4): 889–99.

Matte, J. A., Backster, C. (2000). A critical analysis of Amsel's comparative study of the exclusive v. nonexclusive comparison question. *Polygraph*, 29(3), 261–268.

Page 70. Inside-issue comparison question

States "Empirical support is mixed between advocate and independent research. See: Matte (1996); Mangan, Armitage & Adams (2008); Nelson & Cushman (2011); Shurany, Stein & Brand (2009)."

Corrective Comment

Matte 1996 is a textbook, not a study. Should have listed Matte & Reuss 1989, a field study published in Polygraph. Journal of APA. The studies by Matte & Reuss 1989; Mangan et al 2008; and the Shurany et al 2009 all provide empirical support for the Inside-Issue Comparison question. The remaining study of Nelson & Cushman 2011 purportedly a study with an opposing view cited by the Terminology Reference could not be found in the References section of the Terminology Reference or in the References section of the Meta-Analytic Survey of Criterion Accuracy of Validated Polygraph Techniques. It could also not be found in the four APA journals published in 2011.

Page 71. Inside-issue relevant question

States "Empirical support is mixed between advocate and independent research. See: Matte (1996); Mangan, Armitage & Adams (2008); Nelson & Cushman (2011; Shurany, stein & Brand (2009)."

Corrective Comment

Same as Inside-issue comparison question.

Page 71. Inside-track

States "Empirical support is mixed between advocate and independent research. See: Matte (1996); Mangan, Armitage & Adams (2008; Nelson & Cushman (2011); Shurany, Stein & Brand (2009)

Corrective Comment

Same as Inside-issue relevant question.

Page 87. Non-exclusive (inclusive or inclusionary) comparison question

Cites "Amsel (1999); Horvath (1988); Horvath & Palmatier (2008); Podlesny & Raskin (1978).

Corrective Comment

The Terminology Reference omitted the following published critiques of the Amsel 1999 and the Horvath-Palmatier 2008 studies which are listed below:

Matte, J. A. (November 2011). Commentary Horvath, F., Palmatier, J.J. Critique of Horvath-Palmatier Laboratory Study on Effectiveness of Exclusive v. Non-Exclusive Control Questions in Polygraph Examination. *Journal of Forensic Science* 53(4): 889–99.

Matte, J. A., Backster, C. (2000). A critical analysis of Amsel's comparative study of the exclusive v. nonexclusive comparison question. *Polygraph*, 29(3), 261–268.

Page 90. Othello Error

See: Ekman (1985).

Corrective Comment

Correctly cited in body of Terminology Reference but erroneously cited as Ekman (1992) in the References section.

Page 102. Quadri-Track Zone Comparison Technique

States "Independent research has to date failed to support the construct of the inside track (see Nelson & Cushman. 2011)." "For a full explanation, see Matte (1996)."

Corrective Comment

Empirical support for the Quadri-Track Zone Comparison Technique is provided in the following published field studies. Furthermore the "Nelson & Cushman 2011" citation purportedly a study with an opposing view could not be found in the References section of the Terminology Reference or in the References section of the Meta-Analytic Survey of Criterion Accuracy of Validated Polygraph Techniques (2011). It could also not be found in the four APA journals published in 2011.

Mangan, D.J., Armitage, T.E., Adams, G.C. (2008). A field study on the validity of the Quadri-Track Zone Comparison Technique. *Physiology & Behavior*, 95, 17–23.

Matte, J.A., Reuss, R.M. (1989). A field validation study of the Quadri-Zone Comparison Technique. *Polygraph,* 18(4), 187–202.

Matte, J. A., (1990). *Validation study on the polygraph Quadri-Zone Comparison Technique*. Research Abstract LD 01452, Vol. 1502, 1989. University Microfilm International (UMI, Ann Arbor, MI.

Shurany, T., Stein, E., Brand, E. (2009). A field study on the validity of the Quadri-Track Zone Comparison Technique. *European Polygraph*, 1, 5–24.

Page 126. time bar

States "Research has not supported this hypothesis, however. See: Amsel (1999); Podlesny & Raskin (1978); Horvath (1988); Horvath & Palmatier (2008).

Corrective Comment

The Terminology Reference omitted the following published critiques of the Amsel 1999 and the Horvath-Palmatier 2008 studies which are listed below:

Matte, J.A. (November 2011). Commentary Horvath, F., Palmatier, J.J. Critique of Horvath-Palmatier Laboratory Study on Effectiveness of Exclusive v. Non-Exclusive Control Questions in Polygraph Examination. *Journal of Forensic Science* 53(4): 889–99.

Matte, J.A., Backster, C. (2000). A critical analysis of Amsel's comparative study of the exclusive v. nonexclusive comparison question. *Polygraph*, 29(3), 261–268.

Page 134. Zone Comparison Technique (ZCT)

Includes the "You Phase," "Exploratory", "S-K-Y," "Federal", "Integrated", and "Utah."

Corrective Comment

Should include the Quadri-Track ZCT.

References

The following references should be added to the references section of the Terminology Reference 2022.

Light, G.D., Schwartz, J.R. (1999), The relative utility of the forensic disciplines. *Polygraph,* 28 (3), 240–258.

Mangan, D.J., Armitage, T.E., Adams, G.C. (2008), Rebuttal to objections by Iacono and Verschuere et al. *Physiology & behavior*, 95. 29–31.

Mason, P. (1991). Association between positive urinalysis drug tests and exculpatory examinations. Unpublished doctoral dissertation. United States Army Criminal Investigation Command, Baltimore, MD.

Matte, J.A. (Dec. 1978). Polygraph Quadri-Zone Comparison Technique. *Polygraph*, 7(4). 266-280.

Matte, J.A. (November 2011). Commentary on: Horvath F. Palmatier JJ. Critique of Horvath-Palmatier Laboratory study on effectiveness of exclusive v. non-exclusive control questions in polygraph examination. *Journal of Forensic Sciences*, 5 (6). 1664–1667.

Matte, J.A., Backster, C. (2000). A Critical analysis of Amsel's comparative study of the exclusive v. nonexclusive comparison question. *Polygraph*, 29 (3), 261–266.

Matte, J.A., Reuss, R.M. (1989). Validation study on the Quadri-Zone Comparison Technique. *Research Abstract*, LD 01452, Vol. 1502, University Microfilm International.

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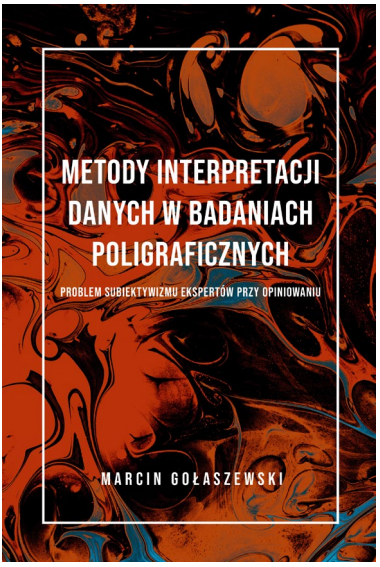

Marcin Gołaszewski, *Metody interpretacji danych w badaniach poligraficznych. Metody interpretacji danych w badaniach poligraficznych* [*Methods of interpreting data in polygraph examinations, the problem of expert subjectivity in forming opinions*], Krakow: Andrzej Frycz Modrzewski Krakow University, 2023 (in Polish)

The research problem addressed by Marcin Gołaszewski has been considered previously, but until now, no single publication has addressed the problem of expert subjectivity in polygraph examinations in a comprehensive manner.

Gołaszewski states in his introduction that polygraph examinations were originally designed for investigative purposes, although they are now used in a much broader context, even by the private sector. He further provides a detailed account of the examinations in question, with a particular focus on their use as evidence in criminal trials followed by a brief overview of polygraph examinations in the eye of Polish law, including their admissibility and the limitations imposed by the Code of Criminal Procedure. The author then proceeds to cite the etymology of the word "polygraph" itself and its Polish equivalent, *wariograf*, proposed by P. Horoszowski, and refers to the Polish synonym in a critical manner. In a series of brief overviews, Gołaszewski discusses the construction of the modern polygraph, the object of interest to the examiner, and the two fundamental polygraph examination techniques: the Control Question Technique (CQT) and the one most prevalent currently, the Guilty Knowledge Test (GKT). From here, he moves to the issue of the expert's opinion, outlining the requirements it has to meet to be used in criminal proceedings and briefly describing the role of the expert in the trial. That is followed by a comprehensive analysis of the issue of scientific evidence, including opinions on polygraph examinations that addresses both the historical development of the admissibility of scientific evidence from the examinations in question and the use of scientific methods in criminal proceedings in general. It is essential here to focus more specifically on the three distinct levels of scientific thinking Gołaszewski elucidated, as they are of paramount importance in the assessment of evidence, as proposed by W. Thomas (pp. 25–27). Gołaszewski dedicates most attention to the second level, being techniques and procedures, and to the third level – the appropriate adjustment of the specific procedure to the context of the case. In a concise and comprehensive manner, he introduces the subject of polygraph examinations in the introduction, presenting the most important issues of their admissibility, the nature of the examinations, the subject of their interest, and the role of the person performing such examinations in the criminal procedure. Pages 30 and 31 are dedicated to the detailed discussion of the five research problems presented here.

The first chapter is a study of the factors that influence the reliability and consistency of polygraph assessments. It commences by delineating the areas of subjectivity inherent in expert opinions within the field and emphasises that the sources of unreliable opinions among expert witnesses may be manifold and should be attributed both to the examination methodology itself and to the human factor (p. 33). Referencing the problem of the expert's lack of impartiality, he mentions that it can manifest itself as favouritism towards the accuser (pp. 34, 37–41). Ad-

dressing the issue of insufficient validation of the method, he notes that it translates into an unverified diagnostic value of the examinations carried out according to it (p. 35). He then turns to the subject of accessibility and representativeness heuristics, which can result in the neglect of other, often complex solutions that are overlooked by following simplistic thinking. This is where Gołaszewski presents the issue of attribution error in polygraph studies, and goes on to present the problem of perceiving a truthful person as a liar and the Othello effect. The argument moves on to the impact of time pressure and the current emotional state of the expert, and the impact of peer pressure and the influence of the information given to the expert on the expert's opinion. Quoted here is G. Barland's doctoral thesis (1975) demonstrating that 17 out of 19 polygraphers who had shared their initial opinion before the examination on the basis of materials they had previously obtained upheld their original opinion after the actual polygraph examination (p. 52). Continuing the above subjects, the author moves to describe Israeli research from the early 1990s (pp. 52–55) and experiments conducted jointly by D. Krapohl and D. Dutton (pp. 56–58). However, a reference to A. Ginton supports the argument that misjudgements in the experiments conducted do not occur to a statistically significant degree. This becomes the springboard for tacking the issue of amending the provisions of the Polish Code of Criminal Procedure governing the provision of case files to experts, with Gołaszewski pointing out that even the appointment of the person ordering the examination may be subjective. He then recalls the conditions under which a polygraph examination should be carried out, and once more describes the devices that the polygraph consists of and the way they record the data to draw attention to a problem that arises when tests are carried out with a computerised polygraph, whereby the recording differs depending on whether the data is recorded in automatic or manual mode. This is illustrated with the recorded curves showing reaction on the EDA channel (p. 79). The further discussion concentrates on the appointment of an expert by the court and the verification of such expert's credibility. The author correctly criticises polygraphers who lack the appropriate qualifications and yet are listed as expert witnesses in court. For the sake of this argument, he cites the position of S. Waltoś that entry on the list of expert witnesses does not guarantee that the expert will provide an opinion in accordance with the highest scientific standards. This segways the argument to the description of the standards of the American Polygraph Association and the training standards adopted by the Polish Society for Polygraph Examination. Gołaszewski remarks that the authoritative confirmation of the qualifications of an expert in polygraph examinations in Poland is provided by certificates issued by entities accredited by the aforementioned organisations, the Polish Association of Polygraph Examiners, and

government agendas. The chapter closes with a description of the personal qualities of a professional polygrapher.

The second chapter opens with a succinct analysis of data analysis, tracing its historical evolution from the highly subjective qualitative method to the partially objectified quantitative-qualitative methods, and follows on to the evaluation of polygraph examinations methods and their underlying assumptions. They are then classified according to three key principles: the method of variable analysis, diagnostic rationale, and decision rules (pp. 116–120). The numerical evaluation scales, which can be classified as qualitative-quantitative, is discussed on pp. 121–155), and followed by the study of the independent polygrapher conducting the examinations and the practice known as blind interpretation (pp. 158–162) and the degrees of automation of operations in manual and computer-based analysis (pp. 162–181). Providing an insight into computer algorithms, Gołaszewski uses the development of the Polyscore system as an example, and additionally cites experiments conducted at the University of Utah, which returned the conclusion that there was no significant difference between the accuracy of expert and computer-generated analyses (p. 167). On that, a Polish experiment, conducted at the University of Silesia in Katowice, is cited. It involved comparative studies between human assessment on a 7-item scale in accordance with the rules of the federal system and the indications of the OSS-2 system (p. 175). The author then proceeds to discuss the use of tools helping human interpretation of data, mentioning the PLE Amplitude Tool and the RLE Tool. Chapter Two concludes with the author's own research into the accuracy of polygraph diagnoses employing a range of analytical techniques. Gołaszewski participated in "Instrumental and non-instrumental methods of insincerity detection – forensic, ethical and legal problems", a project involving fifteen professional polygraphers conducted at the Andrzej Frycz Modrzewski Kraków University whose results were published in 2014 and 2018 (pp. 192–199). Three of the participating polygraphers conducted the tests, while the others performed a blind evaluation of the polygrams obtained. The project allowed the author to identify discrepancies in the reliability of the tests performed and to identify the problems that needed addressing. These discussion of the actual issues became part of the following chapter.

Chapter Three builds upon the preceding section by exploring the potential for reducing the margin of subjectivity in polygraph examinations. Gołaszewski cites the validation of methods for performing polygraph examinations outlining a list of techniques approved for the examinations in question by to the American Pol-

ygraph Association according to its standard (pp. 207–208). Further comes the rationale for diagnosis, commencing with the Backster system, and moving on to the federal system and the one developed at the University of Utah. The section concludes with the more recent Empirical Scoring System and Empirical Scoring System Multinomial. The chapter concludes with the subject of judicial review of expert opinions, and brings out the legal rationale for limiting subjectivity in polygraph examinations in order to provide the most complete, reliable and subjective examination opinions possible.

The reviewed work concludes with a wrap-up on pp. 241–251. The author's reflections and conclusions are worth consideration. His comprehensive description of the issue of subjectivism and the attempts made to reduce it provides a valuable contribution to the existing body of knowledge in the field of polygraph research. It is important to note that the research in question is the subject of ongoing studies that aim at improving the quality of the data obtained. Nevertheless, there are no other equally comprehensive works describing expert subjectivity and propose measures to address it at the moment. *Methods of interpreting data in polygraph examinations, the problem of expert subjectivity in forming opinions*, with argumentation is conducted in a logical manner, and the selection of examples, both historical and stemming from the author's research, comprehensively covers the chosen subject matter, is certainly a valuable contribution.

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For example (in references):

Reid, J., Inbau, F. (1966), *Truth and Deception: the Polygraph ("Lie-detector") Techniques*, Baltimore: Williams & Wilkins.

Abrams, S. (1973), Polygraph Validity and Reliability – a Review, *Journal of Forensic Sciences*, 18, 4, 313.

and (Reid, Inbau, 1966), (Abrams, 1973) inside text.

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