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# ***Polygraph***

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The journal *Polygraph* publishes articles about the psychophysiological detection of deception, and related areas. Authors are invited to submit manuscripts of original research, literature reviews, legal briefs, theoretical papers, instructional pieces, case histories, book reviews, short reports, and similar works. Special topics will be considered on an individual basis. A minimum standard for acceptance is that the paper be of general interest to practitioners, instructors and researchers of polygraphy. From time to time there will be a call for papers on specific topics.

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## **Terminology Reference for the Science of Psychophysiological Detection of Deception**

**Donald Krapohl and Shirley Sturm**

### **Introduction**

In the first edition of this publication five years ago, we sought to create a reference publication useful to polygraph practitioners and non-practitioners alike. This is because, outside of the polygraph community, little is known about the concepts, procedures, and subtleties that constitute polygraphy. We regularly read with disappointment about these misperceptions in the scientific and popular presses. Likewise, polygraphers do not always have a full appreciation for how the remarkable phenomena in polygraphy fit into the larger world of psychological and physiological science. We considered this publication to be a type of translation guide, to permit not only polygraphers of different schools to communicate, and also help polygraphers and scientists to understand what the other is saying.

The last five years we have witnessed great strides in the field of psychophysiological detection of deception (PDD). Among the more notable events, the Committee on Forensic Psychophysiology of the American Society for Tests and Materials began to develop and publish standards for the field, including standards of terminology. Similarly, the American Polygraph Association formalized many terms in its publications and public statements. Because of the tremendous influence of these organizations, it became important to revisit the terminology and concepts from the first edition, to bring them in concert with these official definitions. Also, the present authors received welcomed criticisms of the first work from readers, which required some corrections. Finally, new and promising non-traditional lie detection methods have emerged from research laboratories, some of which may someday supplement the existing PDD data channels.

Though perfection shall always remain an elusive goal, we and the other contributing authors have strived to be as clear and thorough as possible in this project. To help readers gain more from the guide, citations have been added for many of the terms, so that readers can go directly to source materials for more information. The reference list is found near the end of the guide. Within the definitions themselves, cross-references to other terms are shown in *italics*. There is also a listing of Web sites at the end of which provide free information on polygraphy. We hope that readers will find it useful when looking into, and out from, polygraphy.

because these formats interpret lack of phasic responses as indicative of truthfulness. There are anecdotal reports using this explanation for false negative outcomes in the older literature, though there is no empirical or theoretical foundations to support the assertion that adrenal exhaustion eliminates phasic arousal except under extraordinary circumstances, such as those experienced by the most abused prisoners of war. Direct neural connections via the sympathetic nervous system perform most of the stimulation to the affected body systems, obviating the necessity of hormonal influence. As evidence, John Reid reported the successful testing of examinees who had undergone bilateral adrenalectomies.

### **adrenergic**

Those neurons that release the neurotransmitter norepinephrine. Also, substances that mimic norepinephrine in its physiological effects.

### **afferent nerves**

Nerve fibers that carry impulses from the periphery toward the central nervous system. Also called *sensory nerves*.

### **Air Force Modified General Question Test (AFMGQT)**

PDD format, used primarily within the U.S. Government, with flexible question orderings and numbers of relevant questions. The AFMGQT can be used in single-issue, multiple-facet, and multiple-issue PDD examinations. The AFMGQT uses relevant, probable-lie, sacrifice relevant, and irrelevant questions. Symptomatic questions are not used.

### **algorithm**

System of standardized steps that lead to a solution. A series of decision rules. The term algorithm is frequently used in the context of automated data analysis that produces a decision or result. Algorithms have many applications; PDD algorithms analyze the physiologic data from structured examinations and make estimates of the likelihood of deception or to assess which question has elicited the greatest physiologic response. There are at least four algorithms now available for analysis of PDD data. See: Dollins, Krapohl, & Dutton (1999).

### **all or none law**

At threshold stimulus, the tissue or neuron will respond to its greatest ability. Stimuli that do not meet or exceed the threshold will not be sufficient to cause a response in the tissue or neuron. Skeletal muscles, cardiac muscles, and nerve tissues conform to the all or none law.

### **alpha**

A Greek letter ( $\alpha$ ) used to denote the probability of incorrectly rejecting a null hypothesis in statistical testing. If the probability of obtaining the sample result is less than alpha (usually set equal to 0.05 or less), the results are declared "statistically significant."

### **American Association of Police Polygraphists (AAPP)**

Professional organization dedicated to serving the needs of criminal justice and military PDD examiners. Founded in 1977, AAPP has about 800 members.

### **American Polygraph Association (APA)**

Professional organization made up of PDD professionals from law enforcement, government, and the private sector. Incorporated in 1966 in Washington, D.C., the APA resulted from the merger of the several polygraph associations, including the Academy of Scientific Interrogation, the American Academy of Polygraph Sciences, the National Board of Polygraph Examiners, the International Association of Polygraph Examiners, and the International Association for Polygraph Research. It currently has about 2,400 members and is headquartered in Chattanooga, Tennessee.

### **Americans with Disabilities Act (ADA)**

“An Act to establish a clear and comprehensive prohibition of discrimination on the basis of disability.” PDD is used in employee selection and loss investigation in the private sector, and some provisions of the ADA limit the types of inquiries that can be included in the test coverage. Provisions of the Act can be found at the Department of Labor Web site: [www.dol.gov/](http://www.dol.gov/).

### **anacrotic limb**

Ascending portion of an arterial pulse wave.

### **analog instrument**

Device that records data in a continuous form. An analog polygraph registers waveforms as continuous lines on a strip chart, whereas a digital instrument records them as discrete points. While many analog instruments are currently in use, the trend has been toward computerized instrumentation.

### **analog study**

Experimental design that attempts to replicate real world activities under controlled circumstances, i.e. a mock crime study. Analog methodologies are frequently used in polygraph validation studies because it is possible to establish ground truth, something extremely difficult to determine independently in actual crimes. Despite this important feature, mock crime studies in polygraphy have been criticized for not being able to induce the level of emotional involvement or personal risk engendered in real criminal investigations.

### **anecdote**

Personal narrative relating to an issue or event. Anecdotal evidence pertains to non-empirical observations, and it is sometimes used to forward an assertion for which there may be no clear evidence.

### **ANOVA**

ANalysis Of Variance. A family of statistical procedures designed to partition the total amount of variability in a set of scores into two parts: the parts that can and cannot be accounted for by the independent variable(s). The ANOVA is often used in psychophysiologic and PDD research.

### **anticlimax dampening concept**

Theory proposed by Cleve Backster that is based on the principle of “psychological set.” The theory holds that a person’s fears, anxieties, and apprehensions will be directed to that situation which holds the greatest threat to his or her well-being or self-preservation at that point in time. In the polygraph examination, a guilty examinee’s concern over an intense relevant question may result in a full or partial dampening of

responses to other questions, such as less intense relevant questions or comparison questions. See: Backster (1963a).

### **anti-countermeasures**

Preventative measures used by PDD examiners to block or neutralize the countermeasure efforts of examinees. For example, if the aim were to be to preclude an examinee from pressing his toes against the floor during testing, an anti-countermeasure might include elevating the examinee's feet from the floor so that this strategy cannot be acted upon. Lynn Marcy is credited with making the distinction between anti-countermeasures (proactive) and the counter-countermeasures (reactive).

### **aorta**

Main systemic artery from the heart. The aorta receives blood from the left ventricle through the aortic valve. The upward extending portion is considered the ascending aorta, followed by a downward bend, the arch of the aorta. The portion passing through the chest is the thoracic aorta, from where the blood flows to all parts of the body. It is accepted in the field of PDD that blood pressure recordings are more diagnostic as the sensors are placed closer to the aorta; hence the practice of placing the blood pressure cuff over the brachial artery of the arm.

### **apnea**

Temporary cessation of breathing. Apnea is considered the ultimate manifestation of respiratory suppression. When they are specifically associated with certain questions during a PDD examination, they are considered significant physiological reactions and strongly diagnostic of deception. True apneas almost always take place at the bottom of the exhalation cycle.

### **a posteriori**

(L: from what comes later) That which is done after the experiment. This expression is commonly seen in research. An example of a typical a posteriori decision is post hoc statistical analyses of data that had not been anticipated by the experimenters. Opposed to *a priori*.

### **applied stimulus**

Usually in the form of a question given in some testing formats; the question has the sole purpose of eliciting a physiological response so that the PDD examiner can determine whether the proper balance and amplifier gains have been set. This type of question is usually an unrehearsed irrelevant question, an instruction, or a question with a recall or computational task.

### **a priori**

(L: from what precedes) Refers to that which is done before the conduct of an experiment. An example is the number and type of subjects to be recruited for the study. Opposed to *a posteriori*.

### **arousal**

A state of excitement. Lacey proposed that three types of arousal exist 1) behavioral, 2) autonomic, and 3) cortical. Behavioral arousal can be observed in a person's outward responses, autonomic arousal can be measured by psychophysiological

changes in the peripheral nervous system, and cortical arousal can be measured as EEG desynchronization and fast waves. See: Lacey (1967).

### **arousal theory**

One of several theories that attempt to explain PDD. It holds that stimuli have different intrinsic arousal potential for each subject, and discrimination between guilty and innocent subjects is achieved by assessing which type of stimuli has drawn the most responsivity.

### **arrhythmia**

Any variation of the heart's normal rhythm is considered an arrhythmia. An example of a regular variation, associated with respiratory activity, is sinus arrhythmia. Examples of irregular variations include premature contractions, heart block, flutter, and fibrillation. Rapid arrhythmias are termed tachycardias while slow arrhythmias are termed bradycardias.

### **Arther technique**

A probable-lie comparison question technique developed by Richard O. Arther and taught at his training school in New York City. It was built upon the methods of the Reid school, of which he was a student. The Arther technique relies heavily on behavioral indicators to assess deception. His question series is unique in that it includes a known truth pseudo-relevant question. Arther has taught thousands of students in the U.S. and abroad, and has focused on the law enforcement sector.

### **Associated Research, Inc.**

A manufacturer of the Keeler polygraph, which is no longer in production.

### **attention**

The focusing or concentration of mental activity. Attention is central to the theory of *psychological set*, currently the most popular theory to explain the differential arousal patterns observed with the Comparison Question Technique.

### **autogenic training**

Instruction in one form of self-hypnosis. Subjects can be taught to induce a state of profound relaxation through a series of simple exercises. Because autogenic training can help individuals modify physiological arousal, it is considered by some as a potential countermeasure against PDD. There is little data to support or refute this argument. Because autogenic training focuses on self-regulation of tonic levels of physiological activity, and conventional polygraphy relies on phasic response patterns, its usefulness in defeating modern PDD techniques is probably very limited.

### **automatic mode**

Setting for the electrodermal activity channel, which uses a high-pass filter to perform self-centering. All modern polygraphs manufactured in the U.S., both analog and computerized, have this feature. While the self-centering action of the automatic mode is attractive to many PDD examiners for practical reasons, it has been criticized for filtering out diagnostic information that cannot be reconstructed from the final signal. Some polygraph schools recommend using the manual mode to avoid these problems.

**autonomic nervous system (ANS)**

An involuntary physiological division of the nervous system which provides nervous supply to smooth and cardiac muscles. The ANS is divided into the sympathetic and parasympathetic portions. The ANS performs the vegetative functions and regulates arousal levels. All conventional PDD methodologies monitor ANS activity. See *sympathetic and parasympathetic nervous systems*.

**Avex**

Computer polygraph manufactured in Russia.

**Axciton**

An American manufactured computer polygraph, developed and marketed by Bruce White of Houston, Texas.

**axon**

The long central process of a neuron. A single axon extends from each cell body of the neuron to the synapse or end organ and is responsible for the transmission of the nerve impulse. In humans and other vertebrates, most peripheral axons are sheathed in a fatty layer called myelin, which acts to insulate the axon from the surrounding tissue. There are regular breaks in the myelin sheathing, called the nodes of Ranvier, that allow the electrical impulses to jump from node to node (saltatory transmission) rather than transit in the axon via the slower chemical depolarization process.

**Backster, Cleve**

Originator of the Trizone Comparison Test, more often referred to as the Zone Comparison Technique. Backster also introduced to the polygraph profession the concepts of "psychological set," zones, spots, superdampening, anticlimax dampening, symptomatic (outside issue) questions, exclusionary comparison questions, and 7-position scoring for use in chart analysis. Backster's concepts have been widely adopted into practice in PDD, and there are several contemporary methods that can be traced back to Backster's original design. Backster heads a private training facility in San Diego, California, and has provided training for thousands of examiners since the late 1940s. He also began the CIA polygraph program in 1949.

**Barland Chart Overlay**

A transparent chart overlay developed by Dr. Gordon H. Barland in 1982 for the interpretation of the curvilinear polygraph tracings from analog polygraphs. See: Matte (1996)

**baseline arousal**

Term used in PDD to characterize a marked upward shift in the entire respiration tracing. Baseline arousals do not always occur during deception; however, when they are observed they are reliable indicators of stress. Some baseline arousals are relatively short-lived, lasting only a few respiration cycles, while others may continue much longer.

**base rate**

Incidence of something in a population, often expressed as a proportion or percentage. Base rates can affect on the overall accuracy of a technique. When base rates are relatively high, detection is much easier than in low base rate conditions. As an example, in medicine there is a much lower false positive rate with a diagnostic technique

when the base rate of incidence is 50% than 0.1%. Similarly, in PDD it is much easier to find the one guilty individual in a tested population of two (50% base rate) than the 1 guilty person among 1,000 suspects (0.1% base rate). Statements of PDD validity are incomplete unless they also identify the characteristics of the tested population. The base rate problem is not unique to PDD, but is also found in all other diagnostic tests. See: Gastwirth (1987); Kircher & Raskin (1987); Murphy (1987).

### **behavioral analysis**

Method for developing extrapolygraphic information that may be useful in the diagnosis of truth or deception. The behaviors of interest may be naturally occurring within the context of the polygraph examination, or are the result of questions posed by polygraph examiners during the interview phase of the session. The inclusion of behavioral analysis in the polygraph decision process is controversial.

### **behavior countermeasures**

A class of countermeasures by which an examinee attempts to sway the examiner or influence the conduct of the session. The intent is to influence the decisionmaker or restrict the ability of the decisionmaker to conduct a valid examination. By definition, behavioral countermeasures have no influence on the physiologic tracings. The effect is sociopsychological in nature (interpersonal dynamics) rather than psychophysiological. See: Krapohl (1996).

### **Berkeley psychograph (or Lee Polygraph)**

Two-channel polygraph with event marker assembled by C.D. Lee of Berkeley and used in criminal testing. It included a stimulation marker, pneumograph and cardiograph, and recorded these channels simultaneously on moving graph paper. It was designed to be as portable as a suitcase. Lee sold his Berkeley psychographs from the 1930s into the 1950s, and they were delivered complete with pens, sensors, paper, and instructions.

### **Benussi, Vittorio**

One of the first researchers to examine respiration tracings for detecting deceptions. Though Italian, Benussi did most of his work in Austria at the University of Graz. See: Benussi (1914).

### **beta blocker**

Adrenergic blocking agent affecting responsivity of the cardiovascular system and used to treat specific cardiovascular conditions such as high blood pressure and arrhythmias. Because they appear to dampen cardiovascular phasic responsiveness, beta blockers are of concern to PDD examiners because of their potential as a pharmacological countermeasure. Testing of examinees who take beta blockers is routine practice, as some cardiovascular responsiveness usually persists even with the medication.

### **bias**

In research it is a source of systematic error that can influence the outcome of the experiment. Bias can be introduced into research by factors such as, among others, nonrandom sampling, faulty subject instructions, or expectations of the researcher or the participants. In a PDD study looking at the validity of blind scoring, for example, a researcher using only cases which were verified by the original examiner are likely biasing the study, since cases that the original examiner made the wrong diagnosis could be

systematically excluded from the research sample. Researchers attempt to control bias through experimental design.

**biphasic response**

Physiological reaction that has two phasic responses, in opposite directions. Biphasic responses of a diagnostic nature in PDD are found in the skin potential and heart rate recordings.

**biofeedback**

Use of a device to measure and convey physiological information back to a subject. It has been proposed as a potential countermeasure approach. Biofeedback is not a countermeasure in itself, but rather a means of teaching a subject to influence autonomic responsivity. Research indicates that biofeedback is better suited for self-regulation of tonic activity than phasic activity. As a result it may be useful to dampen or increase responsiveness in general during a test, but less so within a test to a given question. It has been suggested that this has implications for test formats such as Relevant/Irrelevant and Peak of Tension, but probably not for tests using comparison questions such as the Reid and Zone formats. Biofeedback can also be used to enhance responsiveness in subjects during testing. It has been hypothesized that the immediate biofeedback serves to elicit greater responding to questions when deception is practiced by the examinee. There is some empirical evidence of this effect, but it has not been unequivocally established.

**bizone**

Incorrect term applied to a Zone Comparison Test containing two relevant questions. See *zone*.

**black zone**

In the Backster framework, it is a twenty to thirty-five seconds block of polygraph chart time initiated by a symptomatic question having a unique psychological focusing appeal to the examinee who is fearful that the examiner may ask an unreviewed question dealing with an outside issue.

**blind chart analysis**

Evaluation of PDD recordings without the benefit of extrapolygraphic information, such as subject behavior, case facts, pretest admissions, base rates of deception, etc. Studies employ various degrees of "blindness." It is a popular research approach to gauge interrater reliability. Assessments of the accuracy of PDD test evaluation techniques also use blind chart analysis.

**blind stimulation test**

Stimulation test in which the examiner does not know the critical item at the beginning of the test. See *stimulation test*.

**blocking**

Pattern sometimes seen in the pneumograph tracing in which the examinee discontinues respiration at or near the inspiratory peak. Blocking can be differentiated from a typical apnea in that the latter most often occurs near the end of the expiratory segment of the respiration cycle. Blocking is many times a deliberate attempt on the part of the examinee to influence the physiological activity recorded by the polygraph.

**blood pressure**

The force blood exerts against the walls of the blood vessels, usually measured in millimeters of mercury, is called blood pressure. PDD examiners evaluate only relative blood volume changes, as current polygraphs are not capable of providing absolute blood pressure measurements. Also see *systolic blood pressure*, *diastolic blood pressure*, *mean blood pressure*, and *pulse pressure*.

**blood volume (BV)**

Quantity of blood in an organ or limb, usually recorded as relative increases and decreases in the circumference of the affected area or size of blood vessels. Localized changes in blood volume are mediated by chemical and neural mechanisms, such as the shunting of blood to the major muscle groups during sympathetic nervous system activations. Traditional PDD methods of recording use changes in blood volume for diagnostic purposes rather than blood pressure per se.

**bogus pipeline (BPL)**

Sociopsychological effect whereby a subject will make more candid and sometimes more incriminating revelations about himself when he believes a device attached to him will reveal his true knowledge or attitudes. The BPL was first reported by Jones and Sigall, who convinced subjects that the electromyograph used in their study could measure internal feelings, and found that their subjects were more willing to disclose socially-undesirable attitudes. Some critics of polygraphy contend that PDD is merely an elaborate BPL that has only the power to elicit confessions but not assess truthfulness or deception. See: Jones & Sigall (1971).

**bootstrapping**

A statistical technique. Bootstrapping involves pooling the data from two samples and drawing samples repeatedly from the pool, with replacement, to create a single distribution. The number of samplings taken to create the distribution is typically in the thousands. Then the two original samples are compared using this grand distribution as an estimate of the true population to determine whether they are significantly different from one another. Bootstrapping has been applied both to PDD and brain wave approaches. See: Farwell & Donchin (1988); Honts & Devitt (1992); MacLaren & Taukulis (2000).

**brachial artery**

Major blood vessel located in upper arm. Occlusion blood pressure sensors are frequently placed there, and it is the preferred placement site for the blood pressure cuff in PDD.

**bradycardia**

Heart rate of under 60 beats per minute. Brachycardia is common among athletes and those with hypothyroidism. Slow heart rate can also indicate the influence of medications.

**bradypnea**

Very slow respiration, longer cycle time. The term does not distinguish between autonomic and deliberate respiration slowing.

**breakdown (or breakout) test**

PDD test in which a single issue is addressed, and is always given after a multiple-issue test has indicated that the examinee has consistently responded to that issue. It is generally conducted in one of the validated test formats, such as Zone Comparison Tests or the Modified General Question Test. Question coverage can be single- or multi-faceted. The rationale for this two-stage approach to PDD testing is that, while multiple-issue screening examinations are very useful in identifying which among several issues the examinee is concerned with, they lack the power of these single-issue formats in making correct determinations of deception or truthfulness. This approach is used in many polygraph screening programs to maximize both utility and accuracy of PDD in preemployment and other applications.

**Brilograf**

Device for measuring changes in skin resistance. Built in the 1940s by Jacques Bril, a criminologist, Brilograf was based on similar work he had done with Rev. Walter Summers on the "Pathometer." Not generally used and is only of historical note.

**Burt, Harold E.**

Researcher into deception tests using respiration. Burt devised a formula to evaluate respiratory responses for detecting deception based largely on the ratio of the time to inhale to that of the exhalation. See: Burt (1918;1921).

**Calibration Verification of Sensitivity Test (CVOS)**

A testing procedure conducted as the first chart, which is designed to assess an examinee's capability to process information, detect psychological or chemical countermeasures, permit adjustment of gain settings to match the response capability of the examinee, determine whether sufficient professional rapport has been established with the examinee, and reduce excessive anxiety.

**card test**

One of several types of stimulation tests used in conjunction with the standard PDD examination. In the traditional card test the examinee is invited to select a card from a deck of cards and then is tested on which number, letter, color, or character is on the card. See *stimulation test*.

**cardioactivity monitor (CAM)**

One of several cardiovascular sensors used in PDD. The CAM sensor is placed on the end of the finger or thumb, and it detects changes in distal blood volume via small strain gauge sensors attached to a metal diaphragm. CAMs require electronically enhanced cardiograph components. While some consider the CAM useful, it is employed less often than the traditional blood pressure cuff.

**cardiograph**

General term for any recording of heart activity. In PDD the use of a blood pressure cuff to monitor relative arterial blood pressure changes and pulse wave is more precisely described as *sphygmography* (recording of the arterial pulse) or *occlusion plethysmography* (partial blockage of circulation to measure volume changes in a body part). While cardiograph is not incorrect in this context, it lacks precision in denoting the actual phenomenon being recorded in PDD. The term *cardiograph* in the psychophysiological and medical literature most often refers to the electrocardiograph.

**cardiograph notch control**

One of the selective enhancement features for the analog polygraph introduced by Lafayette Instrument Company in 1979. Designed to regulate the distinctness of the dicrotic notch in the electronic cardiograph tracing through filtering of specific frequencies.

**cardiograph response control**

One of the selective enhancement features for the analog polygraph introduced by Lafayette Instrument Company in 1979. Used a variable high-pass filter that permitted the operator to regulate the amplitude of the slow wave component (relative blood volume) of the electronic cardiograph.

**cardio-pneumo-psychograph**

A two-channel polygraph developed by John Larson in the 1920s and used in criminal cases to uncover deception.

**cardiosphygmograph**

Alternate term for the pulse wave and relative blood pressure tracing used in PDD. While the term *cardiosphygmograph* was common parlance in the 1930s through 1950s, it is used less frequently today even though it is more precise than the current expression *cardiograph* or its abbreviated form, *cardio*.

**cardiotachometer**

Instrument that measures heart rate. Since heart rate can only be accurately measured over several seconds, real-time displays usually reflect the inter-beat interval that has been converted into the reciprocal to give the cardiac rate.

**card stimulation test**

See *card test* or *stimulation test*.

**catacrotic limb**

Descending portion of an arterial pulse wave.

**central nervous system (CNS)**

That portion of the nervous system consisting of the brain and spinal cord. CNS activity, although closely integrated with autonomic nervous system (ANS) activity, is not separately considered in traditional PDD approaches. It has been used with event-related potentials (ERPs) in Concealed Information Tests.

**chart**

Graphical record of phenomena. In PDD it refers to the polygram on which is recorded the physiological activity during testing. The term *chart* is sometimes used interchangeably with *test*.

**chart identification**

Information annotated on a PDD chart by the examiner to record identifying data such as date, time, test number, examiner, case number, signatures, fingerprints, or other details required by the polygraph program. Not to be confused with *chart markings*.

**chart markings**

Annotation of the physiologic tracings to denote stimulus (question) onset and offset, examinee's answer, question number, question label, artifacts, and other details important to the interpretation of the physiological data.

**chemical countermeasures**

See *pharmacological counter-measures*.

**Cheyne-Stokes respiration**

Periods of cyclical variation in the amplitude of respiratory cycles interspersed with periods of apnea. This pattern of respiration is usually associated with brain damage, congestive heart failure, kidney disease or drug abuse.

**chi-square test ( $\chi^2$ )**

A nonparametric inferential statistical test based on the chi-square distribution. The chi-square test is frequently applied to determining the randomness of deviations between observed and expected values. Generally, the test is used to evaluate hypotheses dealing with the relationship between two categorical variables and "goodness of fit tests." The chi-square test lacks the sensitivity of other available methods and is used primarily when the data can only be tabular in form. It is often reported in PDD literature, principally when comparing groups of test outcomes.

**cholinergic**

Those neurons that release the neurotransmitter acetylcholine.

**classical conditioning**

Characterized by the establishing of a response to a stimulus that does not normally evoke the response. The Russian physiologist Ivan Pavlov reported producing a conditioned reflex in dogs during the last part of the 19th century. He used the sight of food (unconditioned stimulus) to induce salivation in the dog (unconditioned response) and fostered a mental connection between the food and the sound of the bell, and the bell's ring became the conditioned stimulus. It is theoretically possible to classically condition physiological responses to occur uniquely when a subject is deceptive, and this method is one of the promising areas of future research in lie detection. Petty & Cacioppo (1981).

**clinical approach**

Assessment technique used in PDD that includes the use of extra-polygraphic information to arrive at a conclusion of truthfulness or deception. Also called *global analysis*.

**closed-eyes technique**

As the name indicates, it is the PDD examination in which the examinee is instructed to keep his eyes closed during testing. This method is used by a minority of PDD examiners, and questions about the effects of open or closed eyes have not been thoroughly investigated.

**comparison question**

Type of question used to elicit responses that are compared with the responses to relevant questions. There are two main types: directed lie (DLC) and probable lie (PLC).

Subtypes for the DLC are the trivial and the personal. For the PLC they are the exclusive (exclusionary), and non-exclusive (inclusive). Historically called *control question*, *comparative response question*, and *emotional standard*.

### **Comparison Question Technique (CQT)**

An umbrella term for standard testing formats that use probable-lie or directed-lie comparison questions. Included are the Reid, the MGQT, the Zone Comparison, the Positive Control, the Utah, the Arthur, the Quadri-Track, and the Test for Espionage and Sabotage. None of the following are considered CQTs: Relevant/Irrelevant, Peak of Tension, and Concealed Information Tests.

### **comparative response question**

Name given by John Reid in 1947 for what would later be called the *control question*, and ultimately *comparison question*. See *comparison question*.

### **Computer Assisted Polygraph System CAPS**

System developed by David Raskin and John Kircher of the University of Utah that permitted modified field analog polygraphs to interface with a computer. Signals were extracted from the pen drive motors and routed to an analog-to-digital converter, where they were digitized, stored, edited, and analyzed. Discriminant analysis was used to weigh and combine measurements, and the software produced a statement of the probability of deception. CAPS, which stood for Computer Assisted Polygraph System, was later replaced by CPS, Computerized Polygraph System, which used a computer without the analog polygraph. Currently manufactured by Stoelting Instruments.

### **Computer Voice Stress Analyzer (CVSA)**

National Institute for Truth Verification produces the CVSA, first introduced in 1988. The company advertises that this device was developed from the Psychological Stress Evaluator (PSE) and is widely distributed amongst law enforcement agencies. Examiner certification is required. The CVSA testing format is dissimilar to PDD formats. Like other voice-based deception detection systems, published scientific research has failed to find any accuracy with the CVSA. See *Psychological Stress Evaluator (PSE)* and *voice stress*.

### **Concealed Information Test (CIT)**

Otherwise known as the Guilty Knowledge Test. The CIT is actually a series of tests, perhaps as many as 10, in which there is only one critical item in each series, much like the better-known Peak of Tension tests. The tests are constructed so that the order of the item presentations is randomly selected, except the first item which is used as a buffer. The theoretical operating mechanism of the CIT is there is greater signal value in the critical item for guilty examinees than in the irrelevant items. The CIT is believed to rely on cognitive processes, and is therefore not subject to false positives from nervous examinees. CIT tests could be used in a small proportion of all criminal cases where sufficient details were available to construct it, however in most crimes such details are lacking or would be already known to innocent persons via the media or investigating officers. Despite assertions of theoretical superiority of the CIT over the CQT, the CIT has practical limitations that have hindered its broad acceptance among field practitioners. Moreover, the preponderance of independent research suggests that false negatives may be a problem with the CIT. See Lykken (1959); MacLaren (2001); Podlesny (1993).

### **conditional probabilities**

A statistical concept in which the likelihood of an event is predicated on a set of conditions. Conditional probabilities are expressed as  $p(A|B)$ , which may be read as: what is the probability that event A will occur given event B has occurred? More specifically, a false negative polygraph result can be represented as  $p(\text{no evidence of DI responses} | \text{the person is lying})$ . Conditional probabilities are important when characterizing the accuracy of PDD. The following illustration is one offered by critics of the use of PDD in screening. Suppose that PDD is 90% accurate in detecting both deception and truthfulness. Also, assume that it is used to test 1,000 government employees, only one of whom is involved in the activity of interest, say, treason. There is a 90% chance that the one guilty person will be caught. Of the 999 innocent employees, 899 (90%) will pass the examination, and the remaining 100 will be false positives. The ratio of true positives (1 guilty) versus false positives (100 innocent) is a low payoff if the consequences are employment termination or criminal prosecution. Not used in this example is the influence of repeated testing and other methods that can reduce false positives, but it is clear from this example that PDD validity estimates are not well represented by a single percentage. See *base rates*.

### **conditioned response theory**

One of several theories that attempt to explain the underlying mechanisms of PDD. Conditioned response theory holds that physiologic responding is the consequence of an emotional response triggered by the conditioned stimulus. When a given stimulus is associated with strong emotions, larger responses are expected. There is some support for this theory in that physiologic responding has been established to be positively correlated with the personal significance of the test question. It does not explain why PDD continues to work in non-threatening and low motivation conditions, however. The conditioned response theory is not the prevailing explanation for PDD.

### **conductance**

Capacity of a material to permit the flow of electricity. Skin conductance is a common measure used in PDD. A related measure, resistance, is the reciprocal of conductance.

### **confabulation**

The reporting of information from imaginary experiences to fill in gaps of memory without any overt intention to deceive, though the information is most likely false. Confabulation can be a symptom of some organic brain disorders, though developmental factors explain other cases. The effect on deception tests has not been investigated.

### **confession criterion**

A potential confound in field research on polygraphy. If cases are selected for research that use confession as a form of confirmation, then the study sample may be biased, for the following reason. Standard practice in polygraphy is to only interrogate after a deceptive outcome on the examination. Therefore, confessions will only be obtained from examinees who failed the examination, but not from those who managed to defeat the examination. The sample will then represent those cases in which the examinee was caught by the original examiner, rather than all cases in which the examinee was deceptive. It has been asserted that the use of the confession-verified cases in blind scoring studies to assess polygraph validity may overestimate the accuracy of the polygraph, because they may have charts in which deception is the easiest to interpret.

Most field studies that have examined this source of research error have not found a meaningful effect, though the issue is still hotly debated. See: Horvath (1977); Honts (1996); Iacono (1991); Krapohl, Shull & Ryan (2002); Patrick & Iacono (1991); Raskin, Kircher, Honts, & Horowitz (1988).

**confirmatory testing**

PDD examination used to verify the statements of suspects, witnesses, and victims.

**conflict theory**

One of several theories that attempt to explain the underlying mechanisms of PDD. According to conflict theory, the simultaneous activation of two conflicting tendencies, such as the motivations to lie and tell the truth, results in physiologic arousal. The greater the conflict, the larger will be the response. This explanation arises from the work of Luria in the 1920s and 1930s. The conflict theory predicts that psychopaths, by virtue of a defective conscience, do not produce arousal responses as large as non-psychopaths, and this effect has been demonstrated in laboratory studies for psychopaths as a group. However, it does not explain well why phasic responses occur even when an examinee is not required to answer the question, or even when the examinee answers truthfully. The conflict theory is rarely cited as the principal explanation for PDD. See: Gardner, (1937).

**conspicnificance**

Mnemonic device used in the instruction of PDD. It stands for consistency, specificity, and significance, three characteristics of a physiologic response indicative of deception. In order for response patterns to support a PDD outcome of deception, they must appear regularly to the same questions, manifest themselves uniquely to those questions, and be of a magnitude to be distinguishable from baseline variability.

**constant current method**

Measurement of skin resistance where the current applied to the skin is held constant.

**constant voltage method**

Measurement of skin conductance where the voltage applied to the skin is held constant.

**containment approach**

Criminal justice system, treatment team, and polygraph examiner working together in a team concept sharing information equally with the other members of the team. As an offspring some containment teams now include one or more of the following: law enforcement, child protection, rape crisis centers, prosecuting attorneys, judges, and in some cases school counselors, victim advocates, and medical staff. See: Cooley-Towel, Pasini-Hill, & Patrick (2000); English, Pullen, & Jones (1996); Heil, Ahlmeyer, McCullar, & McKee (2000).

**control group**

The group in research that differs from the experimental group only in that the latter receives the positive manipulation pertaining to the independent variable. A control group is necessary to infer that the changes observed in the experimental group are the result of the independent variable. For example, if a researcher wished to know the effects of the drug diazepam (independent variable) on electrodermal responses

(dependent variable), the group that did not receive the medication would be called the control group and the medicated group would be the experimental group.

### **control question**

Superseded term, now call the *comparison question*. Class of questions used in deception examinations that serves to elicit physiologic responses of innocent examinees. There are several types, such as the exclusionary, non-exclusionary, probable-lie, directed-lie, the positive, and minor variations. The term “control” in PDD traces its roots to the 1930s and to what are now called stimulation tests. These tests were used as “controls” for the production of deception response patterns that would later be compared with responses to relevant questions in the Relevant/Irrelevant technique. In 1947 John Reid published a paper in which he referred to two types of questions as controls—one he called a “guilt complex” and the other a “comparative response” question, the latter being a probable-lie question. The “comparative response” question was called a “control question” in a paper published by Fred Inbau in 1948, and the name became the standard terminology in PDD for nearly 50 years. This was not the first use of this class of question, however. Walter Summers used similar questions with his Pathometer technique which he labeled *emotional standards* as early as 1939, and they were used by New York State Troopers from 1939 until at least 1952. Elizabeth Marston, widow of William Marston, and Olive Richard, Marston’s former secretary, reported that they had participated in deception examinations with Marston some years before in which “hot” questions were used for comparison. A typical hot question would be, “Did you ever think of stealing money from that safe?” Elizabeth stated during an interview that they did not believe it wise to publish these types of questions, and consequently they have not been generally credited with this contribution to the science. Beginning in the 1970s, critics of PDD noted that the word “control” as used in PDD tests did not meet the criteria of the term as used in science. The term has since been replaced by *comparison question* in publications of the American Polygraph Association, American Society for Testing and Materials, federal polygraph programs, and scientific papers. See: Waller, 2001.

### **comparison/control question validation test**

Test procedure in which probable-lie comparison questions are tested against relevant questions from a contrived crime to verify that the subject will respond to the comparison questions. These questions are then carried into the actual testing. Proposed and taught by James Matte and used in his testing technique, though not a widespread practice. See: Matte (1976).

### **control test**

An alternate term for a known numbers test. See *stimulation test*.

### **correlation**

Measure of how one variable changes with another, for example, chart scoring ability and years of experience are positively correlated. Measures of correlation range from -1.00 (indicating a perfect negative correlation—as variable *x* increases, variable *y* decreases) to +1.00 (indicating a perfect positive relationship—as variable *x* increases, variable *y* increases). A correlation equal to 0.00 means that two variables are not linearly related. One should not infer cause from correlation; two variables can be correlated without one causing the other. For example, in most cities the number of churches and the number of criminals are positively correlated, but one does not cause the other. Both are correlated to a third factor, population.

**cortisol**

A glucocorticoid or hormone substance found in the bloodstream which is produced by the adrenal cortex of the brain in response to stress.

**counterbalance (or counterweight)**

Feature on analog polygraph recording pens used to adjust the amount of pressure the tips exert against the graph paper.

**counter-countermeasures**

Methods used to detect and neutralize those efforts an examinee has engaged in while trying to defeat the PDD examination. For example, if a PDD examiner concluded from an examinee's behavior that the examinee had tried to dissociate during testing, he could insist that the examinee respond to the test questions with both a key word and the answer, thus ensuring attention to the content of each question. Lynn Marcy is credited with distinguishing counter-countermeasures (reactive) from anti-countermeasures (proactive).

**Counterintelligence-Scope Polygraph (CSP)**

PDD screening examination administered by the Federal Government on individuals with sensitive security clearances to detect and deter espionage, security breaches, sabotage, or other acts against the Government. Sometimes referred to as a *loyalty examination*.

**countermeasures**

Generally, methods used to mislead an observer. In polygraph research it has been labeled either an attempt to create a false negative outcome, or a method to interfere with a correct polygraph outcome. There are several typologies for countermeasures, depending on the definition used. Under some circumstances polygraph countermeasures have been found to be effective, such as when an examinee receives special training and feedback. Most spontaneous attempts are crude and ineffective. Various methods have been devised by PDD practitioners to deter and detect countermeasures. See Krapohl (1996).

**cover question**

Keeler coined this term for a type of question that approximates what later would be called a *control question*. However, cover questions were also used to reveal other crimes of interest to the investigator.

**CPS**

Computer polygraph developed by Drs. David Raskin and John Kircher of the University of Utah. The CPS, which stands for Computer Polygraph System, is marketed by the Stoelting Instrument Company. Like its predecessor, the CAPS, the CPS has a discriminant analysis algorithm that weighs and combines physiological measures to calculate the probability of deception.

**craniosacral division of autonomic nervous system**

An anatomical division of the autonomic nervous system (ANS) that represents the sites for outflow from the parasympathetic division of the ANS, i.e., some of the cranial and sacral nerves carry parasympathetic nerves.

**current exclusive comparison question**

An exclusionary probable-lie comparison question in which the scope includes the time period of the relevant issue, but is excluded from the relevant issue by category, place, or some other delimiter. See: Matte (1996).

**curvilinear tracing**

Lines produced by analog field polygraphs that can become temporally distorted as the recording pens move up or down across the graph paper. This is because the vertical dimension of the graph paper moves in a straight line as time passes, but the recording pens pivot on an axis. Therefore, tracings will be rounded as they are recorded. Manufacturers' offers of curvilinear timelines on the graph paper to help compensate for this effect were not accepted by the profession. Modern computer polygraphs have corrected this problem by rendering rectilinear tracings.

**Daubert v Merrell Dow Pharmaceuticals, Inc.**

Although not a PDD case, the Daubert case set aside the Frye Rule's "general acceptability" provisions in favor of the Federal Rules of Evidence. This paved the way for the admissibility of PDD evidence in most jurisdictions. See: Daubert v Merrell Dow Pharmaceuticals, Inc. (1993).

**deception**

The act of deliberately providing or omitting information with the intention of misleading. The most critical element of the definition is the intention of the information provider. With no intent, deception does not take place regardless of the accuracy of the information being conveyed. For example, in early history humans misunderstood the nature of the solar system, but they were not deceiving when they taught a geocentric universe. Conversely, deception takes place when there is the intent, even if the speaker unwittingly conveys correct information. This is an important concept to consider with regard to PDD. Inconsistencies between ground truth and examinee beliefs may erroneously appear to be mistakes of the PDD technique. One of the great challenges of analog PDD studies is inducing an experiment volunteer to believe he is intending to deceive the examiner rather than merely obeying instructions.

**deception exemplar**

Physiological response pattern which examinees expect to be used as a sample, or exemplar, of that which occurs when they are deceptive, and will be used for comparison against their responses to relevant questions. See: Matte (2000).

**Deception Indicated (DI)**

Along with *NDI* (*No Deception Indicated*) and *Inconclusive*, a conventional term for a polygraph outcome. A decision of DI in PDD means that (1) the physiological data are stable and interpretable, and (2) the evaluation criteria used by the examiner led him to conclude that the examinee is not wholly truthful to the relevant issue. The DI and NDI decision options are used primarily in single-issue testing, and they correspond with *SPR* (*Significant Physiological Responses*) and *NSPR* (*No Significant Physiological Responses*) in multiple-issue, or screening, examinations with the US Government.

**decision rule**

Generically, decision rules determine when data meet the criteria for inclusion in a particular category. Decision rules are the final step in polygraph numerical scoring,

producing decisions of Deception Indicated, No Deception Indicated, and Inconclusive. Optimal decision rules require the following: tracing feature selection; development of best scoring rules, consideration given for base rates; assessing and weighting collateral or countervailing information, and; performance of a cost and benefit analysis to determine the achievable level of accuracy and errors that meet the needs of the consumer. In polygraphy, feature selection and scoring rules have been thoroughly investigated. There are also decision rules in some polygraph analysis systems that include extra-polygraphic information as part of the decision process, though there is no validated method yet published. However, prevailing decision rules do not consider the base rate issue, nor has a formal cost-benefit analysis been published that identifies the appropriate cutting scores for a set of conditions.

**degrees of freedom (df)**

For any set of values, every value within a set can be freely selected except the last, which is determined. Or, in other words, when there is only one value remaining, the final selection is not free to vary. Technically, the concept of degrees of freedom refers to the number of independent observations minus the number of parameters being estimated. The degrees of freedom are essential in the calculation of the threshold or critical value of a test distribution.

**delayed answer test (DAT)**

Experimental methodology used to determine whether physiologic responding was elicited by the stimulus question or an untruthful answer. It was experimentally demonstrated that the physiological arousal was more closely tied to the stimulus presentation than the act of giving the deceptive answer. The DAT is not used in field PDD examinations.

**dendrite**

Receptive surface of a neuron, typically taking the shape of branches. Neurons usually have several dendrites.

**Department of Defense Polygraph Institute (DoDPI)**

Federal PDD training institution and research center, located at Ft. Jackson, South Carolina. It is three core missions: polygraph training, quality assurance, and research. DoDPI was established and dedicated on 15 April 1986 by General Stillwell, then Undersecretary for the Army. Formerly part of the U.S. Army Military Police School (USAMPS) from 1951 to 1986. Web site is located at [www.dodpi.army.mil](http://www.dodpi.army.mil).

**dependent variable**

Variable that changes as a result of the experimenter's manipulation of the independent variable. For example, electrodermal activity could act as a dependent variable to changes in stimulus intensity, an independent variable.

**devil's finger**

See *finger of death*.

**Diagnostic and Statistical Manual IV (DSM IV)**

Reference manual of psychiatric disorders.

**diastole**

Portion of the heartbeat cycle when the heart muscles have relaxed and the chambers fill with blood. The left ventricular diastole is represented in the PDD sphygmograph tracing as the descending limb of the pulse wave (catacrotic limb).

**diastolic blood pressure**

Lowest blood pressure value occurring during the relaxation phase of the cardiac cycle.

**dichotomization theory**

A hypothesis that holds there is a difference in habituation rates for relevant and comparison question responses. According to this theory, guilty subjects habituate more slowly to relevant questions, while innocent examinees continue to respond more strongly to the comparison questions over time. Dichotomization theory has not been generally accepted in PDD. See: Ben-Shakhar, G. (1977).

**dichotomous variables**

Those for which there are only two mutually exclusive and exhaustive possibilities: male or female, yes or no, 0 or 1, etc.

**dicrotic notch**

A regular feature in diastolic limb of the pulse wave recorded on the sphygmograph of the polygraph. It generally occurs between the systole and subsequent diastole of the waveform, and its proximity to either of these two cardiac events is a function of the air pressure in the recording system. The greatest contributor to the dicrotic notch is the rebounding of the blood against the closed aortic valve after systole. It has not been found to be a reliable diagnostic feature in PDD. Also called *incisura*.

**differential responsivity**

Term frequently reported in PDD literature regarding the differences in responses to two types of questions. In Comparison Question Technique (CQT) formats, differential responsivity relates to the response magnitudes from relevant questions as compared to those from comparison questions. Within normal limits, this differential responsivity persists even when overall responsivity is attenuated, or as responsivity habituates. For this reason, CQT formats are unlikely to render false negative decisions that are attributable to countermeasures that attack general arousal, such as the use of drugs, relaxation, or dissociation. By contrast, the Peak of Tension and Concealed Information Tests rely on differential responsivity between critical and neutral items. Decisions in these concealed information tests are based, not on the type of question that induces the response, but rather the presence or absence of significant responses to the critical items only. Therefore, the type of differential responsivity used in decisionmaking in PDD, along with vulnerability to certain types of countermeasures, will depend on the polygraph technique.

**directed-lie comparison (DLC) question**

Type of question used to elicit a response that is compared with the response evoked by the relevant question. The DLC question is different from the probable-lie comparison (PLC) question in that the examinee is instructed by the examiner to answer the DLC question untruthfully, whereas the principle of the PLC requires the examiner to lead the examinee to be untruthful to that question without revealing the purpose. DLCs

can be further delineated into the *trivial DLC* and the *personally significant DLC*, which, as their names indicate, depend on the content of the DLC. DLCs have not been as thoroughly investigated as PLCs, and since their purpose is transparent to the examinee, there is some concern about vulnerability to countermeasures. Moreover, the generator of the physiologic responses to the DLCs may be different from that of the PLC. The true strengths of the DLCs are that they can be standardized much easier than the PLCs, they are less intrusive, and their effectiveness is less subject to examiner skill. DLCs are being used in many quarters of the PDD profession. See: Abrams, (1991); Horowitz, Kircher, Honts, & Raskin (1997); Matte & Reuss (1998).

**disclosure examination**

See *sexual history examination*.

**discontinuous blood pressure method**

Deception test procedure developed by William Marston before 1915. Marston's instrumentation was a standard sphygmomanometer that he used to take intermittent systolic blood pressure measurements during questioning on relevant and irrelevant topics. He plotted these measurements by hand, creating a curve that was interpreted for assessing deception. In 1923 Marston attempted to have the results of his deception test entered into evidence in a murder trial in Washington, DC. The Frye case, which was the first to consider deception tests, established the precedent for exclusion of "lie detector" results. The discontinuous blood pressure method did not enjoy widespread field acceptance, and there are no reports of its use after the 1930s. In the 1920s William Marston, included a cardiopneumo polygraph to augment his discontinuous blood pressure method. In practice, Marston and his wife, Elizabeth, would either ask the examinations questions or take the blood pressure measurements, while Olive Richard, an assistant, operated the equipment. If a stenographer were present, there were four participants in the administration of the examination in addition to the examinee. While William Marston was usually the examiner, Elizabeth Marston and Olive Richard did conduct examinations on occasion without him, making them the first women in this field. Given the great methodological and instrumentation differences, Marston discontinuous blood pressure method is not truly in the lineage of modern polygraphy, though it is frequently included in history lessons at polygraph schools. See: Marston (1917; 1938).

**discovery test**

See *disclosure test*.

**discriminant analysis**

Regression analysis with a categorical criterion—that is, attempting to predict group membership from one or more predictor variables. The CPS algorithm is based on discriminant analysis.

**disguised comparison question**

Comparison questions that are designed to be difficult to identify as such. Typically used in multiple-issue screening examinations. For example, the examinee might have the following disguised comparison question: Did you ever cheat in school? It is expected that nearly every examinee would have doubts about the integrity of his entire academic career, and also believe that truthfulness on the question is required to pass the polygraph examination. Sometimes call *hidden comparison question*.

**dissociation**

Psychologists use the term *dissociation* to denote largely unconscious processes by which normal relationships in thought, memory, attitudes, or other psychological activities do not adhere to their established relationships and become separate or independent. It is also used in PDD to characterize the deliberate disengagement of attention by examinees from the testing situation. Such tactical redirection of attention is considered a mental countermeasure. Examinees who use this approach are hopeful that they may eliminate physiological responding by virtue of their mental distance from the test questions. Dissociation may be effective in test formats where examinees respond with the same answer to each question, such as with the Peak of Tension. In that format the examinee needs only listen for the point when the examiner stops speaking, and give the rote answer. Dissociation is considered a more unlikely countermeasure for those formats that require both yes and no answers, and where the order of the questions is not predictable to the examinee, or where examinees are required to use key words from the test question in the answer.

**double verification test**

Alternate term for *card test*. See *stimulation test*.

**dyspnea**

Labored or difficult breathing, generally resulting from disease.

**Easterbrook Hypothesis**

The premise that attentional resources are more restricted as the level of arousal increases. The Easterbrook Hypothesis is consistent with the theory of "psychological set" in PDD, in that attention is directed to the stimulus most immediately threatening to self-interest at the expense of attention to other stimuli that would ordinarily be very noteworthy to the subject. See: Easterbrook (1959).

**eccrine glands**

One of two types of sweat glands, the eccrine glands influence electrodermal activity as measured in PDD. They are found throughout the skin surface of the body, but in highest concentration on the hands and feet.

**efferent nerves**

Neurons that carry nerve impulse from the central nervous system to the effector organ or muscles. Also called *motor nerves*.

**either-or rule**

PDD scoring rule forwarded by Cleve Backster. According to the rule, if a relevant question does not evoke a physiological reaction, it is scored against the adjacent comparison question with the larger reaction. If the relevant question does produce a significant reaction, it is compared to the comparison question with the smaller reaction. See: Matte (1996).

**electrocardiogram (EKG or ECG)**

Tracing of the electrical activity of the heart. This endosomatic waveform consists of the P, Q, R, S, T, and U waves. The search for diagnostic information in the ECG for PDD purposes has not been fruitful to date. There are preliminary data that suggest that

the pre-ejection period (PEP), which is derived from the ECG and the impedance cardiograph (ICG), are reliable indicators of sympathetic nervous system arousal.

**electrodermal activity (EDA)**

All exosomatic and endosomatic changes in the electrical properties of the skin.

**electrodermal response (EDR)**

Reaction of skin measured by changes in its electrical properties, including skin resistance (SR), skin conductance (SC), and skin potential (SP).

**electroencephalogram (EEG)**

Recording of the electrical activity of the brain generated by the firing of clusters of neurons. In recent years EEG methodology has been applied to deception and concealed information tests. See *P300*.

**electromyograph (EMG)**

Tracing of the endosomatic electrical properties of the voluntary muscles. This activity is recorded through sensors placed on the skin near the muscles of interest. EMG could be used for the detection of physical countermeasures when the sites are correctly chosen by the examiner.

**electrooculograph (EOG)**

Recording of the electrical activity produced during eye movements. EOGs have had two principal uses in deception testing. One is as a deception indicator. Some research has shown lateral eye movements have diagnostic information useful in assessing whether a person harbors concealed information. The second application is with evoked cortical potentials, which also have been used in concealed information paradigms. Brain wave activity generates very small voltages, and eye movements generate electrical potentials that interfere with these signals. EOGs are often collected for subtraction from the brain wave signals

**embarrassing personal question (EPQ)**

A question, frequently with a sexual theme, sometimes used with the Keeler Relevant/Irrelevant test in the late 1940s and early 1950s. Leonarde Keeler experimented with the embarrassing personal question, hypothesizing that guilty subjects would not respond to it, remaining instead focused on the relevant questions, while the innocent examinees would produce significant responses in the opposite pattern. The embarrassing personal question did not have widespread use and was not taught at Keeler's school after 1951. This approach is proscribed in the American Polygraph Association's Ethics and Principles of Practice and some state polygraph laws. Later PDD examiners sometimes asked examinees during testing if they would mind if an unrehearsed question were asked, and then used the resulting physiological response from this question as an indicator of response potential. In that application, no question was actually presented.

**emotional standard**

A term coined by Rev. Walter Summers in his research into lie detection. The emotional standard was an emotion-provoking question to which the examinee answers truthfully, but one that the examinee would prefer to hide. It was included in a test series so the reaction evoked by it could be compared with the reaction elicited by relevant

questions. Summers' test format included an established ordering of pairs of relevant and emotional standard questions, interspersed with irrelevant questions, as needed. It is the first report in the literature of this type of question, and it predates Reid's "comparative response question". See: Summers (1939).

### **empirical**

An approach based entirely on observation rather than speculation. Much of PDD research is empirical in nature, though several theories exist.

### **Employee Polygraph Protection Act of 1988 (EPPA)**

Federally enacted legislation that restricts the use of "lie detector tests" by private employers except under specified conditions. Employers may not compel or request employees or applicants to submit to such testing, nor may they use any results for adverse action. All levels of government are exempt from the provisions of EPPA. There are also exemptions for companies that provide security services and those involved in the manufacture and storage of controlled substances, who may use the polygraph for preemployment screening. Employers may request an employee to undergo PDD testing if it is part of an investigation of a loss to the employer, the employee had access to the property lost, there is a reasonable belief that the employee was involved in the loss, and the employee is given 48 hours notice prior to the examination that outlines the loss, investigation, and the reasons the employee is under suspicion. The employer is prohibited, however, from taking any action against the employee who refuses to cooperate with a PDD examination. Two of the major effects of EPPA have been a sharp decrease in the number of private examiners in the United States, and a move by the professional polygraph associations to upgrade standards of practice. Full text of the law can be found on the Web at [www.dol.gov/dol/compliance/comp-eppa.htm](http://www.dol.gov/dol/compliance/comp-eppa.htm).

### **endosomatic**

Something produced from within the body itself. One type of electrodermal response, skin potential, is produced by electrical activity generated by the dermis. Similarly, EEG signals are generated by bioelectric processes in the brain, and EKG from the heart. For contrast, see *exosomatic*.

### **enveloping questions**

Used at the beginning and sometimes the end of Searching Peak of Tension tests that are selected because it is known that they cannot be the critical items or keys. They can be used to elicit the orienting responses that would interfere with interpretation if they occur on possible critical items. Sometimes called *padding questions*.

### **epinephrine**

A hormonal stimulator of the sympathetic nervous system. It acts to constrict peripheral blood flow, raise blood pressure, increase cardiac activity, promote metabolic activity through the release of glucose, and inhibit digestive processes. Epinephrine is considered a psychogenic hormone because it alters psychological processes when released in large quantities, such as under stress. It is produced in the adrenal medulla, located immediately above each kidney. Called *adrenaline* in British reports.

### **Epos**

Computer polygraph manufactured in Russia.

**error-related negativity (ERN)**

Brain wave time-locked to response selection that corresponds with incorrect choices. One of several electrocortical phenomena being investigated as a deception detection measure.

**eupnea**

Normal quiet respiration.

**event marker**

Device used with analog instruments in which the examiner activates a pen with a button or switch to annotate the beginning and ending points on the strip chart where a question has been presented to the examinee. Sometimes called a “stim marker”.

**event-related potentials (ERPs)**

A change in electrical activity of the brain in response to a stimulus, recorded as changes in voltage at the scalp surface. Current signal processing approaches allow averaging of EEG activity, and ERPs are extracted by the averaging of brain waves over several repetitions of stimulus items. ERPs have been useful to scientists as markers for specific processes in the brain. There are several types of ERPs: the N100, N200, P300, and N400, to name a few. The “N” and “P” designators are conventions for the polarity of the signal, negative and positive. The number denotes the latency after stimulus presentation, measured in milliseconds. The P300 has been reported to be a dependable indicator of concealed information, though its application to deception detection is not established. ERPs are generated by the central nervous system, and their use in deception tests is attractive because they are expected to be resistant to countermeasures.

**evidence-connecting question**

Test question in which the examinee is asked about a particular piece of physical evidence that would incriminate the guilty person. It could be items left at the crime scene by the perpetrator, stolen property that could be discovered in his possession, or even doubts about leaving incriminating fingerprints. For example, if a PDD examination was being administered to resolve a fraudulent use of a credit card, a test question could center on the signature on a receipt, the possibility of a photograph being taken at an ATM where the card was used, or possession of property wrongfully obtained by use of the card. The evidence-connecting question is sometimes more salient to the examinee than the “did you do it” relevant question because the examinee knows it can lead to physical evidence that will implicate him.

**evoked cortical potentials**

Brain waves that are induced by stimuli controlled by the experimenter.

**examination**

The entirety of the PDD process, including pretest, test, and posttest elements, from onset to completion.

**exclusive (exclusionary) comparison question**

Probable-lie comparison questions that are designed to prevent overlap of the relevant issue. This is accomplished by constructing comparison questions that are different from the relevant issue by time period, location, or type of activity. Although they have great face validity over non-exclusive comparison questions, research has not

conclusively resolved whether one is superior. See: Amsel (1999); Podlesny & Raskin (1978); Horvath (1988).

### **exculpatory examination**

A PDD examination offered to an accused against whom other strong evidence exists. The exculpatory examination is often used in the military services when urinalysis has indicated a service member has used an illegal drug. The service member is not obligated to undergo the PDD examination with the military investigative services, but because adverse action can be taken based solely on the urinalysis, many avail themselves of the opportunity.

### **exosomatic**

Something generated from outside the body. Both skin conductance and skin resistance are exosomatic measures because electrical currents are applied from outside sources to detect the electrodermal activity. As opposed to *endosomatic*.

### **ex parte phenomenon**

Literally, from the Latin meaning taken from one side or party. Legal term that has been used to indicate the “friendly polygrapher” hypothesis.

### **experimental group**

In research, subjects fall into two broad categories: *experimental* and *control groups*. The experimental group is subjected to the independent variable—that is, the variable of interest to the experimenter. The control group is treated exactly the same, except that it does not receive the independent variable. When the dependent variables of the experimental and control groups are compared, their differences are attributable to the independent variable. Consider research examining the validity of PDD. One group would be assigned to the innocent condition, and the other to the guilty condition. Since the variable of interest is the detection of deception, the guilty would be the experimental group and commit the mock crime, and the innocent would not commit the mock crime and would be the control group.

### **exploratory test**

Zone Comparison Technique test format for dealing with multiple issues.

### **extrapolygraphic**

That which is not derived exclusively from the polygraph tracings. Some polygraph schools teach that there are sources of information to assist the polygraph examiner in rendering a decision that are not registered on the strip recordings. These sources of extrapolygraphic information include case facts, behavioral indicators, and base rates. Blind interpretation of polygraph charts is one way of parsing out what information is available in the test recordings and that which comes from other sources.

### **extrasystolic beat (ESB)**

See *premature ventricle contraction*.

### **false key**

A term coined by Arther (1970) for the deliberate placement of a false distracter item among other items on a Peak of Tension test that the examiner has hinted is the correct item. It is useful to divert the attention of the innocent examinee who does not

know the true key or critical item. The false key is the most plausible item in a list for the naive examinee, though it is by design the incorrect item. The false key is used exclusively in Known Solution Peak of Tension tests.

### **F3**

Common shorthand in polygraph training for the stereotypic alarm reaction: fight, flight, freeze.

### **false negative**

The failure to detect the presence of a particular event or item. A false negative in PDD refers to the incorrect decision that deception was not practiced by the examinee.

### **false positive**

The false detection of something that is not actually present. In PDD, it is the incorrect decision that deception was practiced by the examinee.

### **fear of detection model**

One of several theoretical explanations for the psychophysiological mechanisms underlying arousal during deception. According to this model, examinees physiologically respond to test questions to which they are lying out of concern that their deceptions will be detected and adverse consequences will follow. The greater the fear, the greater will be the response. This is the prevailing theory of PDD practitioners because it explains most, although not all, aspects of PDD. An exception relates to those instances where the PDD test continues to be effective even when there are no or trivial consequences for detection, such as in some laboratory studies.

### **fear of error**

Concept forwarded by James Matte to account for a portion of false positive errors in polygraphy. According to the theory, the innocent examinee is inclined to physiologically react to relevant questions if he is excessively concerned about a polygraph error. See: Matte (1996).

### **feature**

In polygraphy, the term refers to a specific waveform, pattern or measurement in a tracing. Features are the fundamental components of chart interpretation, on which scoring and decision rules depend. Currently there are 11 individually validated manual scoring features. In the respiration channel they are: apnea, baseline increase, suppression, and increase in cycle time (slowing). For the electrodermal channel they are peak amplitude, complexity, and duration. In the cardiograph, the features are amplitude and duration. The finger plethysmograph relies on the duration and magnitude of the constriction of the pulse amplitude. Other features are sometimes taught as part of validated scoring systems, though their efficacy has not yet been established. See: Kircher & Raskin (1988); Bell, Raskin, Honts & Kircher (1999).

### **field research**

Scientific investigation using actual PDD cases conducted by practicing examiners on suspects, witnesses, and victims. In contrast to *laboratory research*.

**fight, flight, freeze**

Three stereotypic behavioral responses to threat, sometimes simply called *F3*. The physiological responses concomitant to these behaviors are the same, namely mobilizing bodily resources for an expenditure of energy, and narrowing attentional focus to the features of the threat. This preparation activity of the body explains the pattern of arousal responses that are recorded during PDD.

**finger of death**

Somewhat whimsical informal expression for a tracing pattern sometimes found in the electrodermal channel that is putatively associated with deception. It is the sudden plunging of the electrodermal tracing shortly after the presentation of a relevant question followed by a normal return to baseline, creating the visual impression of a "finger." The sudden drop and recovery may or may not have been preceded by a phasic response. Some writers have attributed the phenomenon to a loss of contact between the sensors and the skin, such as when certain types of physical countermeasures are practiced. The cause of the phenomenon is not well understood, and it has not been scientifically established as a reliable indicator of deception. Sometimes called the *devil's finger*.

**finger pulse amplitude (FPA)**

Cardiographic measure of the pulse wave recorded by plethysmograph (both occlusion and photo type) at the finger. Constrictions in amplitude are associated with sympathetic nervous system arousal. See: Kircher & Raskin (1988).

**foil**

An irrelevant item in a Concealed Information Test. Sometimes called *padding*, *buffer*, *control*, or *non-critical item*.

**forensic psychophysiological detection of deception examination**

A process that encompasses all activities that take place between a forensic psychophysiologicalist and an examinee during a specific series of interactions. These interactions include the pretest interview; the use of the polygraph to collect physiological data from the examinee while presenting a series of tests; the diagnostic phase, which includes the analysis of physiological data in correlation with the questions asked during each test to support a diagnostic decision; and the posttest phase, which may or may not include interrogation of the examinee. See: Yankee (1995).

**forensic psychophysiologicalist**

A person who has successfully completed an academic program in Forensic Psychophysiology, including the appropriate internship, which has been inspected and accredited by the American Polygraph Association.

**forensic psychophysiology**

Defined by Dr. William J. Yankee in 1992 as the science that deals with the relationship and applications of psychophysiological detection of deception (PDD) tests to the legal system. It is the academic discipline that provides the student, the practitioner, and the researcher with the theoretical and applied psychological, physiological, and psychophysiological fundamentals for a thorough understanding of PDD tests, and the skills and qualifications for conducting PDD examinations. The modifier "forensic" delineates and delimits this discipline from the broader discipline of psychophysiology.

**“friendly polygrapher” hypothesis**

A hypothesis proposed by Martin Orne that a deceptive examinee would not be as detectable by an examiner who conducts a polygraph examination on behalf of the examinee’s attorney because the examinee has no fear of adverse consequences. There are no studies supporting this hypothesis with the CQT, and all field studies that have investigated it have failed to find the effect. See: Ishida & Sevilla (1981); Matte & Reuss (1990); Orne (1973); Raskin (1976).

**functional Magnetic Resonance Image (fMRI)**

An image of the brain processes created from the metabolism of neurons. As the brain regions are engaged in a task they require more blood. The fMRI is an image of changes in blood flow based on task demands. The fMRI is one tool being researched to find central nervous system indicators of deception.

**Galvanic Skin Response (GSR)**

A superseded term for the electrodermal response measured exosomatically by the change in the electrical resistance of skin. GSR is sometimes erroneously called Galvanic Skin Resistance or Galvanic Skin Reflex. The modern term is *electrodermal response (EDR)*.

**galvanograph**

Polygraph component responsible for producing the graphic recording of skin resistance.

**ganglion**

A cluster of nerve cell bodies. (pl. *ganglia*).

**general state countermeasures**

Attempts to defeat the polygraph examination by influencing tonic physiological activity, or altering phasic lability. Typical approaches include the use of drugs, meditation, biofeedback, and fatigue. The goal of state countermeasures is to diminish the body’s responses to all polygraph questions. State countermeasures may affect testing techniques that rely on the presence or absence of responses to diagnose deception, such as the Concealed Information Test, or Peak of Tension tests. Because comparison question tests use differential responsivity to different types of questions, state countermeasures are more likely to result in inconclusive findings than errors. See: Honts, C.R., & Amato, S.L. (2002).

**generalizability**

Extent to which a set of research results can translate to other research paradigms or to the real world.

**general nervous tension (GNT)**

Expression used in the practice of PDD to characterize recorded physiological patterns that suggest the examinee’s basal level of arousal is high. This arousal is not indicative of deception in itself. GNT is sometimes indicated by very fast heart rates, unusually labile electrodermal activity, and uneven respiration cycles. PDD examiners try to bring examinee’s emotional state to a median level of arousal to optimize the interpretability of the test charts.

**general question technique**

Alternate expression for the Keeler Relevant/Irrelevant Technique.

**global analysis**

Evaluation of the polygraph recordings as a whole, as opposed to making systematic comparisons among questions. Global evaluation can also represent the use of extrapolygraphic information such as subject behavior and case facts when rendering a polygraph decision, an approach championed by Reid and Arther. When information beyond the physiological tracings are considered to produce the final outcome, it is also called the *clinical approach*.

**green zone**

Term used by Cleve Backster to describe a twenty to thirty-five seconds block of polygraph chart initiated by an exclusionary comparison question which has a unique psychological focusing appeal to innocent (truthful) examinees.

**Groteck**

Computer polygraph manufactured in Russia.

**ground truth**

Reality. In the PDD context it is the veridical state of truthfulness or deception against which polygraph outcomes are compared in validity studies. Ground truth is an elusive feature in field studies because it is difficult to independently verify guilt or innocence in many cases. In laboratory studies, it is delineated into programmed guilty and programmed innocent groups.

**GSG**

Invented expression by a polygraph manufacturer to represent a measure of skin conductance. An adaptation of GSR, substituting the letter "R" with "G," the engineering shorthand for conductance. However, GSR stands for Galvanic Skin Response, not Resistance. The phenomenon called GSG is more appropriately denoted as *skin conductance (SC)*.

**guilt complex reactor**

Hypothetical personality trait that causes innocent examinees to physiologically respond to any question that they consider accusatory. Guilt complex questions have been used in many of the contemporary formats at one time or another in an attempt to identify those examinees who would produce a false positive outcome because of this tendency.

**guilt complex test**

A PDD test format in which an examinee is tested on a fabricated crime. The guilt complex test has several purposes, primarily in avoiding false positive outcomes. It is also powerful evidence in court testimony if it indicates truthfulness while the other testing results in a conclusion of deception. The guilt complex test was taught in the earliest years of the Reid and Keeler schools. See: Abrams (1977).

**Guilty Knowledge Test (GKT)**

A test published by Dr. David Lykken, and based on a concealed information paradigm. While similar tests are described in the literature as early as 1904 (Wertheimer

& Klein), and Hugo Munsterberg outlines a comparable approach in his 1908 book On the Witness Stand, Lykken formalized the procedures, and advocated its use in place of the CQT. Recent writers have renamed this method the *Concealed Information Test* (CIT), arguing it is a more correct name because knowledge can't be guilty of anything. See: Lykken (1959).

### **habituation**

Adaptation to a stimulus over time. As an organism habituates to a stimulus or environment, its response diminishes both in intensity and frequency. In PDD, habituation has been found within tests, but little or none between tests. See: Dollins, Cestaro, & Pettit (1998); Kircher, Raskin, & Honts (1984).

### **halo effect**

Tendency of an observer to be unduly influenced by a single trait of an individual. This term was coined by Thorndike in 1920 in the context of psychological assessment. For the PDD examiner, it is a potential source of error if subject-examiner interactions are factored into the final PDD decision.

### **heart rate**

Rapidity of ventricular contractions, usually measured in beats per minute. It is one index of physiological arousal. Recent research indicates that after stimulus onset, cardiac arousal takes the form of an immediate decrease in heart rate. Heart rate and the interbeat interval are reciprocals of one another.

### **hertz**

Term for frequency, in cycles per second. For example, a heart rate of 80 beats per minute would equal 1.33 hertz. Frequency measures in psychophysiology are often reported in hertz, particularly when identifying engineering specifications of instrumentation. Named for German physicist Heinrich R. Hertz. Sometimes called *cycles per second (cps)*.

### **Hg**

Chemical symbol for the element mercury. Millimeters of mercury is the reference for measures of pressure, such as barometric and blood pressure. Conventional polygraph notation for air pressure in the sphygmomanometer is gauged in millimeters of mercury (i.e., 72 mm Hg). Hg stands for *hydrargyrum*, from Greek for water and silver. Sometimes called *quicksilver*.

### **hidden comparison question**

Question designed to evoke a response from a truthful person, but appears to be relevant to the examinee, and therefore its true purpose is concealed. Useful for the testing of victims, or those knowledgeable in CQT formats. Sometimes called *disguised comparison question*.

### **hidden key**

Critical item in the Known Solution Peak of Tension test. It is called *hidden* because it is not known to be the critical question to the innocent examinee, and it is embedded in a list of apparently similar questions. There is one key per test.

**Hobson's Choice**

An expression referring to an apparently free choice that offers no genuine alternative. It was named after Thomas Hobson, a stable owner in the 16<sup>th</sup> century, who offered patrons the horse nearest the door, or none at all. For Hobson's customers, there was the illusion of choice, but no actual options. Hobson's Choice is used in polygraphy when the probable-lie questions are developed in the pretest interview. The examinee feels as if he or she must pass this question to pass the examination. During the pretest interview the question is presented and refined until the examinee chooses to deceive rather than to accept the much less desirable option of acknowledging socially proscribed behaviors. Truthfulness is not a true choice in that circumstance, and therefore the examinee's decision to lie is based not on a free choice but on a Hobson's Choice. The lack of alternatives or "escapes," which is associated with a state of "learned helplessness," may be a mechanism in the arousal level. See: Vendemia (2002).

**homeostasis**

Complex interactive regulatory system by which the body strives to maintain a state of internal equilibrium.

**hope of error**

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. 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).

**Horizontal Scoring System**

A method devised by Gordon and Cochetti in the 1980s. All responses within each channel are ranked from largest to smallest; ranks assigned to comparison questions are given positive values, while those to relevant questions receive negative values. For example, if a test had three each of relevant and comparison questions, and the magnitude of the responses in a given channel resulted in an order of R3, R1, C1, R2, C3, and C2, their values would be designated as -6, -5, +4, -3, +2, and +1, respectively. This method is repeated for all channels in all tests and then summed for a grand total. Thresholds suggested by Gordon and Cochetti were two points per relevant question per test, and a minimum of two tests. See: Gordon & Cochetti (1987).

**hot questions**

Informal parlance for the relevant questions.

**hydrosphygmograph**

Device used by Cesare Lombroso at the end of the 19th century to detect changes in blood pressure during deception, though the hydrosphygmograph had been invented years earlier for medical purposes. It consisted of a container of water and a rubber seal through which an examinee's fist was placed into the water. Once the container was sealed, changes in relative blood volume changes were transferred to the closed system and could be recorded with tubing leading to a recording pen that wrote on a smoked drum. This is the first mechanical device reported in the literature used specifically for deception tests.

**hyperventilation**

Increase in rate and depth of respiration.

**hypnosis**

Altered state of consciousness in which the subject is very receptive to suggestion and direction. Hypnosis has been a concern to PDD practitioners because it is thought to be a possible undetectable countermeasure. In a highly suggestible state, guilty subjects could conceivably have memories of their crimes blocked, altered, or replaced so that physiologic responsiveness would be unreliable for diagnosing deception. It could also be used to enhance desensitization training, or autonomic conditioning. The little research on hypnosis has not conclusively settled the issue. See: Weinstein, Abrams, & Gibbons (1970); Timm (1991).

**hypothenar eminence**

Prominence on the palm corresponding with the musculature of the little finger. One of the most productive recording sites, along with the thenar eminence, for electrodermal activity.

**imagery**

The use of visualization to experience memories or fantasies. Imagery has been shown to produce profound physiologic responses, and because it can be performed covertly by an examinee, it is a concern to PDD examiners as a possible countermeasure. Imagery is one form of *dissociation*.

**impedance cardiogram (ICG)**

Specialized cardiogram by which the timing and stroke volume of the heart can be derived. Though not currently used in PDD, it has been shown to provide a gauge of sympathetic arousal when used in tandem with the ECG.

**incisura**

A notch or indentation on any form. See *dicrotic notch*.

**inclusive (inclusionary) comparison question**

Comparison question that potentially encompasses the activity of interest in the relevant questions. Also called a *non-exclusionary*. While contemporary practice tends to favor exclusionary comparison questions, no research has not found them to increase decision accuracy over inclusive comparison questions. See: Amsel (1999); Podlesny & Raskin (1978); Horvath (1988).

**incomplete**

PDD outcome used in some sectors that indicates that testing was terminated before sufficient physiological information was collected. This may be due to the sudden onset of health problems, extreme emotional distress, or the examinee's unwillingness or inability to remain for further testing. It may also signify that the examinee provided information after initial testing that necessitated subsequent testing, but it was not completed due to examinee fatigue, time limits, or equipment problems. A PDD decision of incomplete implies that testing may continue at a future date.

**inconclusive**

PDD outcome where testing was completed, but neither deception nor truthfulness can be diagnosed because the physiological data are inconsistent, inadequate, artifactual, or contaminated. There is disagreement whether an inconclusive outcome should be considered an error when computing validity of PDD. Some argue that examinees are either truthful or deceptive, but never inconclusive; therefore, such an outcome is necessarily in error. Conversely, in the forensic sciences it has been asserted that the inconclusive outcome is used to assess utility, but not validity, because samples in forensic disciplines are often inadequate, or contaminated. For example, fingerprint data is more frequently inadequate than adequate, though fingerprint analysis is considered highly accurate in spite of the relatively modest percentage of cases that it can render a positive identification. Because of this controversy, PDD validity studies report accuracies both with and without inconclusive results. In practice, inconclusive outcomes are the default results when the criteria for deception or not-deception decisions are not satisfied. Alternate term is *indefinite*, or *no opinion*.

**indefinite**

See *inconclusive*.

**independent variable**

The variable manipulated by the experimenter to determine the effects on the dependent variable. As an example, if a researcher were interested in sex differences in PDD validity, the independent variable would be the gender of examinee and the dependent variable would be the accuracy of the PDD technique for each sex.

**Inex**

Computer polygraph manufactured in Russia.

**innervate**

Provide nerve supply to.

**inside-issue comparison question**

Test question unique to the Quadri-Track Comparison Technique that is designed to elicit a response from the truthful examinee concerned about a false positive error. See: Matte (1996).

**inside-issue relevant question**

Test question unique to the Quadri-Track Comparison Technique that is designed to elicit a response from the deceptive examinee hoping for a false negative error. See: Matte (1996).

**inside track**

One of four tracks in the QuadriTrack Zone Comparison Technique which also include the primary, secondary, and outside tracks. The inside track employs two questions. One of these questions addresses an examinee's fear of a false positive error, and is used as a comparison question. The other concerns the examinee's hope of a false negative error, which is treated and interpreted as a relevant question. See: Matte (1996).

**inspiration (inhalation) / expiration (exhalation) ratio (I/E ratio)**

The duration of inhalation compared with that of exhalation. Normally the ratio is about 1:2 in a resting human and changes during stress. Changes in the I/E ratio are a diagnostic criterion in PDD and were first reported by Benussi in 1914.

**instant offense examination**

A form of *Post-Conviction Sex Offender Testing*, conducted when a subject is in denial of the offense or of some significant element of the offense for which he or she was convicted, and is often used to break down the denial barrier. This is also an examination that can be given when a new allegation has been made while the subject is on probation or parole. The polygraph is used to determine whether the allegations are true. Also called a specific issue examination. See: Cooley-Towel, Pasini-Hill, & Patrick (2000); Dutton, (2000); English, Pullen, & Jones (1996); Heil, Ahlmeyer, McCullar, & McKee (2000).

**Integrated Zone Comparison Technique**

The Integrated Zone Comparison Technique (IZCT) was developed in 1987 by Nathan J. Gordon, William Waid, and Philip Cochetti at the Academy for Scientific Investigative Training. The design of the IZCT placed emphasis on scientifically founded formatting principles from the Zone Comparison Technique, however, it allowed the examiner the flexibility to use the same test structure for both single-issue or multiple-issue cases. Unlike other popular techniques, the first chart is conducted as a silent answer test, and in the third chart there is a reversal of the positions of comparison-relevant questions to relevant-comparisons. See: Gordon, Fleisher, Morsie, Habib, & Salah. (2000).

**integument**

Covering of the body (skin). Human skin consists of three primary layers: *epidermis*, *dermis*, and *subdermis*.

**intent question**

Question used in polygraph testing to determine whether the examinee had engaged in an act with criminal intent, rather than merely committed the act. It is considered the least reliable of all types of relevant questions in PDD testing and is avoided whenever possible.

**interbeat interval (IBI)**

Period between cardiac pulse waves, usually measured from systole to systole. The IBI has been shown to shorten just after the onset of stress in most people. IBI and heart rate are reciprocals of one another.

**inter-chart stimulation**

Examiner-examinee interaction that takes place in the few minutes between runnings of individual tests. The interaction might include general reminders for the examinee to answer all questions truthfully (in the case of PLC techniques), or further emphasizing the comparison questions. Some research suggests that inter-chart stimulation may improve the validity of polygraphy, though it remains a very controversial procedure. See: Abrams (1999); Honts (1999; 2000); Matte (2000).

**international 10-20 system**

Standard guide to electrode placement on the scalp for recording EEG activity. The system uses letters and numbers to indicate coordinates on the scalp. The P300 brain wave, used in concealed information paradigms, is recorded maximally at site Pz.

**introductory test**

Alternate term for a stimulation test. See *stimulation test*.

**irrelevant question**

A question designed to be emotionally neutral to examinees. Irrelevant questions are most often placed in the first position of a question list, because an orienting response of no diagnostic value usually follows the presentation of the first question. In CQT formats it is also used after a relevant or comparison question that has elicited a strong response so as to permit physiologic arousal levels to return to baseline before presenting another diagnostic question. Irrelevant questions are used in nearly every type of PDD test. Also called *norms* or *neutrals*.

**jackknife procedure**

Statistical technique sometimes used to test a model. All data sets are used to develop a model except one, and the excluded set is tested against the model. This method is repeated until all sets have been excluded once and tested against the model built with the remaining data. This method produces a distribution of outcomes constructed from the individual outcomes of each data set, and is a method sometimes used to validate a model. Jackknife procedures have been used in PDD algorithm development.

**Karpman's classification of lying**

Classification of lies and their underlying motives. They are *benign lies* (for social conventions), *hysterical lies* (to attract attention), *defensive lies* (to avoid an adverse situation), *compensatory lies* (to impress another), *malicious lies* (for gain), *gossip* (exaggeration), *implied lies* (deceive with partial truths), *"love intoxication" lies* (idealistic exaggeration), and *pathological lies* (self-destructive or maladaptive). See: Karpman (1949).

**Keeler, Leonarde**

Student of John Larson and influential PDD pioneer. Among Keeler's accomplishments are: the addition of the electrodermal channel to the polygraph, establishing the first PDD school, and devising the Keeler Technique.

**Keeler Polygraph**

Originally manufactured by the Western Electro-Mechanical Company, this instrument was not produced after 1938. It had three tambours: one for the cardiosphygmograph, another for the pneumograph, and a third for either a second pneumograph or a muscular movement device. The kymograph could be geared to move the graph paper 3, 6, or 12 inches per minute. Associated Research, Inc. later produced the Keeler polygraph, similar to the original design except it permitted a galvanograph channel, and the chart speeds were 6 and 12 inches per minute. The Keeler polygraph is no longer in production.

### **Keeler Technique**

A Relevant/Irrelevant testing method devised by Leonarde Keeler and used in single- and multiple-issue testing. While its popularity has declined since the introduction of the CQT formats, it is still used by many PDD examiners and is considered one of the profession's acceptable techniques.

### **key**

The critical item in a series of similar but neutral items used in Peak of Tension (POT) tests. In a known solution POT, the key is the relevant question that contains the incriminating information that only a guilty person should know. A key in a searching POT is the test item that holds information that only the guilty person knows and the PDD examiner is trying to uncover. In stimulation tests, the key is the question to which the examiner directs the examinee to lie. Also see *false key*.

### **key word method**

Procedure employed during PDD testing in which the examinee is instructed to provide not only a yes or no reply, but repeat an important word from the test question. The key word method is used to neutralize dissociation countermeasures.

### **Kircher features**

Ensemble of measurable physiological features found in traditional polygraph recordings that correlate highest with deception. They are: respiration line length, electrodermal response amplitude, blood volume amplitude, and finger pulse amplitude. See: Kircher, J.C., & Raskin, D.C. (1988).

### **known numbers acquaintance test**

Stimulation test with several variants, it has as a central feature that the critical item is known to both the examinee and the polygraph examiner prior to the test. See *stimulation test*.

### **Known Solution Peak of Tension test (KSPOT)**

Peak of Tension test in which the critical item, or key, is known only to the investigator, polygraph examiner, a guilty person, or a person with incriminating knowledge. The key is placed in a question series among other items equally plausible to an innocent examinee and presented to the subject to determine if a consistent physiologic arousal occurs to the key. Like all Peak of Tension procedures, trend responses are used in addition to specific responses to interpret the recordings. Also known as a "Type A" test to graduates of the Keeler polygraph school.

### **known truth question**

Question in the Arther Technique based on a fabricated crime, but one that appears plausible to the examinee. It serves to ensure that the examinee is not responsive to all crime questions irrespective of guilt. The known truth question also provides a powerful interrogational wedge during the posttest phase for those examinees who have produced charts indicative of deception to the actual crime, but not to the fabricated crime.

**kymograph**

Motorized mechanism that moves strip chart paper at a specified rate. The current standard in PDD is 6 inches per minute, though historically there have been other speeds.

**labile**

Unstable, inconsistent, or dynamic. PDD tracings that display a high degree of responsivity or broad amplitude changes are referred to as labile.

**laboratory research**

Scientific investigation in which experimental procedures are designed to mimic real-world circumstances, but in which there is direct control over the independent variables.

**Lafayette Instrument Company**

An American manufacturer of polygraphs, both analog and computer-ized, founded by Max Wastl.

**Lantern**

A voice stress device. The Diogenes Company produces the Lantern, first introduced in 1998. Examiner certification is required. The Lantern testing format is dissimilar to PDD formats. See *voice stress analysis*.

**Larson, John**

One of the first modern researchers in PDD, Dr. Larson first used continuous recordings of respiratory and vasomotor activity with a test format using relevant and irrelevant questions. Dr. Larson's 1932 book, Lying and Its Detection, provided the best scientific evaluation of PDD up to that time.

**latency**

The delay between stimulus presentation and the response. Onset latency relates to the delay between the stimulus presentation and the beginning of the response, while the peak latency uses the time of the maximum amplitude of the response as the second point. Latencies of specific physiologic responses vary. The latency of an electrodermal response, for example, from stimulus onset is about one to three seconds for the average person, while hormonal influences on blood pressure require several seconds more. A significant departure from typical latencies can indicate that a given response is unrelated to the stimulus, that there are problems in attention for the subject, or that countermeasures are being engaged. Because of individual differences, within-subject analyses are warranted.

**law of initial values (LIV)**

The magnitude of a given physiologic response will be constrained by the level of arousal present when the response begins. If a response occurs when arousal is already high, the amplitude of the response measured from onset to maximum expression will be less than if the same response occurred during a median level. While there are differing opinions regarding this psychophysiologic principle, it can certainly be said that all biological systems do have upper limits in their potential for response, and ceiling effects can come into play. This is because compensatory systems such as the sympathetic and

parasympathetic nervous systems work to limit response intensities. Similarly, the finite number of sweat glands establishes the maximum electrodermal response.

**law of intensity**

Within limits, response magnitudes and stimulus intensities share a linear relationship; the stronger the stimulus, the greater the magnitude of the response. Response magnitudes are used in PDD to infer the type of question the examinee considers most salient or threatening.

**lens model**

Model for studying the decision rules used by human decisionmakers, first proposed by E. Brunswik in the early 1950s. Conceptually, the model characterizes the decision process as the selection and evaluation of cues in the assessing of reality. Which cues are used and how they are weighted are central to this model. The term *lens model* springs from the sense that subjects view reality through the lens of these cues. This approach has been applied in the study of PDD decisions at the University of Utah. The lens model is useful to assess the diagnosticity of physiological responses, in identifying how examiners use the physiological information, and to determine the combination and weights of the cues that will maximize decision accuracy. See: Kircher & Raskin (1983); Kircher, J.C., Raskin, D.C., Honts, C.R., & Horowitz, S.W. (1995).

**lie detector**

A common but inaccurate term for the polygraph.

**lie question**

Rarely used terminology for probable lie comparison question.

**likelihood ratio**

In polygraphy, it is the ratio of the probability that the Deception Indicated (DI) alternative is true relative to the probability that the No Deception Indicated (NDI) alternative is true. Diagnostic decisions are rendered after a criterion, or cut score, is placed on this likelihood ratio variable such that obtained values greater than the cut score lead to a DI decision while lesser values lead to an NDI decision.

**Lombroso, Cesare**

Italian physician and biologist who first employed instrumentation to the problem of detecting deception in criminals, and employed it with live criminal cases. He reported in 1885 in the second edition of his book, *L'Homme Criminel* the use of the "hydrosphygmograph," a mechanical arrangement invented for medical purposes, to detect blood pressure changes during interrogation. One of his students, Angelo Mosso, also went on to perform instrumental deception detection experiments.

**loyalty examination**

See *Counterintelligence-Scope Polygraph*.

**Luria, Aleksandr**

Russian researcher and originator of the conflict theory, one of the theories that tries to explain the psychophysiological mechanisms underlying PDD. Luria did deception detection experiments with a tremograph. See: Luria (1930); Runkel (1936).

**Lykken, David T.**

Psychologist and ardent critic of the CQT. Dr. Lykken has produced numerous writings for the scientific and general press, including a book, A Tremor in the Blood, in which he argued strongly that the CQT is fatally flawed, that it resulted in wrongful criminal convictions, and it was vulnerable to countermeasures by the guilty. Dr. Lykken did not publish any research of his own on the CQT, but used anecdotal histories and interpretations of other research to form his arguments. Lykken endorses the Guilty Knowledge Test (GKT), an alternate PDD testing format. The GKT has never been widely used in the field. See: Lykken (1998).

**Lykken scoring**

System of scoring electrodermal responses in the Concealed Information Test (formerly the Guilty Knowledge Test) and establishing the threshold for rendering decisions. The Lykken scoring system compares the responses of the critical test items in a rank order method against those of the neutral items. One variant uses averaged ranks. See: Lykken (1998).

**maintenance examination**

A form of *Post-Conviction Sex Offender Testing* (PCSOT) that is requested by a treatment provider, and looks at treatment-type issues; i.e., weekly report logs, masturbation habits, boredom tapes etc. See: Cooley-Towel, Pasini-Hill, & Patrick (2000); English, Pullen, & Jones (1996); Heil, Ahlmeyer, McCullar, & McKee (2000).

**manual mode**

Setting for the electrodermal activity channel in conventional PDD instruments in which filtering is not applied to the signal. All modern polygraphs manufactured in the U.S., both analog and computerized, have this feature. As opposed to *automatic mode*.

**Marin Protocol**

Method of limiting polygraph examination decision errors when there are testable statements made by two polygraph examinees, and the statements of one examinee are in direct conflict with statements made by the other examinee. The results of both examinations are used for evidentiary purpose only if one of the examinee passes the polygraph examination, and the second examinee fails. Otherwise both sets of examination results are discarded. See Marin (2000; 2001)

**Marston, William**

Psychologist, inventor of the discontinuous blood pressure method deception test, and author of the 1938 book The Lie Detector Test. Marston was the first to attempt to have instrumental deception test evidence entered into evidence in court, for which resulted the Frye decision of 1923. Marston's test entailed the use of a conventional blood pressure cuff and sphygmomanometer with which he manually plotted the examinees blood pressure during questioning at several points during the interview. He taught his technique to the U.S. Army, and he used his method to resolve espionage cases during World War I. Marston had several interests, and he was also the co-creator of the Wonder Woman comic book character. Both William Marston and his wife, Elizabeth, were lawyers, and worked together to perform deception testing. See *discontinuous blood pressure method*.

**math question**

Stimulus irrelevant question used in at least one type of RI screening format, and involves the unrehearsed presentation of a simple arithmetic problem. The math question is used when an examinee has not reacted during testing to the relevant issues, and the examiner wants to ensure that the examinee was capable of responding.

**Matte Polygraph Chart Template**

Chart overlay for analog polygraph charts that corrects for curvilinear tracings, developed by Dr. James A. Matte in 1975 and marketed by Stoelting Instruments. See: Matte (1996).

**mean**

The average. The most common, the *arithmetic mean*, is the sum of values divided by the number of values. If five subjects in a PDD study were ages 19, 23, 28, 22, and 29, the mean age of this group would be  $(19+23+28+22+29) / 5 = 24.2$  years.

**mean blood pressure**

The value of the pressure during the entire cardiac cycle. An approximation of the value of the mean blood pressure can be derived by averaging the systolic and diastolic values, or by summing of the diastolic pressure and one-third of the pulse pressure.

**median**

The middle score. The *median value* is one where one-half of the scores are above and one-half are below this value. It is in the middle of the distribution, but only in terms of order. Medians are useful when evaluating highly skewed distributions, such as national housing prices, because they are not affected by extreme scores. Medians are not as frequently reported in PDD research, but may have application such as when examinee pools have characteristics that are not normally distributed.

**mental countermeasures**

A class of countermeasures in which the examinee attempts to affect the polygraph recordings through self-manipulation of attention, memory, emotion, cognition, semantics, or arousal. See: Krapohl (1996).

**microtremor**

Low-frequency oscillation of the human voice in the range of 8 to 12 hertz, and the component used to infer deception with the Psychological Stress Evaluator and the Computer Voice Stress Analyzer. It is claimed by the manufacturers of these devices that there is an inverse relationship between stress and the microtremor. Independent research has not yet found any spectral component of human voice a reliable predictor of deception. Research summaries can be found at [www.voicestress.org](http://www.voicestress.org).

**Minnesota Multiphasic Personality Inventory (MMPI)**

One of the most common personality inventories employed in psychology and psychiatry. It uses a series of questions to make diagnoses according to standard psychiatric clinical criteria. Among the most cited scales reported in the PDD literature are *psychopathy* and *social introversion-extroversion scales*, both of which have been shown to influence physiologic arousal levels, particularly in the electrodermal response. Evaluation and interpretation of the MMPI is generally based on profiles resulting from

individual scales. Test-retest validity for the MMPI averages above 70%, though the validity of the individual personality scales has not been conclusively demonstrated.

### **Mixed Question Test**

A Reid polygraph test in which the straight-through (ST) test questions are changed in order, and some of them are repeated. When the Mixed Question Test is used, it is always conducted after the ST.

### **mode**

The most commonly occurring value in a distribution.

### **Modified General Question Test (MGQT)**

Test format patterned after the Reid test and developed by the U.S. military. Unlike the Zone formats, it has more relevant questions than comparison questions and does not include symptomatic questions, though some versions employ a sacrifice relevant question. The MGQT is widely used in the field.

### **Modified Relevant Irrelevant (MRI) technique**

Specific-issue PDD format based on the Keeler RI format, but it uses situational comparison questions. Users of the MRI discuss all tested issues with the examinee during the pretest interview, but prefer not to review the relevant questions word for word. The prohibition against relevant question review is not an absolute, however. Results from the MRI are based on extrapolygraphic information, and 3- and 7-position scoring.

### **monitoring examination**

A form of *Post-Conviction Sex Offender Testing* (PCSOT) that is requested by a probation or parole officer to ensure compliance with the conditions of the offender's release from prison; i.e., alcohol or drug issues, computer violations, contact with children etc. See: Cooley-Towel, Pasini-Hill, & Patrick (2000); Dutton, (2000); English, Pullen, & Jones (1996); Heil, Ahlmeyer, McCullar, & McKee (2000).

### **Mosso, Angelo**

Student of Cesare Lombroso, who in 1896 developed the scientific cradle, a device for recording bodily responses to fear.

### **motivation**

The multidimensional forces acting on an individual to initiate, direct, and maintain the intensity of that individual's responses. Plainly, motivation refers to an individual's desire to achieve a specific outcome.

### **motor nerves**

Neurons that carry nerve impulses from the central nervous system to the effector organ or muscles. Also called *efferent nerves*.

### **movement sensor**

Mechanical sensor placed beneath or attached to legs of a PDD examination chair that is sensitive to shifting weight. The movement sensor is used to detect certain types of physical countermeasures.

### **multiple-facet test**

Test format in which the relevant questions are targeted toward different elements of the same crime. For example, in a counterfeiting case, the PDD examiner might use three relevant test questions with a suspect. One could cover printing the bills, the second passing the bills, and the third knowing where the printing equipment is. In such a test the spot scores would determine whether a diagnosis of deception is made, as opposed to the overall score. The Zone “exploratory,” the Modified General Question Test, and criminal RI are three possible formats for this approach.

### **multiple-issue test**

Test typically used in screening, it allows the PDD examiner to determine which of several areas should be followed up with further questioning. It is somewhat uncommon to make decisions of truthfulness or deception in these types of tests. Such decisions are generally made after subsequent testing on the isolated issue in a single-issue test format. Among the more common multiple issue test formats are the Relevant/Irrelevant screening test and the Test for Espionage and Sabotage. See: Barland, Honts, & Barger (1989).

### **Munsterberg, Hugo**

Chairman of the Psychology Department at Harvard who, in his 1908 book On the Witness Stand, suggested the possibility of devising deception tests using blood pressure, respiration, and electrodermal activity. In his book Munsterberg also described the Concealed Information Test. He had as a student William Marston, who later went on to develop the discontinuous blood pressure method deception test.

### **name test**

Peak of Tension test in which the examinee’s name is inserted among other names to determine his response capability to a known lie of personal significance.

### **nervous system**

Consists of the brain, spinal cord, and peripheral nerves, each performing specific functions. Processing of nerve impulses in the brain is somewhat localized. Basic functions are mediated in the lower parts of the brain, activities such as hunger, thirst, and thermoregulation. Sensory regions of the brain are located above, along with most voluntary control of muscles. The highest regions of the brain are dedicated to processing and integrating information, and the production of thought. The spinal cord is the primary pathway by which most of the nerve impulses are carried to the brain. Nerves throughout the body send pulses through the spinal cord to the brain where they are processed, and the brain sends back impulses to regulate and control organs and muscles. There are two main divisions to the nervous system: the *central*, consisting of the brain and spinal cord, and the *peripheral*, nerves that branch out to all parts of the body.

### **neuron**

Structural unit of the nervous system and is the conducting cell. The typical neuron consists of a soma body, dendrites, axon, and often myelinated sheathing along the axon.

**neurotransmitter**

Chemical involved in the transport of the neural signal to another neuron or effector organ. Neurotransmission has six stages: synthesis of the neurotransmitter, storage, release, receptor interaction, reuptake, and inactivation. There are many pharmacological agents that influence neurotransmission, and they are of interest in PDD research due to their effects on tonic and phasic arousal levels.

**neutral question**

Another term for the irrelevant question in a CQT. Also called a *norm*.

**No Deception Indicated (NDI)**

In conventional PDD, NDI signifies that (1) the polygraph test recordings are stable and interpretable and (2) the evaluation criteria used by the examiner led him to conclude that the examinee was truthful to the relevant issue. The NDI and DI (Deception Indicated) decision options are used in specific-issue testing and correspond to NSPR (No Significant Physiological Responses) and SPR (Significant Physiological Responses) in multiple-issue, or screening, examinations.

**non-current exclusive comparison question**

A probable-lie comparison question that is of the same type or category as the relevant issue, but excludes the relevant issue by use of a time-bar. It is the type of comparison question developed and advocated by Cleve Backster. See: (Matte 1996)

**non-exclusive (inclusive or inclusion-ary) comparison question**

Comparison question that overlaps the relevant issue by time, location, or issue. Also called *Reid*, *inclusionary*, or *inclusive comparison question*. As an example, if the relevant issue were the robbery of a particular bank on a specific date, the comparison question might be, "Have you ever stolen anything in your life?" There is a long-running debate in the PDD community regarding the supremacy of the exclusive over the non-exclusive comparison questions. See: Amsel (1999); Podlesny & Raskin (1978); Horvath (1988).

**noradrenaline**

British term for *norepinephrine*. See *norepinephrine*.

**norm**

Verbal shorthand currently used by some PDD examiners to signify an irrelevant question in Relevant/Irrelevant and comparison question test formats. Much earlier (1922) John Larson referred to "norms" as individuals who were possible-but-unlikely suspects to a crime whom he added to his list of persons to be tested so he could account for variables such as anger, indignation, and fright that he could expect from innocent-but-likely suspects he would be testing.

**norm chart**

A single test conducted before diagnostic tests are administered to allow the examinee to become accustomed to the PDD instrumentation and procedures. Sometimes used in screening examinations, but rarely in criminal examinations. They can be useful for comparison of tracings from the diagnostic tests if there are suspicions that the examinee has deliberately altered his physiological tracings. Norm charts may

use rehearsed irrelevant questions, unrehearsed irrelevant questions, or no questions at all.

**No Opinion**

Alternate form of an Inconclusive call, especially in the Federal Government. Sometimes used to denote an Incomplete call in other sectors.

**No Significant Physiological Responses (NSPR or NSR)**

Accepted verbiage in the Federal Government for polygraph screening examination outcomes equivalent to No Deception Indicated in single-issue tests. The alternate language comes from an acceptance that screening examinations do not produce the high validity of single-issue tests, and, therefore, the results are better reported as the absence of physiologic arousals rather than inferring truthful intent on the part of the examinee.

**numerical analysis**

Systematic assignment of numbers to physiologic responses, along with decision rules, so that PDD data analysis is more objective and standardized. The first such system was published by Dr. John Winter in 1936. Contemporary numerical analytic methods include the *Rank Order Scoring System*, *Horizontal Scoring System*, *3-position scoring system*, *7-position scoring system*, and *Lykken Scoring*. Sometimes referred to as *semi-objective analysis*.

**numerical approach**

Method of rendering polygraph decisions that are based exclusively on numeric values that have been assigned to physiological responses recorded during a structured polygraph examination. The numerical approach does not consider extra-polygraphic information such as case facts or examinee behaviors. The numerical approach has four primary components. They are: feature identification, numerical value assignment, computation of the numerical values, and decision rules. Current numerical approaches include the Backster method, the Utah method, and the automated computer algorithms.

**Objective Scoring System (OSS)**

A form of 7-position scoring where the individually assigned values are derived from ratios that come from measurements of the "Kircher features." Because the scores come from measurements, the OSS eliminates subjectivity in chart interpretation. However, it is very time-intensive when performed manually, and impractical for routine use. The OSS has been automated by at least one computer polygraph manufacturer. See Dutton (2000); Krapohl & McManus (1999).

**offset**

Term often used to indicate the consequence of using different length recording pens with analog polygraphs. The practice in the profession was to use a longer (0.5- to 0.8-inch) pen for the electrodermal channel to permit wide excursions of the pen without it becoming entangled with the respiration and cardiosphygmograph recording pens. The result was that the electrodermal channel was "offset" from the other tracings, usually the equivalent of 5 to 8 seconds. None of the U.S.-manufactured computer polygraphs have this offset.

**operant conditioning**

Type of conditioning in which reward or punishment is given to the subject, depending on the preceding behavior. Rewards increase the likelihood of the recurrence of the behavior, and punishment discourages the behavior. Biofeedback uses operant conditioning to help patients reduce blood pressure, electrodermal activity, and other physiological processes. Since operant conditioning can be used to teach individuals to regulate their own autonomic responses, it is a method of teaching PDD countermeasures. The little research that has evaluated the influence of biofeedback training on PDD efficacy has not found an effect.

**orienting response (OR)**

Heightened sensitivity to specific sensory input that is characterized by increased information processing, narrowed attentional concentration, and physiologic excitation. PDD test question series never begin with a relevant question because the physiological pattern of an OR can be easily confused with a response indicative of deception.

**Othello error**

Expression coined by Paul Ekman to denote the misattribution of the fear or emotional distress of an innocent person as an indication of guilt. See Ekman (1985).

**outlier**

A value beyond the normal range of values. For example, the last value in the following series could be considered an outlier: 5,9,2,6,6,8,3,1,6,9,5,32. Outliers may be excluded from data collection because they have inordinate influence on central tendency. What constitutes an outlier, or extreme score, is established a priori. A real life experimental example of an outlier might be where reaction times are being measured, and the subject falls asleep during one trial. While most scores might be in the 0.5- to 0.9-second range, the subject's latency of response to the stimulus where he begins sleeping might go several seconds, thus producing an outlier. The term *outlier* has been introduced into the science of PDD with the development of computerized scoring algorithms along with their precise measurements of responses.

**outside issue question**

See *symptomatic question*.

**outside track**

One of four tracks in the Quadri-Track Zone Comparison Technique, which include the primary, secondary, and inside tracks. The outside track consists of two symptomatic questions. See: Matte (1996).

**overall truth question**

PDD test question that addresses the examinee's overall truthfulness or intention to be truthful during testing. Used in some multiple-issue screening tests.

**P300**

Event-related potential (ERP) of the brain measured at the scalp that has a average latency of approximately 300 milliseconds from stimulus onset and is recorded maximally at site PZ in the International 10-20 System. The P300 is related to unique characteristics of the stimulus, and is most often associated with the "oddball" or rarely occurring stimulus. For example, the P300 is known to be evoked by a low incidence

auditory tone that is of a different pitch than another tone that is occurring much more frequently. A P300-based Concealed Information Test has been developed for criminal testing, though field testing is incomplete. See: Farwell & Donchin (1991); MacLaren & Taukulis (2000); Rosenfeld (1998).

**padding**

An alternate expression for irrelevant items in a Known Solution Peak of Tension test. In some reports, padding relates to only the first or last one or two items in these tests.

**pain countermeasure**

Special type of physical countermeasure in which an examinee will attempt to evoke physiologic responses by covertly self-inducing discomfort. Included in this group are strategies such as biting the tongue, pressing against a sharp object in the shoe, forcing a fingernail into the thumb cuticle, and irritating a wound. While spontaneous use of these tactics has not been found effective, they can be more powerful when the examinee receives training and feedback. See: Krapohl (1996).

**parameter**

Term used in PDD to denote a single physiological data channel, such as the pneumograph, cardiograph, etc.

**paradigm**

Example or model. Experimental paradigms attempt to explain real world phenomena by assessing the critical elements and their relationships with one another.

**parasympathetic nervous system**

Division of the autonomic nervous system consisting of some cranial and sacral nerves. Functionally, it is involved in conservation and restoration of energy. The parasympathetic and sympathetic divisions of the autonomic nervous system function to maintain homeostasis.

**parasympathomimetic**

Drugs that mimic the action of parasympathetic nerves.

**Pathometer**

Device used by Rev. Walter Summers to perform deception tests in the 1930s. Researchers had to order Pathometers from Fordham University, and they were only assembled upon order. Summers conducted testing on hundreds of subjects using this recording galvanometer and a testing procedure he devised that included what would be later known as comparison questions. See: Summers (1939).

**Peak of Tension (POT)**

Family of testing procedures, including *known solution*, *searching (probing)*, *concealed information* and *stimulation tests*. A Known Solution POT (KSPOT) is used to determine whether the examinee is aware of details of a crime that have been kept from the general public and would presumably only be known to the perpetrator of the crime or those with incriminating knowledge. A Searching POT (SPOT) is used to determine details of a crime that are not known to officials, such as the location of an unrecovered body, but would be known to a participant in the crime. The Concealed Information Test can be

used in either the known solution or searching condition, and is differentiated from the former two tests primarily on the number of tests given, and the random placement of the critical item in the test list. Stimulation tests come in several varieties and are covered in more detail under that heading. The evaluation criterion of Peak of Tension strip charts is simply identifying the point in the tracings where physiologic arousal has peaked, hence the name. Peak of Tension tests are not generally used to determine truth or deception, but rather to assist in the investigation or interrogation.

### **Pearson product-moment correlation**

A test of correlation between two sets of interval level data (see *scale of data*). The coefficients will lie between -1 and +1. A value of 0 would indicate no correlation, while -1 and +1 would mean perfect negative and positive correlations, respectively.

### **penile plethysmograph**

A device that measures engorgement of the penis. It is sometimes used in psychological evaluation of sex offenders. The value of the penile plethysmograph has been reported in the PDD literature. See: Abrams (1984).

### **pen starter**

Suction bulb with plastic tube used to draw ink from the reservoir, through the pen, to the pen tip. Used on old analog polygraphs with community ink systems.

### **percentage of inhalation time**

Psychophysiological measure of respiratory activity. It is the duration of inhalation divided by the duration of the entire respiration cycle. One common excitatory response pattern in breathing is a longer period of exhalation as compared with the non-aroused state. This decreases the ratio of inhalation time to total respiration cycle time. These changes are one index of arousal. Also called *I fraction* and sometimes denoted as %I.

### **peripheral nervous system**

Portion of the nervous system resident outside of the brain and spinal cord.

### **pertinent question**

Rarely used term for *relevant question*.

### **PG1**

Computer polygraph manufactured in the Peoples Republic of China. The designation of "PG" by the Chinese was for "polygraph" in English.

### **phalanx**

Any bone of the fingers and toes. In research and as commonly practiced in PDD, electrodermal sensors are attached to the distal phalanx, or end of the finger tips. Plural is phalanges.

### **pharmacological countermeasures**

Class of countermeasures in which the examinee attempts to affect the polygraph recordings through the use of ingested drugs or application of topical preparations. See: Krapohl (1996).

**phasic response**

A relatively rapid reaction, characterized by a change from and return toward baseline.

**photopolygraph**

A polygraph created by C.W. Darrow in the 1930s. It was one of the most elaborate polygraphs of that era, recording relative blood pressure, skin resistance, respiration, reaction time, and bilateral hand tremors. It had two stimulus markers, one activated by hand and the other was a voice key. Costing upwards of \$2,000 and requiring a separate technician to operate, Darrow's photopolygraph was primarily a laboratory instrument and was not used extensively by the PDD community. Also called the *Darrow Photopolygraph*.

**physical countermeasures**

Class of countermeasures in which the examinee attempts to manipulate the polygraph recordings through the discreet use of movements. Some of these movements are also used to self-induce pain. See: Krapohl (1996).

**pilomotor response**

Contraction of the piloerector muscles in the skin that erects hairs and produces "goose flesh." One of the symptoms of a sympathetic nervous system activation. Sometimes called *piloerection*.

**Pinochio response**

Nonexistent lie-specific physio-logical response. The expression sometimes used by polygraph critics to deride the notion that the act of deception produces stereotypical physiological response patterns.

**placebo**

Procedure or substance with no intrinsic effect but is useful to convince the patient or subject that an effective treatment has been applied. Placebos often have effects that are attributable to suggestion. They are used extensively in medical research for control purposes during drug testing and for certain psychosomatic illnesses. In PDD it addresses one type of mental countermeasure whereby examinees use ritual objects, incantations, or other ineffectual actions with the expectation that the power of the polygraph to uncover deception will be impeded.

**plethysmograph**

Device that measures changes in blood volume in a part of the body. Two common types of plethysmographs are *occlusion* (blood pressure cuff or a finger transducer) and *photo* (use of light from a diode directed into the skin and the reflection is detected with a sensor). Sometimes called the *PLE*.

**pneumograph**

A device that records respiration, and one of the three traditional channels of the modern polygraph used in PDD. Most contemporary polygraphs use two pneumograph recordings: abdominal and thoracic. The sensors are either the traditional convoluted rubber tube, the mercury strain gauge, or the newer piezoelectric.

**polygraph**

By definition, an instrument that simultaneously records two or more channels of data. The term now most commonly signifies the instrument and techniques used in the psychophysiological detection of deception, though polygraphs are also used in research in other sciences. In PDD the polygraph traditionally records physiologic activity with four sensors: blood pressure cuff, electrodermal sensors, and two respiration sensors. Some instruments also record *finger pulse amplitude* using a photoplethysmograph.

**polygraph surveillance**

See *maintenance polygraph examination*.

**polygram**

Complete graphical recording of physiological data from a polygraph test, with the required annotations. Usually called a *polygraph chart*.

**positive control pair**

The combination of the subjective truth question and the subjective lie question, to form a set in the Positive Control Technique.

**positive comparison question**

In the Positive Control Technique, each question is presented to the examinee twice in a row, and the examinee is instructed to answer differently the first time from the second time. Therefore, each question serves as its own comparison question.

**Positive Control Technique**

Technique that employs most of the standard test questions except probable-lie comparison questions, and each question is presented twice in succession during the testing. The examinee is instructed to answer truthfully to the first presentation, and untruthfully the second time, or vice versa. While the technique is amenable to the 7-position scoring, it has its own unique set of decision rules that are different from the more familiar comparison question formats. The Positive Control Technique is one form of the Yes-No Technique. See: Howland (1981); Reali (1978).

**Post-Conviction Sex Offender Testing (PCSOT)**

Specialized application of poly-graphy which aids in the management of the convicted sex offender who has been released into the community, though sometimes is employed as part of treatment of offenders who are incarcerated. There are four principal types of PCSOT examinations: *instant offense examination*, *sexual history/-disclosure examination*, *maintenance examination* and *monitoring examination*. See: Dutton (2000).

**post hoc**

(L: after this) Establishment of criteria or analyses after the conduct of the experiment is completed.

**posttest**

Final portion of a polygraph examination. The posttest could include a debriefing of an examinee who passed the examination, or an interview or interrogation of an examinee who failed the examination. The posttest may or may not be a part of any given polygraph technique, and plays no part in the formulation of the results in any polygraph technique.

**pre-ejection period (PEP)**

Time between the Q wave of the electrocardiogram and the B wave of the impedance cardiogram for the same pulse. Shorter periods are thought to correlate very highly with sympathetic nervous system arousal. The sensors for the production of the PEP phenomenon are relatively noninvasive, and if future research validates it as a diagnostic measure, the PEP could be added as an alternate PDD channel.

**premature ventricle contraction (PVC)**

Term loosely applied to any premature heart contraction, but more precisely it is a ventricular contraction between two sinus cycles without a compensatory pause. Sometimes referred to as *extrasystolic beat (esb)*.

**pretest interview**

The earliest portion of the PDD examination process during which the examinee and examiner discuss the test, test procedure, examinee's medical history, and the details of the test issues. During the pretest interview, in some techniques, the examiner will make behavioral assessments of the examinee to help determine the PDD outcome. The pretest interview also serves to prepare the examinee for the testing. The length of the pretest interview ranges from 30 minutes to 2 hours or longer, depending on the complexity of the case, examiner-examinee interactions, and testing technique. All PDD techniques use pretest interviews.

**primary track**

One of four tracks in the QuadriTrack Zone Comparison Technique, which include the secondary, outside, and inside tracks. The primary track contains a relevant question, and a non-current exclusive probable-lie comparison question against which the relevant question is compared. See: Matte (1996).

**probability**

Likelihood of an occurrence, expressed as a number. By convention, probabilities are reported in scientific reports as numbers between 0.00 and 1.00. Probabilities are most often reported in PDD studies to characterize the likelihood of the experimental results occurring by chance.

**probable-lie comparison question (PLC)**

One of two major types of comparison questions. PLCs are questions to which it is likely that the examinee is untruthful or unsure with his answer. Their intended purpose is to create a competition of salience such that the anxious innocent examinees will expend more of their physiologic responses on them than the relevant questions, but the guilty examinee will still find the relevant questions more arousing than the PLCs. Most systems of analysis compare the physiological responses elicited by the PLC with those from the relevant questions. A PLC is fundamentally different from a DLC (directed lie) in that the examinee believes he must pass the PLC question to pass the examination, whereas the true purpose of the DLC is more apparent to the examinee. Two main types of PLCs are the *exclusionary* (Backster type) *non-exclusionary* (Reid type).

**probation polygraph testing**

Regularly scheduled or aperiodic PDD testing of offenders on probation or parole, with the purpose of deterring repeat offenses. See *maintenance polygraph examination*.

**Probing Peak of Tension**

See *Searching Peak of Tension*.

**programmed innocent/guilty**

Those persons in a PDD experiment that play the role of either an innocent examinee or guilty examinee. PDD examiners sometimes make the mistake of referring to these examinees as *programmed NDI* (No Deception Indicated) or *programmed DI* (Deception Indicated). NDI and DI are PDD outcomes and not the examinees' experimental assignments.

**pseudorelevant question**

A test question so worded as to appear to be relevant to the examinee. Example: "Did you lie to any question on this test?" or "Do you intend to answer truthfully each question on this test?"

**Psychogalvanic Reflex (PGR)**

Expression coined by Veraguth for what is now called the *electrodermal response*. See Veraguth (1906).

**psychograph**

A term from the 1930s for the polygraph that consisted of the pneumograph, sphygmograph, and a stimulus marker. Sometimes referred to as the *Berkeley Psychograph*, the *Lee Polygraph*, and the *cardio-pneumo-psychograph*.

**psycho-kurgograph**

Obscure historical word for the polygraph.

**psychological set**

In psychology, *set* is defined as a temporary orientation or state of preparedness toward a particular stimulus or type of stimulus. Examples of set include perceptual, motor, and neural sets. The expression *psychological set* in PDD was introduced by Cleve Backster, who attributed it to a psychological writer, Floyd L. Ruch (1948). Backster has made the concept central to his Zone Comparison Technique. According to this PDD theory, examinees are expected to attend more to the category of question that presents the greater threat to their interests, either the relevant or comparison questions. Subjects who are lying to the relevant issues consider these questions more threatening than the others, which, in turn, draws more attention to the relevant questions, and more physiological arousal. Similarly, innocent subjects find the probable-lie comparison questions more disconcerting, and the greater attention paid to them generates the larger arousals. The expression *psychological set*, together with its underlying assumptions, have long been questioned by scientists on both sides of the polygraph debate, and there is not uniform agreement even within the polygraph community that they are adequate. Nevertheless, *psychological set* is the most cited expression for the differential responsivity evoked by the Comparison Question Technique. See: Krapohl (2001); Matte & Grove (2001).

**Psychological Stress Evaluator (PSE)**

A voice stress device. Dektor Counterintelligence and Security and Allan Bell Enterprises produced the PSE, first introduced in 1971. This device, which is no longer

manufactured, is the original voice stress analyzer. See: Horvath (1978; 1979); Lynch & Henry (1979).

**psychopath**

An individual with a personality marked with impulsivity, lack of empathy and conscience, and need for excitement. While popular lore holds that the psychopath, with his diminished conscience, is able to defeat PDD testing, all research has found that the guilty psychopath is no different from guilty non-psychopaths in being detected by the polygraph. See: Barland & Raskin (1975); Raskin & Hare (1978); Patrick & Iacono (1989).

**psychophysiological detection of deception (PDD)**

Common scientific term to denote the use of the polygraph to diagnose deception.

**psychophysiological veracity (PV) examination**

Expression proposed by James Matte to describe the process of making assessments of truthfulness or deception using a polygraph. Dr. Matte offered the term as an alternate to polygraph examination, and forensic psychophysiological detection of deception examination. The expression has not yet gained wide acceptance. See: Matte (1996).

**pulse pressure**

The arithmetic difference between the systolic blood pressure and the diastolic blood pressure.

**pulse transit time (PTT)**

Period of time for the passage of a mechanical pulse wave between two points on the body. PTT is used as a measure of sympathetic nervous system arousal and may have some usefulness as a PDD parameter.

**pulse wave velocity**

Propagation speed of a pressure pulse through the vascular system. One of many cardiovascular measures being evaluated as a PDD diagnostic feature.

**punishment theory**

One of several theories that attempt to explain PDD. It holds that physiologic arousal during deception is activated by the fear of the consequences if detected.

**pupillary response**

Change in the diameter of the pupil of the eye in response to stimuli. Pupil size is regulated by the sphincter pupillae muscles in the iris, which respond to parasympathetic stimulation, and the dilator pupillae muscles, innervated by the sympathetic nervous system. Dilation can result from sympathetic nervous system stimulation or the suppression of the parasympathetic nervous system. Pupil dilation has been investigated by several researchers as an index of stress, and continues to be a phenomenon of interest in PDD. See: Bradley & Janisse (1981).

**Purposeful Non-Cooperation (PNC)**

An expression first reported by John Reid to denote a PDD outcome in which examinees had used physical countermeasures in an attempt to defeat the polygraph examination. Reid did not consider PNC to be synonymous with the practicing of

deception, though he wrote that it was a fairly reliable indicator of the examinee's motives to deceive.

### **Quadri-Track Zone Comparison Technique**

A single-issue polygraph technique developed and advocated by Dr. James Matte, which extends the method devised by Cleve Backster. This technique has four "tracks:" *primary track*, *secondary track*, *inside track*, and *outside track*. The primary and secondary tracks consist of pairings of two relevant questions with two non-current exclusive probable-lie comparison questions. The inside track contains two questions, one relating to the examinee's concern about a false positive error, and the other regarding the examinee's hope for a false negative error. The outside track is made up of two *symptomatic questions*. A 7-position scoring system is used for analysis. For a full explanation, see Matte (1996). Formerly known as the *Quadri-zone Technique*.

### **Quinque-Track Zone Comparison Technique**

A multiple-issue test format based on the principles of the Quadri-Track Zone Comparison Technique by Dr. James Matte. Relevant areas in this format include direct involvement, indirect involvement, and concealed knowledge. A 7-position scoring system is used. See: Matte (1996).

### **Quadri-Zone Comparison Technique**

Superseded name for the Quadri-Track Zone Comparison Technique developed by Dr. James Matte. See *Quadri-Track Zone Comparison Technique*.

### **R-wave peak to carotid incisura (RWPCI)**

A cardiac response measured by the interval between the peak of the R-wave on an electrocardiograph (indicating ventricular contracture) and the arrival of the pulse waveform at the carotid incisura in the neck. It has been investigated as a possible additional measure of sympathetic nervous system arousal in the PDD setting.

### **radial artery**

Major artery in the forearm and wrist along with the ulna artery, and one of the alternate PDD recording sites for cardiovascular activity using the blood pressure cuff.

### **random assignment**

Research strategy whereby each selected subject is placed in a given group by chance. This can be accomplished through random numbers tables, coin flips, or other chance methods. Random assignment is one way of assuring that experimental effects are not the result of a systematic error in groupings of subjects. Random assignment is not the same as random selection, which addresses which subjects will participate in the study. Most validity studies of PDD randomly assign subjects into programmed guilt or programmed innocence.

### **random selection**

Method in research for extracting samples from a population where each individual has an equal opportunity for selection, and the selection of a subject has no influence on the selection of other subjects. Random selection is used to avoid the systematic error that can occur from other strategies. Random selection is not the same as *random assignment*, which addresses to which group the selected subjects will be placed. In practice, true random selection from the larger population is difficult to accomplish in

PDD research. Either subjects are drawn from subgroups, such as military recruits or college students, or they self-select in proportions that do not well represent the larger population, such as through newspaper recruitments.

**rank order analysis**

Any of the methods of PDD scoring that entail the assignment of ranks to response intensities within channel. Rank order analysis methods for the CQT include the Horizontal Scoring System and the Rank Order Scoring System. See: Gordon & Cochetti (1987); Honts & Driscoll; (1987); Krapohl, Dutton & Ryan (2001).

**rationalization**

Self deception. In the psychoanalytic model, rationalization is a psychic defense mechanism in which one's veridical motives or behaviors that are threatening to the psyche are reinterpreted to be other motives that are more acceptable. For example, some child molesters reconcile their self-image and their criminal sexual behavior by adopting the belief that they are only providing love and affection for their victims, or that they are merely satisfying the curiosity of the children. Similarly, isolated reports from criminal interrogations reveal that some murderers justify their killings in the most creative manner, including blaming the weapon. PDD examiners routinely watch for indications of rationalization during the pretest interview in order to prevent a false negative through faulty test questions that empower the self-deceit. No research has evaluated the effects of rationalization on PDD efficiency.

**reaction tracing**

Section of a physiologic tracing in which an arousal is apparent.

**Receiver Operating Characteristics (ROC)**

Psychophysical conceptual model for detection efficiency based on *signal detection theory* (SDT). The ROC characterizes the sensitivity of the decision criteria, and is useful to predict false positive and false negative rates across all levels of a criterion (cutting score, in PDD). It is an extension of work from the 1940s regarding the ability of radar operators to discriminate radar signals of friendly aircraft from those of enemy aircraft or noise. See: Swets, Daws & Monahan (2000).

**recovery half-time**

Interval between response onset and the return of the response to one-half of the maximum amplitude of the phasic response. Recovery half-time has been investigated as a diagnostic feature with electrodermal data using automated analysis. See: Kircher & Raskin (1988).

**recovery time**

Period between maximum amplitude of a phasic response and the return to a predetermined level.

**rectilinear tracing**

Tracing produced by an instrument that records linearly correct across time. Rectilinear tracings are produced by laboratory instrumentation and computer polygraphs, but not analog field polygraphs used in the practice of PDD. For contrast, see *curvilinear*.

### **red zone**

In the Backster framework, it is a twenty to thirty-five seconds block of polygraph chart time initiated by a relevant question having a unique psychological focusing appeal to the guilty (deceptive) examinees. One of the three primary zones in the Zone Comparison Technique (red, green, black).

### **regression analysis**

Method for mathematically modeling a relationship, and is used in prediction and description. Unknown values for the dependent values can be estimated by what is known about the corresponding independent variables. Independent and dependent variables must be at least interval scale. Regression analysis comes in various forms and is very useful to parse out the contributions individual variables make to an outcome. Multivariate and univariate regression are distinguished by the number of independent variables. At least one PDD algorithm uses a form of regression analysis.

### **Reid, John**

One of the first modern PDD examiners, Reid developed many techniques still in use today. Reid is credited with bringing the probable-lie comparison question into common practice in the field. He also developed the Reid Technique, which includes the Yes Test and the Guilt Complex Test. Reid helped bring about the first state licensure for PDD practitioners in Illinois in 1963. Reid instructed hundreds of students at his school and offered the first Masters program in PDD. The Reid Technique, which emphasizes global evaluation, is used by many PDD examiners today.

### **Relevant/Irrelevant (RI) Technique**

Family of polygraph test formats in which traditional lie comparison questions are not employed. While originally used in criminal testing, RI tests currently are more often found in multiple-issue screening applications. The RI test can trace its roots to word association tests employed in the early 1900s, and these word tests were later used occasionally during the monitoring of electrodermal activity. The RI was used extensively by pioneers John Larson and Leonarde Keeler in the 1920s through the 1940s, and it is still used today. Variants include the NSA RI, which is used in multiple-issue screening, and the Modified Relevant/Irrelevant (MRI), used in criminal testing.

### **relevant question**

A question that deals with the true issue of concern to the investigation. In addition to "did you do it" types of questions, relevant questions also include evidence-connecting and "do you know who" questions. Strong relevant questions address the "did you do it" type of questions, while moderate-strength relevant questions address evidence connecting and prior knowledge, such as participation in planning, providing help the perpetrators, or knowing the identity of the perpetrators. Moderate-strength relevant questions also address the examinee's alibi or place him at the scene of the crime. The term *relevant question* is not appropriate for Peak of Tension or Concealed Information Tests. Rather, terms such as *key* and *critical item* are used in these formats. Relevant questions are sometimes called *pertinent questions* or, more informally, *hot questions*.

### **reliability**

Stability or consistency of measurement. Reliability studies in PDD often examine the rate of decision agreement among examiners on polygraph test charts. *Interrater reliability* denotes agreement among examiners, whereas *intrarater agreement* (test-retest

reliability) pertains to an examiner agreement with his or her own decisions when evaluating the charts on different occasions. Reliability is not the same as validity, which means accuracy. A technique cannot be more valid than it is reliable. A technique can have high agreement without high accuracy, though the reverse is not true.

**relief tracing**

Section of a physiologic tracing in which a recovery from an arousal is apparent.

**resistance**

Degree to which a material hinders the flow of electricity. Skin resistance is one of the measures used in conventional polygraphs. Resistance and conductance are reciprocals of one another.

**resonance control**

Feature on some older analog polygraphs that allowed the operator to regulate the diameter of the pneumatic line of the cardiograph between the internal bellows and the external coupling. Its effect was to change the amplitude of the pulse wave tracing.

**respiration**

One of the traditional physiologic activities recorded in PDD. The 90% confidence interval for respiration is 10 to 25 cycles per minute, and it is currently recorded with sensors placed about the abdomen and thorax. The feature of the pneumographic tracing considered most diagnostic is an overall suppression in the amplitude of the cycle after stimulus presentation. Other features include baseline arousals, changes in the amount of time for inhalation compared to that of exhalation, and a "staircase" type pattern of respiration cycle recovery to prestimulus amplitude levels. Automated scoring algorithms typically use the length of the line that makes up the waveform, since virtually all diagnostic features produce lines of shorter length. Not only are there diagnostic features for deception in this tracing, respiration changes can influence the other PDD channels. Deep breaths can elicit electrodermal responses. They can also cause immediate increases in relative blood pressure, followed by a rapid fall. Moreover, since respiration is more readily controlled than other activity recorded with the polygraph, it is one of the first areas examiners look for indications of countermeasures. Such indications are paced breathing, holding one's breath, very slow breathing, irregularly shaped waveforms, hyperventilation, and tactical use of deep breaths. In physiology, *respiration* refers to the movement of gases across membranes in the lungs, while *ventilation* is the term used for the expansion and compression of the chest during breathing.

**respiratory amplitude (RA)**

One of several features found in the respiratory pattern. Suppression of the RA is a reliable indicator of sympathetic nervous system arousal and is one of the features evaluated in the diagnosis of deception. This principle presupposes stable respiratory patterns.

**respiratory cycle time (RCT)**

One of several diagnostic features found in the respiratory pattern. The RCT is calculated by measuring the time or linear chart distance between two inspiratory maximums, divided by the same measure of two inspiratory peaks after the subject's vocal response. Lower ratios indicate longer respiration cycle time after stimulus presentation

and, therefore, sympathetic nervous system arousal. This principle presupposes stable respiratory patterns.

### **respiration line length (RLL)**

Feature in a respiration tracing that changes during arousal. It is a linear measure of the respiration waveform over a specified period time. RLLs are inversely related to sympathetic nervous system activation. This is because the typical breathing response to stimulation or orientation is a suppression in the rate and amplitude of respiration. It was first reported in the PDD literature by Dr. Howard Timm, and several studies have since supported the use of this measure in deception tests. The use of RLL as a deception criterion presupposes stable respiratory patterns. See: Timm (1982).

### **respiratory sinus arrhythmia (RSA)**

Variations in heartbeat that are directly related to respiration; slower during inspiration and faster during expiration.

### **rise time**

Period between the start of a response to its greatest amplitude.

### **sacrifice relevant question**

Question introduced by Cleve Backster and used in most forms of the ZCT as well as other types of tests. The sacrifice relevant is a question that asks the examinee if he intends to answer truthfully to every question related to the relevant issue. Its standard role is to dissipate the responses of innocent persons who frequently react to the first relevant question. The sacrifice relevant question is not numerically scored. See: Capps, (1991); Horvath (1994).

### **salience**

In learning theory, salience refers to the strength of the relationship between a response and a reinforcer or outcome. In general, as the intensity of the outcome increases, the intensity of the response increases. In the framework of deception, as the threat of potential punishment increases, the intensity of arousal associated with the deceptive response will increase.

### **scale of data**

Data come in four levels. *Nominal data* are those that are name or designations only. Social Security Numbers are nominal data. They have meaning, but cannot be mathematically manipulated beyond being tabulated. The next level is *ordinal data*. Ordinal data allow meaningful interpretations of the order, but not the distances between the measurements. For example, scores in an Olympic event of 8, 9, and 10 mean that 10 is better than 9, which is better than 8. They do not mean the athlete who received the 9 was 90% as good as the one who received the 10, nor the one who received the 8 only 80% as good. There are not equal intervals between the units. The next level, *interval data*, does have this property. Both Fahrenheit and Celsius temperature scales are interval. The units are equally spaced. In order to satisfy the requirements for the last scale of data, *ratio*, there must be a true zero. The zero point in Fahrenheit and Celsius scales is not a true zero in the sense of an absolute lack of heat, though the Kelvin temperature scale has as its zero point (absolute zero), making it a ratio scale. Other ratio scales include measures such as distance, weight, and speed. The scale of data will set the type of statistical test that can be performed. For example, polygraph decisions are

nominal, either deceptive, truthful, or inconclusive (though if these outcomes are based on scores, some have argued that they are ordinal scale). Precise measurements of response amplitudes, latency, and recovery time are ratio data and allow sophisticated statistical treatments and automated algorithms that render probability statements.

### **scientific cradle**

Device built by Angelo Mosso (1896) to record respiratory and cardiovascular responses to fear. It consisted of a fulcrum base onto which was placed a platform for his subject to lie upon. Using counterweights to bring the platform into balance, the device recorded on a smoked drum the changing balance of the platform that accompanied the undulations of breathing and the shifting concentration of blood in the body.

### **screening examination**

Multiple-issue PDD testing of applicants, employees or persons with U.S. security clearances. Testing formats vary and can include the Relevant/ Irrelevant, ZCT “exploratory,” Test for Espionage and Sabotage, Modified General Question Test, and others. The strength of screening examinations is in their utility to develop significant information that is most often not obtainable from any other source. Its weakness is that it is not as powerful an examination as is the specific issue test in terms of validity and reliability.

### **Searching (or Probing) Peak of Tension (SPOT)**

Peak of Tension test in which the testing examiner does not know the critical item, and it is used to determine information concealed by a guilty examinee. Applications of this format include determining the location of stolen goods or the bodies of murder victims, the amount of cash stolen, or the name of an accomplice. In practice, SPOT tests are not often used alone, but rather are a post hoc procedure once deception has been established with comparison question or relevant/irrelevant tests. Called a *Type B* by Keeler graduates, and a *Probing Peak of Tension* by Backster.

### **secondary track**

One of four tracks in the Quadri-Track Zone Comparison Technique, which include the primary, outside, and inside tracks. The secondary track contains a relevant question, and a non-current exclusive probable-lie comparison question against which the relevant question is compared. See: Matte (1996).

### **selective enhancement**

Feature included with the electronic cardiograph of the Lafayette polygraph in 1979 that allowed for manual setting of the high-pass filter via the “response control” knob, and low-pass filter with the “notch control” knob.

### **sensitivity**

Ability of a test to detect specific features at all levels of magnitude or prevalence. If a deception test, for example, could detect physiologic responses that accompany deception only when they are dramatic, it is not a sensitive test. Conversely, if it enjoyed perfect efficiency in detecting deception, but misclassified a high percentage of truthful examinees as deceptive, it would have sensitivity but poor specificity. Sensitivity and specificity are two dimensions that define the validity of the test.

**sensory nerves**

See *afferent nerves*.

**Senter Rules**

The combination of two existing decision models used with the Zone Comparison Test. One existing model, referred to as the 3T model, uses only the total sum of assigned scores to produce decisions, with values of -6 or less resulting in decisions of deception indicated (DI), and values of +6 or greater resulting in decisions of no deception indicated (NDI), and values in between resulting in no opinion (NO) decisions. The other existing model, referred to as the 3S model, produces decisions using the three individual question pair totals and the total sum of assigned scores. Total sums of -6 or less or a value of -3 or less for any of the three question pair totals result in a DI decision. Total sums of +6 or greater and values of +1 or greater for all three individual question pair totals result in a NDI decision. All other cases result in a NO decision. The two Senter Rules use both of the existing 3T and 3S models in two-stage formats. The 3T3S model uses the 3T model as a first stage, and if this results in a NO decision, the 3S model is used as a second stage. The 3S3T model uses the 3S model as a first stage, and if a NO decision is produced, the 3T model is used as a second stage. Senter and Dollins (2002) applied these four models to assigned scores from 820 laboratory decisions and 799 field decisions (all blind-scored), produced by 23 different reviewers. Across all data sets, the 3T3S and 3S3T models produced 8.3% more correct decisions, 11.5% fewer NO decisions, and 3.1% more incorrect decisions than the 3T and 3S models in isolation. The pattern of results was nearly identical across laboratory and field data. Although the 3T3S and 3S3T models produced more incorrect decisions than the 3T and 3S models, the percentage of correct decisions excluding NO decisions for all models was very similar, with the 3T and 3S models averaging 88.5% and the 3T3S models averaging 86.5%. Thus, the application of the 3T3S and 3S3T models produces the same high level of accuracy as the 3T and 3S models, with a large reduction in NO decisions. See: Senter & Dollins (2002).

**serrated respiration pattern**

Respiration tracing that also includes the examinees pulse due to the proximity of the respiration sensors to the heart. In some schools the sudden onset or disappearance of the serrated pattern is taught to be noteworthy for diagnosing deception, while in others it is an artifact. Empirical research is lacking.

**sexual history examination**

A form of *Post-Conviction Sex Offender Testing* (PCSOT) which entails an in-depth look at the entire life cycle of an offender and his or her sexual behaviors up to the date of criminal conviction. Sometimes referred to as a *disclosure examination*. See: Cooley-Towel, Pasini-Hill, & Patrick (2000); Dutton, (2000); English, Pullen, & Jones (1996); Heil, Ahlmeyer, McCullar, & McKee (2000).

**sexual offender monitoring**

Use of the polygraph to verify that sexual offenders on parole or probation are in compliance with the conditions of their release from incarceration.

**signal detection theory (SDT)**

Theory which explains how to make "optimal" decisions when ground truth is unknown. If the benefits and costs of true positives, false positives, true negatives, and false negatives of a PDD decision can be determined, and the probabilities of each event

can be estimated, then signal detection theory can be used to determine the optimal cut scores over many decisions. SDT is a rational approach to establishing cutting scores in polygraphy. See Green & Swets (1988).

### **signal value**

The perceived significance of a stimulus for a subject. External significance is assigned to a question when it appears to differ from others based on appearance (e.g., is much longer or is read in a louder tone of voice). Internal significance is assigned to a question because of the subject's perception of the question's scope or content. The objective of a CQT examination is to make the external significance of relevant and comparison questions appear equal, and for their internal significance to vary. An innocent examinee would be expected to generate higher internal significance for the comparison questions, whereas the relevant questions would hold higher internal significance for the deceptive.

### **Significant Physiological Responses (SPR or SR)**

Accepted verbiage in the U.S. polygraph screening programs, and is equivalent to *Deception Indicated* in specific-issue tests. This alternate language comes from an acceptance that screening examinations do not produce the high validity of specific-issue tests and, therefore, the results are better reported as the presence of physiologic arousals rather than inferring deceptive intent on the part of the examinee.

### **silent answer test (SAT)**

Specialized procedure in which the examinee is directed to answer to himself instead of making a verbal response. The use of the SAT is prescribed by some PDD experts to help avoid distortions to the pneumograph tracings attributable to speech disorders, or to uncover certain countermeasures. To ensure examinees are attending to the content of the test questions, some PDD examiners instruct the examinees to indicate their responses by slightly nodding or shaking their heads. When the SAT is used with head movements, it is called an SAT Nod. See: Horvath (1972).

### **situational comparison question**

Question used for comparison in the Modified Relevant/Irrelevant (MRI) technique that elicits physiologic responses for comparison against those of the relevant question. Situational comparison questions are a departure from their conventional counterparts in that the examinee is not faced with a question to which he is deceiving or uncertain. Rather, this type of comparison question addresses how the examinee is linked to the crime, such as having legitimate access to money that later disappeared or being the last person to see a murder victim alive. The truthful examinee is allowed to respond to a question related to the crime that is not a relevant question, but one for which the examinee may feel uncomfortable because it put him on the list of suspects.

### **skin conductance (SC)**

Broad term for two exosomatic electrodermal phenomena, *skin conductance level* and *skin conductance response*. In recent years PDD instrumentation has moved away from skin resistance measures toward skin conductance because SC measurement has less impact on the underlying mechanisms that produce the effect.

### **skin conductance level (SCL)**

Basal conductance of the skin. SCL is the tonic measure of SC.

**skin conductance response (SCR)**

A change in the electrical conductance of the skin elicited by a stimulus. SCR is a *phasic response*.

**skin potential (SP)**

General term for the endosomatic electrodermal properties of the skin. Though not currently used in PDD, preliminary laboratory research has shown SP to be as diagnostic as the exosomatic measures.

**skin potential level (SPL)**

Basal electropotential of the skin. SPL is the *tonic level*.

**skin potential response (SPR):**

An endosomatically produced electrodermal response, and of interest as a parameter in PDD. It is frequently measured between the forearm and the hypothenar eminence. (Special note: In the Japanese PDD literature the term *skin potential* was sometimes reported in the English translation when *skin resistance* was actually used. Caution is advised.)

**skin resistance (SR)**

General term for the phenomena of skin resistance level and skin resistance response. SR is recorded exosomatically and was the primary means of detecting electrodermal activity throughout much of PDD history until the introduction of computerized instrumentation with SC.

**skin resistance level (SRL)**

Tonic level of electrical resistance of the skin.

**skin resistance response (SRR)**

Phasic response measured by electrical resistance of the skin.

**S-K-Y**

Abbreviation for *Suspect, Know, You*. A standardized Zone Comparison Technique test format that is included under the umbrella of the Backster Zone Comparison Technique. In a structured format, the S-K-Y allows for broadening of the scope of a single-issue test to include questions relating to secondary involvement and knowledge. Along with the questions addressing direct involvement, such as "Did you shoot Henry Jones?", other moderate strength relevant questions could be used, such as "Do you know for sure who shot Henry Jones?" or tertiary issues such as those that place the examinee at the crime scene, address his alibi, or tests prior knowledge. As with the exploratory test, the mixing of different relevant questions allows for only vertical scoring when applying the 7-position scoring method.

**smoked drum recording**

An antecedent to the continuous strip chart. A cylinder was wrapped with paper that had been covered with soot over a yellow flame. The paper-covered cylinder was rotated against a stylus at a selected rate to produce a graphic recording of physiologic and other events. The recording was preserved by a coat of shellac varnish.

**smooth muscles**

All of the involuntary nonstriated muscles involved in autonomic functions, except the heart. Smooth muscles are located in the bladder, intestines, and blood vessels. Also called *unstriated muscles*.

**Spearman Rank Correlation**

Statistical technique for testing the correlation between ordinal-level data (see *scale of data*). This method can be used to assess interrater reliability for rankings to questions assigned by different evaluators.

**specificity**

A term most used in the scientific literature to describe the selectivity of a test. It is the ability of a test to separate one element from among many elements regardless of their similarity. The specificity of a test will determine its efficiency. If a PDD test can detect deception 100% of the time, but classifies artifacts such as PVCs and coughs as deception, it does not have good specificity. Specificity and sensitivity constrain the validity of a test.

**specific issue polygraph examination**

A single-issue PDD examination, almost always administered in conjunction with a criminal investigation, and usually addresses a single issue. Sometimes called a *specific* by PDD practitioners to differentiate from preemployment or periodic testing.

**Specific Physiological Response (SPR)**

See *Deception Indicated*.

**specific point countermeasures**

Attempts to defeat a polygraph examination by the self-induction of physiological responses to particular questions. Typical strategies include targeting comparison questions with manipulated respiration, self-inflicted pain, covert tensing of muscles, and sometimes mental imagery. See: Honts, C.R., & Amato, S.L. (2002).

**sphygmograph**

An instrument for graphically recording arterial pulse and blood pressure. A more precise term for the *cardiograph channel* in PDD.

**sphygmomanometer**

Aneroid gauge used to register air pressure in the polygraph cardiovascular sensor system. Changes in a closed sphygmomanometer system signal changes in relative blood volume at the recording site on the examinee.

**spontaneous countermeasures**

Efforts used to interfere with PDD testing for which the examinee has not prepared in advance. These types of countermeasures have been shown in laboratory studies to be ineffective.

**spontaneous response**

Any reaction not associated with an identifiable stimulus. A high incidence of spontaneous responses can be used as an index of general arousal.

**spot**

A permanently assigned location of a relevant question in a CQT question series.

**spot analysis**

The numerical evaluation of a relevant question by comparing it to a comparison question no further than one position to the left or right of that spot location. A “spot” represents the location of a relevant question in a question series; the physiological data at the relevant question (spot) are compared with those of an adjacent comparison question.

**spot responder**

Examinee who has a propensity to physiologically respond to a question by virtue of its position in a sequence of questions rather than the content of the question. Some techniques rotate the serial position of relevant questions because of the possibility of spot responses.

**SPS-2000**

Computer polygraph manufactured in the Peoples Republic of China. The Chinese used “SPS” to stand for “Super Polygraph System” in English.

**stable**

Resistant to change. Opposed to *labile*.

**staircase respiration**

Expression for a pattern of respiration in which the tops of the inhalation cycles move higher or lower with each subsequent cycle, forming the characteristic “staircase” appearance. The increase in respiratory amplitude is called an ascending suppression, while the opposite pattern is a descending suppression. These patterns are often associated with sympathetic arousal and are considered diagnostic features used in PDD tests.

**standard deviation**

Statistical term for a standardized unit of dispersion of scores. When scores are clustered closely together, the standard deviation is small, whereas a wide spread would have a larger standard deviation. Mathematically, the standard deviation is the square root of the variance. Conceptually, the standard deviation is the square root of the average squared deviation from the mean.

**statistic**

A measurement of a sample. There are several ways to measure samples, including the *mean*, *standard deviation*, and *variance*. When these measurements are taken from an entire population they are referred to as *parameters*.

**statistical significance**

Phrase to describe an experimental result that is unlikely to have occurred by chance. Conventional probability thresholds of statistical significance are 0.05 and 0.01.

**stim marker**

See *event marker*.

**stimulation test**

Procedure used by many PDD examiners before or between the regular tests. One of its purposes is to demonstrate to examinees that the polygraph works with them, and in doing so, reassure the innocent while heightening the guilty person's concern about the relevant questions. Other purposes include allowing the testing examiner set the gains properly, to verify that the sensors are properly placed and functioning correctly, and to acquaint the examinee with the examination procedures. Virtually all stimulation tests use a question set of very similar items in which is embedded a single item that the subject is directed to lie about. There are several types of stimulation tests. The more common are the *card test*, *known numbers acquaintance test*, *blind numbers test*, *control test*, and *true blue control test*. Tests of this nature were used by early polygraph examiners for the purpose of comparing the reactions on the stimulation test with those from the relevant questions on the R/I test. Stimulation tests are sometimes referred to in general as *stim tests*.

**stimulus irrelevant question**

Question used in some RI screening formats to determine whether the examinee is capable of responding physiologically and is employed when significant responses have not occurred to relevant questions. It may take the form of a simple mathematics question, a regular irrelevant question read incorrectly, or other types.

**Stoelting Instruments**

C.H. Stoelting of Chicago, Illinois. An American manufacturer of analog and computer polygraphs.

**straight-through test (ST)**

A Reid polygraph test with a standard sequence of questions, usually conducted before other sequences are used. In contrast to *Reid's Mixed Question Test (MQT)*.

**strain gauge**

Generally, any sensor for registering changes occurring in the dimensions of a solid or body. In PDD, respiration is recorded with pneumatic strain gauges placed about the thorax or abdomen, or both.

**striated muscles**

Includes all skeletal muscles that perform voluntary contractions, as well as cardiac muscle responsible for the involuntary muscular activity of the heart. Also called *striped muscles*.

**stroke volume (SV)**

Measure of the amount of blood ejected from the heart in each beat.

**strong relevant question**

PDD question that goes directly to the heart of the matter under investigation, as compared to knowledge or complicity questions.

**subjective lie/truth question**

In the Positive Control Technique, examinees are presented with each question two times in succession as a set. Examinees are instructed to admit committing the offense under investigation after the first presentation of each question, and deny it after the

second reading of the same question. The first time the question is read, it is called the subjective lie question, while the second presentation is called the subjective truth question.

### **successive hurdles approach**

In screening, it is a method to maximize accuracy when base rates are unbalanced or very low. For example, an agency may have a vital interest in uncovering past activities of applicants before hiring them, behaviors that are very difficult to investigate effectively with any method except the polygraph. The agency may choose to conduct a single-issue polygraph for each of the subject areas. If there only two or three areas, this approach may be effective, however, if the number is greater, it would tax the agency's resources in terms of polygraph examiners and processing time. Alternatively, in the successive hurdles approach, each applicant would begin with a multiple-issue examination. Though multiple-issue examinations have a higher false positive rate (incorrect decision of deception) than do single-issue examinations, they have a very small rate of false negatives. If the applicant were found non-deceptive during the multiple-issue examination, the polygraph session would be over. However, if there were indications of deception during the multiple-issue examination, the polygraph session would continue. Next, a single-issue examination would be administered in the area the examiner found suspicious during the multiple-issue examination. The single-issue examination has much better discrimination power, and would confirm or disconfirm the suspected deception. In this way, the more resource-intensive single-issue examinations would be reserved for the smaller subset of applicants who did not pass the multiple-issue examination. The net effect of the two-stage screening process is a better accuracy without increased resources. See: Meehl & Rosen (1955).

### **Summers, Walter**

Early researcher of deception testing who used an electrodermal recording device and a structured test series to verify truthfulness and deception. Summers reported the use of what he called *emotional standards*, which are similar in many respects to present day comparison questions. See: Summers (1939).

### **superdampening concept**

Concept forwarded by Cleve Backster which holds that there will be a suppression of general reactivity to relevant and comparison questions when the examinee is more concerned that the examiner will ask an unreviewed question about another issue outside the scope of the current examination questions. The theory is widely accepted, though the available evidence suggests that the effect is negligible or nonexistent. See: Backster, (1964); Capps, Knill, & Evans (1993); Honts, Amato, & Gordon (2000); Krapohl (2001); Matte (2001).

### **suppression**

Initial respiratory response to orienting and arousal, characterized by breathing that is shallower and slower than tracing average. The PDD respiration tracing of suppression will show a decrease in amplitude, a possible change in the inhalation/exhalation (I/E) ratio, and often a slower rate. Suppression has been found to be a reliable indicator of stress since the first part of this century, and it is a primary reaction criterion for diagnosing deception.

**surreptitious respiration tracing**

Recording of the respiration cycles of an examinee during a portion of the polygraph session when the examinee is not aware of it. Frequently, though not always, this is done just before or immediately after a test is conducted. Surreptitious respiration recordings are useful to help assess whether an examinee has altered his breathing during testing. Differences can indicate countermeasures. The motives of the examinee may be discerned with a Yes Test or other specialized techniques that help assess the examinee's level of cooperation. A related but less precise method is the counting of the examinee's respiration cycles during the pretest interview while he is otherwise occupied, such as during his reading of the consent form or while the examiner is readjusting the electrodermal sensors.

**Suspicion-Knowledge-Guilt Test (SKG)**

Technique used to tentatively identify suspects who may have had direct or indirect participation in the crime under investigation, or concealed knowledge relating to the crime. It is used before a CQT as a screening tool when there are multiple suspects and possibly different levels of criminal involvement. The SKG also includes some of the comparison questions used in the Quadri-Track Zone Comparison Technique. Developed by Dr. James Matte. See: Matte (1996).

**sympathetic nervous system**

Thoracolumbar portion of the autonomic nervous system centrally involved in responding to arousing stimuli. Most sympathetic nerves are *adrenergic* and prepare the body to respond to increased demands. Sympathetic nervous activation increases blood flow from the heart, triggers the release of glucose and epinephrine, dilates the pupils, and initiates other responses in preparation for action. Unlike most of the sympathetic nervous system, sympathetic nerves to the eccrine sweat glands are *cholinergic*.

**sympathetic chain**

A system of 21 to 22 pairs of ganglia located in the thoracic and abdominal areas and is the site of synapse between pre- and postganglionic sympathetic neurons. There is one notable exception—there is no postganglionic sympathetic nerve to adrenal medulla.

**sympathomimetic**

Drugs that mimic the action of sympathetic postganglionic nerves or their neurotransmitters.

**symptomatic question**

A question type developed by Cleve Backster which is used to identify whether or not an examinee is fearful the examiner will ask an unreviewed question embracing an outside issue that is bothering the examinee. This mistrust of the examiner will putatively dampen the examinee's responses to other test questions. Symptomatic questions are widely used, though the trend in the research is that there is no meaningful effect. See: Backster (2001a); Honts, Amato, & Gordon (2000); Krapohl & Ryan (2001); Matte (2001).

**synapse**

Junction between neurons. Site where the nervous impulse is transferred from one neuron to another. Neurotransmitters reside in vesicles of one neuron and are

released by the axon into the synapse to chemically induce the next neuron or organ to respond.

### **systole**

Contraction of the cardiac muscles. Left ventricular systole results in movement of blood out of the heart into the aorta. Systoles can be subdivided into three primary components: *preejection*, *ejection*, and *relaxation periods*. The left ventricular systolic peak is represented on a conventional polygraph tracing as the highest vertical point in the pulse wave of the tracing.

### **systolic blood pressure**

Force exerted by blood against the wall of the arteries at the height of ventricular contraction. Also called *maximum pressure* and expressed in millimeters of mercury (mmHg).

### **t test**

A statistical test frequently used with small samples (when the number of observations is less than 30) to determine whether the mean of one sample is significantly different from that of other.

### **Takei**

Japanese manufacturer of analog polygraphs.

### **tachycardia**

Abnormally rapid heart beat, greater than 100 beats per minute. Tachycardia can result from poisoning, medications, certain illnesses, and during states of anxiety or excitement. A rapid heart beat is normal for the very young or during the physical exercise of normal adults. While not a diagnostic feature in itself, PDD examiners pay attention to heart rate during evaluation of the polygraphs as it may signal pharmaceutical countermeasures or atypical levels of stress.

### **tachypnea**

Rapid breathing, usually shallow.

### **target intensity**

A variable considered by examiners in the rating and selecting of test issues (targets), as well as in the sequence of test questions in multiple-issue testing. It is anticipated that the guilty examinee's psychological set (greatest concern) will be directed toward questions dealing with the most serious test issues—those with the greatest consequences to the examinee—with less or no attention being allocated toward relevant questions where the consequences of discovery of guilt are relatively less costly to the examinee, such as minor criminal acts.

### **taxonomy**

A system of categorization based on specific criteria. A typology. Taxonomies are used to organize concepts or phenomena into meaningful groups. There are currently PDD taxonomies for techniques, scoring systems, and countermeasures.

**test**

In PDD, the *test* is frequently used to differentiate a single running of a question series (sometimes also called a *chart*) during physiological recording from the examination, which is considered to be the totality of the PDD process. It can also refer to specialized procedures within techniques, such as the Yes Test and stimulation test. *Test* has been used to refer to polygraph techniques, such as the Zone Comparison Test, or Modified General Question Test. The specific meaning of *test* can depend on the context.

**Test for Espionage and Sabotage (TES).**

Multiple-issue testing format employed by some U.S. Government agencies for screening purposes. The TES uses a repeated series of relevant and directed-lie comparison questions, and the conventional 7-position scoring system. See: Reed (1994); Research Staff (1995;1998).

**thenar eminence**

Prominence on the palm at the base of the thumb. One of the optimal recording sites for electrodermal activity, and a preferred location in psychophysiological research.

**thermal imaging**

A technique that uses a camera to record the emission of radiant energy from the body. The basis for the technology is that any object with a temperature greater than 0 degrees Kelvin radiates energy in the infrared (IR) range. Although IR energy cannot be seen by the human eye, thermal cameras are equipped to record this form of energy. Changes in thermal patterns on the face have been shown to be associated with physiological arousal, and preliminary evidence suggests that thermal imaging can discriminate between truth-tellers and deceivers at better than chance using a probable-lie comparison question technique.

**thoraco-lumbar division of autonomic nervous system**

An anatomical division of the autonomic nervous system (ANS) that represents the sites of outflow from the sympathetic division of the ANS (i.e., nerves from the thoracic and abdominal parts of the body). It is the location of the 21-22 pairs of ganglia that constitute the sympathetic chain.

**thumb transducer**

Cardiovascular sensor consisting of an external ring and internal bladder, into which is placed the thumb. The bladder is inflated to a small pressure, and the sensor detects changes in the relative blood volume of the thumb. Because of the weakness of the signal, the thumb transducer requires an electronically enhanced cardiograph channel.

**time bar**

Method of restricting the coverage of the comparison question so that it will not include the time in which the incident under investigation took place. Time bars generally predate the crime. A typical time bar for the comparison question might be phrased "Before the age of X, did you ever..." or "Prior to 1998, did you ever ..." The time bar is one way of ensuring that the comparison question is not also a relevant question, and when used, creates an *exclusionary comparison question*.

**TiPi**

A voice stress device. Nemesysco produces TiPi, first introduced in 2001. Prior versions of the product were Vericator, produced by Integritek Systems, and TrusterPro, produced by Trustech. Training can be obtained but is not required. Multiple testing formats are possible, including PDD formats. See *voice stress analysis*.

**tone**

Homeostatic state.

**tonic change**

Shifting of tonic level to a new baseline.

**tonic level**

Baseline level. This terminology in PDD is frequently used to delineate basal electrodermal levels from short-term responses induced by stimuli. Tonic levels change slowly compared to phasic activity.

**tonic response**

Shifting of tonic level in response to an identified stimulus.

**total chart minutes concept (TCMC)**

Variation in the rate of habituation for the individual physiological parameters recorded in PDD. Backster developed a habituation curve for each of the parameters for the amount of time these activities were recorded during testing, and published his report in 1963. It has not received much attention among researchers, and is not currently taught in the field. See: Backster (1963b; 2001b); Krapohl (2001).

**tracing average**

Section of the physiological tracing used as a comparative baseline, and in which there are no indications of physiologic arousal. Also referred to as the *homeostatic level*.

**tracing distortion**

Contamination of a physiologic tracing, typically by movements of an examinee. Also referred to as *artifact*.

**track**

Term relating to pairs of polygraph test questions that are used for evaluative purposes, and a concept central to the Quadri-Track Zone Comparison. See: Matte (1996)

**transducer**

Device for transforming energy of one type into energy of another type. In PDD a transducer is most often used in the context of converting pressure changes into electrical signals.

**Traube-Hering-Mayer (THM) wave**

Rhythmic low-frequency fluctuation in heart rate (~0.1 hz) linked to a blood pressure feedback loops and involving the carotid baroreceptors. The THM wave is a contributing component to the variability expressed in the respiratory sinus arrhythmia. See *vagal tone*.

**tremograph**

Instrument for recording tremors and an early deception detection approach. In the 1930s Luria proposed that trembling could be used as index of emotional arousal, leading to possibilities in detecting lying. His hypothesis was based on his conflict theory (i.e., incompatible emotions affect bodily responses). See *conflict theory*.

**tri-zone**

An incorrect term sometimes used for a ZCT with three spots, or relevant questions. See *Zone Comparison Technique*.

**Tri-Zone Indication-Remedy Table**

A “first aid” technique of the Backster methodology to immediately detect and remedy any Zone Comparison technique defect or weakness.

**true blue control test**

Stimulation test somewhat similar to the known numbers test, except that the examinee is also directed to lie to an item that is partially both true and false. See *Stimulation Test*.

**true negative**

Correct decision that the variable of interest is not present (i.e., an accurate PDD outcome of innocence).

**true positive**

Correct decision that the variable of interest is present (i.e., an accurate PDD outcome of guilt).

**type A test**

See *Known Solution Peak of Tension test*.

**type B test**

See *Searching Peak of Tension test*.

**type I error**

The probability of rejecting a true null hypothesis. Alternatively, it is the probability of incorrectly accepting the alternate hypothesis. Denoted as  $\alpha$ .

**type II error:**

The probability of not rejecting a false null hypothesis, and denoted as  $\beta$ .

**United States Army Military Police School (USAMPS)**

Former polygraph instruction center for U.S. Federal PDD examiners from 1951 through 1986. Now called the Department of Defense Polygraph Institute (DoDPI).

**United States v Frye**

James Alphonzo Frye was administered a deception test by Dr. William M. Marston in 1923 using Marston's discontinuous blood pressure method. Marston's opinion was that Frye was truthful in his recanting of a murder confession for the killing of a prominent Washington, DC, doctor. At Frye's trial his defense attorneys attempted to have the results entered into evidence, but were unsuccessful (United States v Frye 54

App D.C.46, 293 F 1013). The Frye Rule, as it came to be known, stated that “expert testimony based on a scientific technique is inadmissible unless the technique is generally accepted as reliable in the relevant scientific community.” The Frye Rule was invoked thereafter in many jurisdictions to bar PDD evidence from admissibility. The Frye Rule has been superseded by Federal Rule 702, cited in *Daubert v Merrell Dow Pharmaceuticals, Inc* (1993), except in those states that do not follow the Federal Rules of Evidence. See: Daubert v Merrell Dow Pharmaceuticals, Inc (1993)

### **Utah technique**

An offshoot of the Zone Comparison Technique. A major component of the Utah technique is the use of question modules consisting of one relevant, one comparison, and one irrelevant question. It also differs in that the relevant questions are not bracketed by comparison questions. Though it is not used in the field as frequently as other techniques, the Utah technique has been validated in mock crime analog studies. More recently the developers of the Utah technique have also endorsed the use of directed-lie questions in place of probable-lie questions. See: Raskin & Honts (2002).

### **vagal tone**

A measure of parasympathetic influences on the heart as measured by the variability of inter-beat intervals in heart rate (R-to-R wave intervals on an electrocardiogram). This variability, also known as respiratory sinus arrhythmia (RSA), fluctuates at the same frequency as respiratory activity. Characteristically, the inter-beat interval will begin with inhalation, and shorten with exhalation. It has been investigated as a possible alternative measure of stress in a PDD setting. See Miller (1994).

### **vagus nerve**

Tenth cranial nerve that provides parasympathetic innervation to the heart and other visceral organs.

### **vagus roll (or pattern)**

A cyclical rising and falling in the cardiograph tracing which is synchronous with respiratory activity. Although this same pattern may be created by physical movement contamination (e.g., if the arm with the blood pressure cuff is placed too close to the body and consequently moves in synchrony with chest wall expansion), a vagus effect is distinct. Parasympathetic innervation (through branches of the vagus nerve) driving both respiratory and heart rate activity may be so prominent as to induce this characteristic synchronous wave in the cardiograph tracing. Also referred to as *respiratory waves* in arterial blood pressure.

### **validity**

Accuracy. There are several types of validity. The degree to which a test measures what it professes to measure is *construct validity*. *External validity* relates to the generalizability of the research results out of the laboratory. While there are other types of validity as well, these two types go to the heart of research in PDD.

### **Valsalva's maneuver**

Performed by forced exhalation against a closed glottis, thus increasing internal abdominal and thoracic pressure. This results in a short-term increase in blood pressure and frequently a phasic electrodermal response. Because Valsalva's maneuver can directly affect physiologic channels recorded with the polygraph, it is considered a type of

physical countermeasure when used during testing. Named for eighteenth century Italian anatomist Antonio Maria Valsalva.

**variance**

A standardized measure of dispersion and is the average squared deviation from the mean. Mathematically, the variance of a sample or population is equal to the square of the standard deviation. Variance is a useful measure for tests of effects.

**variable**

Variables in the behavioral science context are those elements that influence or are influenced by something. For example, habituation is a variable that affects responsivity.

**variograph**

Term sometimes used in the Polish literature to denote the polygraph.

**vasoconstriction**

Narrowing of blood vessels, especially arterioles, thereby reducing blood flow to a region of the body. During sympathetic nervous system activation vasoconstriction takes place in some parts of the body, shunting blood supplies to major muscles in preparation for defense or flight. Some medications influence vasoconstriction.

**vasodilation**

Expansion of blood vessels, especially arterioles, which deliver increased blood flow to a region of the body. Vasodilation and vasoconstriction are regulated by the *autonomic nervous system* and can be affected by some medications.

**vasomotor**

Relating to the influences of the smooth muscles on the internal diameter of a blood vessel.

**ventilation**

Regular movement of the chest cavity during the act of breathing.

**vertical scoring system**

Numerical evaluation method in which spots are individually scored by relevant-comparison question assessments. Vertical scoring is used in the ZCT exploratory and S-K-Y tests. Term generally used in contrast to *rank order analysis*.

**voice stress analysis**

Any analytical technique implemented to determine whether changes in the vocal signal are indicative of changing levels of stress. Most techniques assess the frequency or amplitude modulation of the vocal signal in one or more frequency bandwidths. Emphasis is often placed on modulation in the 8-10 Hz frequency bandwidth, otherwise known as *microtremors*. Numerous voice stress analysis devices have been introduced since the first was made available in 1971. All purport the ability to detect deception. Today, this genre of credibility assessment devices enjoys a wide distribution, possibly due to their low cost and brief training requirements relative to the polygraph. However, no independent scientific assessment has validated the use of voice stress analysis for credibility assessment. Because of this, the U.S. Department of Defense Polygraph Institute, which is charged with investigating all detection of deception technologies, has

not endorsed its use. Brand names include *Computer Voice Stress Analyzer (CVSA)*, *Lantern*, *Psychological Stress Evaluator (PSE)*, *TiPi*, and *VSA Mark*.

### **voir dire**

French term meaning "to say the truth." It is the process of questioning jurors for the purpose of excluding those with biases. Pronounced "vwa dear."

### **VSA Mark**

A voice stress device. CCS International produces the VSA Mark series, first introduced in 1979. Examiner certification is not required. The VSA Mark does not use a standard testing format but open-ended conversations or interrogations. A numerical output provides the results. See *voice stress analysis*.

### **Wheatstone bridge**

Early electrical circuitry used to detect electrodermal activity. It employed a null-type resistance-measuring circuit in which the examinee's resistance was continually compared to that of known resistors.

### **Winter, John**

Earliest known developer of a scoring system used to interpret polygraph recordings in the detection of deception. His method did not come into wide use and is of historical interest only. See: Winter (1936).

### **Yerkes-Dodson Inverted U**

Yerkes and Dodson proposed in 1908 that an inverted U characterized the relationship between arousal and performance. The level of performance increases with arousal until it reaches some optimum level, beyond which performance experiences a decrement. This model implies that a subject who is under-aroused will not respond sufficiently on a PDD examination, while a subject who is over-aroused will also not respond adequately.

### **Yes-No Technique**

First reported by this name by Richard Golden in 1969, this technique is similar to the Positive Control Technique. Also *Positive Control Technique*.

### **Yes Test**

PDD test series attributed to John Reid in which all comparison questions are omitted from the question list, and an examinee is told to answer "yes" to all of the remaining test questions. It is preceded by special instruction so to invite physical countermeasures from guilty examinees. The Yes Test is especially useful in identifying examinees who wish to defeat the polygraph test, and is generally used only when the examiner has reason to believe that the examinee is attempting countermeasures.

### **You Phase**

The strongest and one of the most commonly used of the formats in the Backster Zone Comparison Technique. The standardized test addresses a single issue and single degree of involvement in the issue. The format provides for two or three relevant questions, worded slightly differently from one another, addressing the single issue and degree of involvement. It also requires a repeat of the relevant question wording in the sacrifice relevant question. The You Phase ZCT is a very powerful test because it is so

highly focused on essentially one question. An example of You Phase question wording is: sacrifice relevant—"Regarding whether or not you shot Henry Jones, do you intend to answer truthfully each question about that?"; relevant 1—"Did you shoot Henry Jones?"; relevant 2—"Did you fire the shot that caused the death of Henry Jones?"; relevant 3—"Last Friday night, did you shoot Henry Jones?"

### **zone**

Concept coined by Cleve Backster. A zone is a twenty to thirty-five seconds block of polygraph chart time initiated by a question having a unique psychological focusing appeal to a predictable group of examinees. In his ZCT, Backster used color-coding to identify the three zones in the ZCT: *red*, *green*, and *black*. Respectively, the red zone for relevant questions, the green zone for comparison questions, and the black zone for symptomatic questions.

### **Zone Comparison Technique (ZCT)**

PDD technique developed by Cleve Backster that contains three Zones (black, red, green), with comparison of responses between two of the Zones (red and green) for a determination of truth or deception. The ZCT is designed to pose a threat to the well-being of examinees, regardless of their innocence or guilt, and compel them to focus their attention on a specific zone question(s). There are several varieties, including the "You phase," "Exploratory" "S-K-Y" "DoDPI," and the "Utah". The ZCT was the first modern PDD technique in general use to incorporate numerical analysis. The ZCT is probably used more often in forensic applications than any other format.

The information published in the *Terminology Reference for the Science of Psychophysiological Detection of Deception* does not necessarily reflect the position of the US Government or the American Polygraph Association.

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## **Informational Web Sites**

### **American Polygraph Association**

[www.polygraph.org](http://www.polygraph.org)

### **Polygraph Law Resource Pages**

[www.truth.boisestate.edu/polygraph/polylaw.html](http://www.truth.boisestate.edu/polygraph/polylaw.html)

### **Journal of Credibility Assessment and Witness Psychology**

[www.truth.boisestate.edu/jcaawp/default.html](http://www.truth.boisestate.edu/jcaawp/default.html)

### **Crimelynx**

[www.crimelynx.com/forensic.html](http://www.crimelynx.com/forensic.html).

### **The Polygraph Place**

[www.polygraphplace.com](http://www.polygraphplace.com)

### **Employee Polygraph Polygraph Act**

[www.dol.gov/dol/allcfr/ESA/Title\\_29/Part\\_801/Subpart\\_A.htm](http://www.dol.gov/dol/allcfr/ESA/Title_29/Part_801/Subpart_A.htm)

### **National Polygraph Consultants**

[www.nationalpolygraphconsultants.com](http://www.nationalpolygraphconsultants.com)

### **Society for Psychophysiological Research**

[www.wlu.edu/~spr/](http://www.wlu.edu/~spr/)

### **Voice Stress Site**

[www.voicestress.org](http://www.voicestress.org)