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Guiding Principles and Benchmarks for The Conduct of Validity Studies of Psychophysiological Veracity Examinations Using the Polygraph

Background

There has been much controversy regarding scientifically accurate and persuasive methods of validating psychophysiological veracity (PV) examination techniques using the polygraph in the identification of guilty and innocent examinees (Krapohl 2006, Gordon 2007, Matte 2007a, 2007b, OTA 1984, NRC 2003). This controversy extends to the use of field studies versus laboratory studies, both of which have their usefulness depending on whether the PV examination technique being evaluated is a lie test such as the Zone Comparison Test or a recognition test such as the Concealed Information Test. This Guide is designed to provide researchers who wish to conduct a validity study on

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a PV examination technique with guiding principles and benchmarks that will establish scientifically acceptable validation results.

Field versus Laboratory Studies

Determining whether a person is lying or telling the truth regarding an issue or allegation normally involves the use of a polygraph instrument that records the physiological activity of that person to reviewed questions contained within a psychologically structured test. The emotional involvement of the examinee in such circumstance includes *fear of detection* by the guilty examinee, *fear of error*, also known as the Othello Error (Ekman 1985), by the innocent examinee, and potential *anger* by either type of examinee, all of which can cause an autonomic response indistinguishable from the deception syndrome (Bongard, Pfeiffer, Al'Absi, Hodapp & Linnenkemper, 1997; Ekman, 1985; Matte, 1978; Matte & Reuss, 1989; Matte 2007c; Mangan, Armitage, Adams 2008; Shurany, Stein, Brand 2009; National Research Council, 2003).

Field studies examine PV examinations conducted on persons suspected or accused of committing real-life crimes or incidents with serious consequences that can arouse any of the aforementioned *emotions* and ensuing autonomic responses, also classified as *defensive responses* (Verschuere, et al. 2004; Sokolov & Cacioppo 1997; Graham 1979; Graham & Clifton 1966; Cook & Turpin 1997), which will inhibit or block orienting stimuli (Hernandez-Peon, et al. 1956; Lang, Simons & Balaban, 1997).

The theoretical concept of the Defensive Response (DR) and the Orienting Response (OR) and their autonomic signatures are among the most heavily investigated topics in psychophysiology (Sokolov & Cacioppo in Lang, et al., 1997). According to Lang, Bradley, and Cuthbert in Lang, et al. (1997),

"all emotions are organized around a motivational base. In this sense, we consider valence and arousal to be the strategic dimensions of the emotion world. Emotions are products of a Darwinian development, and can be characterized as motivationally tuned states of readiness. In human beings, the presumed indices of these affects include responses in three reactive systems: (a) expressive and evaluative language; (b) physiologic changes mediated by the somatic and autonomic systems; (c) behavioral sequelae, such as patterns of avoidance or performance deficits. This is the database of emotion."

Published research conducted by Raul Hernandez-Peon, Harald Scherrer and Michel Jouvet (1956) involved modification of electric activity in cochlear nucleus during *attention* in unanesthetized cats which revealed that "during presentation of visual stimuli (two mice in a closed bottle), the auditory responses in the cochlear nucleus were greatly reduced in comparison with the control responses; they were practically abolished as long as the visual stimuli elicited behavioral evidence of attention. When the mice were removed, the auditory responses returned to the same order of magnitude as the initial controls. An olfactory stimulus that attracted the animal's attention produced a similar blocking effect." This research and others (French, Verzeano and Magoun, 1953; Hagbarth and Kerr, 1954; Adrian, 1954) support the theory of *Psychological Set* in PV examinations using the polygraph (Backster, 1974; Matte & Grove, 2001), also known as Selective Attention, which is an adaptive psychophysiological response to fears, anxieties, and apprehensions with a selective focus on the particular issue or situation which presents the greatest threat to the legitimate security of the examinee while filtering out lesser threats (Matte, 1996). This phenomenon explains the reason for the primary dominating stimulus "Fear" of consequences inhibiting secondary stimuli such as guilt[1] and lie avoidance conflict, as well as orienting responses normally found in laboratory studies such as the promise of reward and increased self-esteem.

While studies by Verschuere, et al. 2004; Sokolov & Cacioppo 1997; Graham 1979, Graham & Clifton 1966; Cook & Turpin 1997, identified orienting responses (OR) by a deceleration of heart rate and defensive responses (DR) by an acceleration of heart rate, other researchers (Smith, et al., 1974; Gaunt & Gan, 1969; Rosenmann & Morrison, 1974; Smith & De Carvalho, 1985; Smith & Woodruff, 1980; Causby & Smith, 1981; Adams, Baccelli, Mancia, & Zanchetti, 1971; Espmark & Langvatin, 1979, Gabrielsen, Blix, Ursin, 1985, and Butler & Jones, 1982) have demonstrated that certain species, e.g. alligator, crocodile, deer mouse, turtle, woodchuck, swamp rabbit, cat aggressor, red deer calf , ptarmigan hen, and duck, will experience heart deceleration when confronted with a threatening situation. Smith, Allison & Crowder, 1974, described their recording of a free roaming alligator's heart rate which ranged between 25 to 35 BPM during diving and surfacing, but when approached by a manned canoe, the alligator submerged and remained inactive and its heart rate decreased from 30 BPM to approximately 2 to 5 BPM. This significant decrease in heart rate was described by Smith, et al., as an example of fear bradycardia. Their research further demonstrated that fear bradycardias are typically much larger than orienting response bradycardias.

However, Byron Campbell, Gwendolyn Wood and Thomas McBride, in Lang, et al. (1997) offer four possible criteria distinguishing between fear bradycardia and orienting response bradycardia. The aforementioned authors noted that many of the listed characteristics are strikingly similar to those used to distinguish defensive responses from orienting responses (Graham 1979), except that the direction of the cardiac response is deceleration rather than acceleration.

"1. Fear bradycardia is typically much larger than orienting response bradycardia."

"2. Fear bradycardia habituates slowly, if at all, whereas orienting response bradycardia habituates rapidly."

"3. Fear bradycardia is directly proportional to intensity of the threatening stimulus, whereas orienting response bradycardia is typically maximal at low to moderate stimulus intensities."

"4. Fear bradycardia should occur primarily in species and in settings where concealment or behavioral immobility is an adaptive predatory avoidance strategy; orienting response bradycardia should be relatively independent of context."

The above suggests that fear bradycardia can be distinguished from orienting bradycardia by its greater magnitude, slower habituation, greater responsiveness to high than low to moderate stimulus intensity, and the context in which it is elicited. (Campbell, et al. in Lang, et al., 1997).

Lang, Bradley and Cuthbert in Lang, et al. (1997) explain that the Fight/Flight and Freezing responses and its autonomic changes in heart rate and increases in blood pressure "are mediated through different neural centers: The autonomic response is dependent on an intact pathway through lateral hypothalamus (LeDoux, 1990), and the somatic components require an intact midbrain (periaqueductal) central gray area. Furthermore, the ventral central gray is the fear "freezing" path, whereas the dorsal gray is a critical part of the fight/flight action circuit. (See Fanselow, DeCola, De Oca, & Landeira-Fernandez, 1995, and the papers edited by Depaulis Bandler, 1991)."

Smith & Woodruff, 1980, reported that vertebrate species that are purely terrestrial such as woodchucks responded to threat in two distinctive ways: When

approached in the open, their response was fear tachycardia (increased heart rate) and flight. When the woodchuck was threatened near or in its burrow, fear bradycardia (decrease heart rate) was the response.

Lang, et al. (1997) reported that Orienting Response (OR) and the Defensive Response (DR)

"were initially conceptualized as having common and context-specific adjustments and were often treated as artifacts to be avoided in studies of classical conditions. In Perception and the Conditioned Reflex (Sokolov, 1963), both conceptions were changed. The OR and DR were reformulated as behavioral phenomena that subserved perception and learning (e.g. by amplifying or reducing the effects of stimulation), evidenced many common features across evocative contexts, and could be quantified by psychophysiological measures. For instance, a distinction was made between the physiological adjustments that generalized across evocative stimuli and more stimulus-specific associated adaptational reflexes. In contrast to the adaptational responses, the autonomic components or signatures of both the OR and DR were posited to (a) be independent of stimulus quality, and (b) act directly on sense receptors and indirectly by feedback to central mechanisms to control receptor sensitivity. The OR and DR were further differentiated as follows: (a) an OR is elicited by stimuli of low or moderate intensity, whereas the DR is elicited by stimuli of high intensity; (b) an OR is marked by reciprocal peripheral vasoconstriction and cephalic vasodilation, whereas the DR is associated with peripheral and cephalic vasoconstriction; (c) an OR has the same autonomic signature to the onset and offset of a stimulus because both represent changes in stimulation, whereas the autonomic response to stimulus onset is larger than to stimulus offset in the DR; and (d) the OR habituates rapidly to stimulus repetition, whereas the DR is either intensified or diminished much more slowly by stimulus repetition."

It should be noted that the study findings of Hare, 1972, support Sokolov's (1963) proposal that cephalic vasoconstriction is a component of the Defensive Response (DR) and cephalic vasodilation is associated with the Orienting Response (OR).

The relationship between vasoconstriction and heart rate decrease and vasodilation and heart rate increase in PV examinations was noted by this author (Matte), who conducted a study that included an analysis of polygraph charts from field cases which was reported in Matte (1980 and 1996). The re-

sults showed that at the onset of a threatening test question and during the 30 seconds that followed prior to the next question in the collection of the physiological data, there was a decrease in heart rate for Alpha Adrenergic Responders (vasoconstriction) followed by a compensatory increase in heart rate (relief), or there was an increase in heart rate for Beta Adrenergic Responders (vasolidation) followed by a compensatory decrease in heart rate (relief) (Matte, 1980. P. 113-114; Guyton & Hall, 2000, P. 701). However, unlike Sokolov's (1963) study, these were non-cephalic recordings of vasomotor activity in the arm. Matte also noted that deceptive subjects of field cases that employed single-issue PV examinations[2], such as the Quadri-Track Zone Comparison Technique or the Backster Zone Comparison Technique, generally did not habituate to the relevant test questions but did habituate to the neighboring control[3] questions, whereas innocent subjects generally did habituate to the relevant questions but showed no habituation to the control questions that elicited their psychological set or selective attention.

Fanselow (1994) described three stages in predator confrontation:

"1. Pre-encounter, in which target specific defense behavior is not yet engaged and appetitive motivation may be simultaneously present. Presumably, this is the realm of transient detection responses (TDR); Graham, 1992), determined by modest differences in the arousal value of stimuli, readily habituated, and not valence relevant."

"2. Post-encounter, For Fanselow (1994) motor responses at this stage include "freezing" – mediated by ventral gray. This is also the stage of focused attention (conceivably conscious appraisal in man, Ohman, Esteves, Flykt, Soares, 1993), associative learning, sustained cardiac deceleration, defensive nonopiate analgesia, and potentiated startle."

"3. Circa-strike, the final stage, involves active defense and is mediated by the dorso-lateral gray in the rat. Like Masterson and Crawford's "alarm" stage, it involves active fight or flight, cardiac rate acceleration, and a shift of blood to the gross muscles – processes that prompt the motor system and thus eliminate reactions to secondary, probe stimuli."

Tuvia T. Amsel (1997) conducted a field study on "Fear of consequences and motivation as influencing factors in the psychophysiological detection of deception" involving 100 subjects who could suffer court and employer sanctions upon failure (IPI Group) versus 100 subjects who would suffer no sanctions

upon failure (SSI Group). The results of this study indicated that "The conclusion of this research is that the extent of psychophysiological detection of deception reaction is a function of the extent of fear of consequences (FOC) in proportion to the extent of motivation (MO), that exist within the subject while being tested. Fear of detection (FOD) is an additional factor existing within the IPI Deceptive Group subjects, that amplifies their psychophysiological reactions."

It becomes obvious from the above reported research studies that autonomic defensive responses generated by the strong emotion of "fear" which inhibits other potential secondary responses are significantly different in origin and potency of stimuli, and strength, duration and tenacity of response than non-emotional orienting responses. Arne Ohman in Lang, et al., 1997, stated that it is a common theme across the experiments reviewed in his chapter on Preattentive Processing of Threat, that stimulus content counts. "Whereas stimuli implying some evolutionary relevant threat can preattentively activate skin conductance responses both in phobics and conditioned normals, automatically capture spatial attention, and preattentively enter into association with aversive unconditioned stimulus, none of these effects were evident for fear-irrelevant stimuli."

Laboratory studies, also referred to as analog studies of PV examination techniques, employ mock paradigms that suffer the absence of serious consequences to the deceptive examinee and a total absence of the fear of error by the innocent examinee which in real-life can result in a false positive (an innocent examinee misdiagnosed as deceptive). Furthermore, laboratory studies are based on *non-emotional* responses generated by the offer of a reward such as additional college credits or a small sum of money, usually about twenty dollars, and/or by a desire for increased self-esteem if they can defeat the test. Responses in laboratory studies have thus been classified as *orienting responses.* (Verschuere, et al. 2004; Sokolov & Cacioppo 1997; Graham 1979; Graham & Clifton 1966; Cook & Turpin 1997).

Additionally, the potential for anger is absent due to the fact that the examinee is a volunteer in a mock crime paradigm. Furthermore, programmed guilty examinees are not motivated to employ countermeasures. For the non-truthful examinee in the analog study, the potential for embarrassment or punishment if found deceptive to the relevant questions is nonexistent. However, the control questions for these examinees deals with their actual past behaviors, which could lead to embarrassment or fear if found deceptive, thus the com-

parison of a control question with DR potential against a relevant question of OR value can result in overpowering control questions that could produce a false negative (deceptive examinees misdiagnosed as truthful). Finally, the subject sample is not representative of the diverse population that includes the criminal element present in field cases.

Therefore, laboratory studies which are based on *non-emotional orienting responses* absolutely fail to replicate the field conditions that elicit *emotional defensive responses* wherein both the guilty and innocent examinee's *primary emotion* is "fear" of the consequences if found deceptive, which in criminal cases could result in the horror of imprisonment. As stated by Iacono (2001) "These mock crime studies are too unlike real life to offer any realistic insight to how polygraph tests work in the field." The argument that laboratory studies offer complete control over subjects used in their study, such as the assignment to deceptive and non-deceptive groups and the holding of variables constant in order to study the variable of interest, is useful in supporting the results of examinations involving non-emotional subjects role playing in a mock crime. However its results cannot be applied to field situations, nor can they be used to validate the use of a PV examination technique on real suspects of crimes whose results pose a serious threat to the security of the examinee. It is noteworthy that most published laboratory studies on polygraph contain a caveat at their conclusion that warns against generalizing the results to field applications.

The courts should be especially concerned about polygraph results produced by a polygraph technique that was validated exclusively with laboratory studies, inasmuch as most test results are proffered by defense attorneys as proof of their client's innocence, which often raises the question whether a guilty client successfully defeated the test with the use of physical or mental countermeasures. Studies based on field cases embody the potential and actual use of countermeasures by real-life criminals motivated to learn and employ them. Whereas laboratory studies employ mock paradigms that offer no threat of serious consequences to deceptive examinees, hence no motivation to use countermeasures, and in those laboratory studies that did instruct subjects to use countermeasures (on the control questions) (Stevenson & Barry, 1988; Honts & Hodes, 1983; Honts, Hodes, Raskin, 1985), there was no competing fear of detection and ensuing autonomic response from the neighboring relevant test questions that can dampen potential responses to the control questions and interfere with the mental effort required in the use of mental/physical coun-

termeasures, especially those of mental origin which currently prevail in the anti-polygraph literature as a result of overt advertisement of movement sensors by manufacturers of polygraph instruments.

Nevertheless, laboratory studies are useful in validating PV examination techniques that are designed to identify the examinee who *recognizes* a key item amongst equally plausible alternative items in what is referred to as a Concealed Information Test, Guilty Knowledge Test, or Known-Solution Peak-of-Tension Test. In contrast with the Control Question Test, the Concealed Information Test contains one key item that only the guilty will recognize amongst several incorrect but equally plausible alternative items that provide genuine controls in the scientific sense of the term. It is the *recognition* of the key item that produces an orienting or defensive response in analog and field studies respectively. The examinee need not answer any of the test questions. Hence, the fear of detection and fear of error emotions present in Control Question Techniques are absent in the Concealed Information or Guilty Knowledge Tests. These tests are not considered Lie Tests (Lykken, 1981, 1998), inasmuch as the examinee is not presented with relevant test questions and control test questions that have the potential of eliciting a lie from both truthful and non-truthful examinees with an ensuing autonomic response.

It becomes quite evident from the aforementioned discussion of the differences between field and laboratory studies and the intense emotions present in real-life cases versus the lack of such emotions in the laboratory setting that Control Question Tests must be validated by field studies, and laboratory studies be more appropriately used to validate non-lie tests such as the Concealed Information or Guilty Knowledge test.

Source of Data for Field Study

1. A minimum sample of 50 confirmed PV examinations conducted on examinees suspected or accused of criminal offenses, civil violations or infractions of mores with significant consequences. The greater the number of examinations, the more the sample would be representative of the general population. It is recommended that studies which use less than 100 subjects perform and provide a statistical power analysis of their sample size that must attain a statistical power of .80 or higher, using a .05 significance level.

2. The aforesaid sample of confirmed cases must be acquired from a period of time that includes all confirmed and unconfirmed examinations, i.e. 1 January 2007 thru 31 December 2007. All examinations that employed the PV examination technique being validated during that period must be accounted and reported, which would include all unconfirmed examinations, confirmed examinations, inconclusives, and known errors.

3. All PV examinations used in the field study being validated must have polygraph charts that contain as a minimum the following physiological activity: (a) Thoracic and abdominal breathing patterns recorded separately, using two pneumograph components; (b) Electrodermal activity reflecting relative changes in the resistance or conductance of current by the epidermal tissue; (c) Cardiograph recording of relative changes in pulse rate, pulse amplitude and relative blood volume (APA 2007).

Establishing Ground Truth

An index of validity shows the degree to which a test measures what it purports to measure, when compared with accepted criteria, hence the validity of a PV examination using the polygraph depends on whether it can accurately determine truth and deception.

Selection of satisfactory validation criteria and demonstration of a reasonable degree of validity are fundamental in psychophysiological testing. The first necessary condition of a valid test is that it has an adequate degree of reliability. Reliability is that which can be relied on; dependable; hence the reliability of a PV examination depends on whether the same set of data will consistently produce the same results. This consistency, known as reliability, is usually the degree to which a test yields repeatable results. Therefore, to assess the validity of any type of PV examination, it is necessary to obtain a criterion measure against which to compare the test results (Matte, 1996). This criterion is acquired from any one or a combination of the following:

a. Confession.

b. Judicial conviction confirmed by:
   1. A plea of guilty to the charge that formed the basis of the PV examination.
   2. A plea of guilty to a lesser offense wherein the allocution supports the original charge.

c. Judicial acquittal through forensic evidence such as DNA, fingerprint, serology, ballistics, etc., rather than insufficient evidence to convict.

Confessions provide *direct* evidence of guilt, and when properly acquired include corroborating information that can produce additional testimonial and physical evidence of the suspect/examinee's guilt. Whereas the results of forensic tests provide *indirect* evidence from which an inference of guilt can be made, usually supported by testimonial and other physical evidence. Even DNA evidence, while most probative, does not necessarily provide all of the necessary elements of proof for conviction or exculpation. The protocol of Control Question Techniques prohibits any type of accusatory or interrogative approach during any portion of the pretest interview and the collection of the physiological data, and the entire examination including the posttest interview must be video-recorded. Hence, resultant confessions acquired from legitimate PV examinations do not suffer the abuses of suspect's rights that may be found in the general police interrogation arena. A confession can be used to confirm a deceptive PV examination result or confirm the truthful result of a PV examination related to the same case, inasmuch as the truthful results are based solely on the analysis and scoring of the physiological data collected from the truthful examinee, subsequently confirmed by confession from the deceptive examinee in that same case.

Published research (Huff, et al. 1986) has established that wrongful convictions in the United States are 0.5 percent, but that is an estimate that may vary greatly within each state. However, a conviction that is confirmed by a plea of guilty to the charge that formed the basis of the PV examination or a plea of guilty to a lesser offense wherein the allocution supports the original charge reduces the wrongful conviction rate to a minimal level that offers compelling confirmation of the results of a PV examination.

Also, a judicial acquittal due to the introduction and admissibility of forensic evidence is compelling confirmation of the results of a PV examination.

Selection of Confirmed PV examinations

The purpose of a validity study is to determine whether a PV examination technique, when applied and administered in strict accordance with the requirements of its protocol, will accurately identify the truthful and deceptive examinee regarding the relevant issue. Therefore, it is imperative that only

those confirmed PV examinations that conformed to the requirements of the technique's protocol be included in the study.

The following are cause for invaliding a PV examination and its exclusion from the sample of confirmed examinations:

a. Procedural violations committed by the polygraphist during the pretest interview that can adversely impact the physiological data collected from the examinee.

b. Alteration of the psychological test structure in violation of the technique's protocol.

c. Modification of a test question contrary to its intended use within the psychological construct of the technique.

d. Violation of paragraph 3.4.1, APA Standards of Practice, wherein the PV examination should have been aborted due to the mental, physical or medical condition of the examinee. This includes a low intelligence quotient or language obstacle that prevents the examinee from clearly understanding with proper interpretation any of the test question(s) which forms the basis for the construct validity of the test.

e. Examination based on inadequate case information, case intensity or distinctness of issue.

f. Inadequate number of valid charts used for a determination of truth or deception.

Establishing Reliability through Blind Scoring of Charts

The blind scoring of polygraph charts acquired from a random sample of the confirmed PV examinations must be conducted by at least two polygraphists formally trained in the PV examination technique being validated, that were not involved in the conduct or administration of the examinations. An in-depth knowledge of all of the physiological features used in the technique being validated and its applicable rules of chart interpretation are essential for the polygraphists selected for the task of blind scoring of the physiological data contained in the polygraph charts of the random sample of confirmed PV ex-

aminations. Blind scoring of charts from confirmed examinations establishes repeatability of the results, hence reliability. A sample of 20 or more examinations (10 in each category) is acceptable for this purpose.

Inconclusive Results Affect Utility, not Accuracy

A psychophysiological veracity (PV) examination cannot have an Inconclusive rate greater than 20% to be utilitarian. Nor can a PV examination be considered valid unless published research indicates that its accuracy in correctly identifying both Guilty and Innocent examinees is at least 90% for evidentiary examinations, and 80% for investigative examinations (APA May/June 2007).

An Inconclusive result occurs when the scores obtained from the analysis and quantification of the physiological data collected from the examinee fails to attain the minimum score (threshold) required to reach a determination of truth or deception. This threshold is established from statistics acquired from empirical data of cases in field studies. This score threshold ensures that charts lacking sufficient physiological data for an accurate determination of truth or deception are not included in the decision-making process. Hence the term "Inconclusive" means that *no decision of truth or deception* was rendered due to inadequate physiological data. This Inconclusive threshold is a safeguard against false positive and false negative conclusions, so that conclusive results will enjoy high validity and reliability.

An analogy can be made of the fingerprint expert who renders an inconclusive opinion when the suspect print fails to meet the "minimum point rules" that require a minimum number of points of identification in order to render a conclusion of a positive match or a negative match to a suspect's print developed and lifted from a crime scene, which seldom produces a perfect print. The fingerprint expert has no control over the quality of the developed latent print, and when the print fails to meet the minimum point rules, the fingerprint expert must render an Inconclusive result. No rational person would suggest that this fingerprint expert made an error when he rendered an inconclusive finding. Similarly, the expert polygraphist has no control over the quality of the physiological data collected from the examinee and his conclusion is based solely on the scores acquired from the analysis of that physiological data, and unless the scores reach or exceed the established minimum score threshold, an inconclusive result must be rendered. The traditional reporting of PV examination results with and without inconclusive results is still advisable and

required as it reflects the utility as well as the accuracy of the polygraph technique. However, the inconclusives should not be viewed and reported as errors, inasmuch as the quality of the collected data failed to meet the required standard that would allow the forensic psychophysiology expert to render a decision of truth or deception.

Unfortunately, the Office of Technology Assessment in their November 1983 report entitled "Scientific Validity of Polygraph Testing: A Research Review and Evaluation" included inconclusive results of PV examinations as errors in the calculation of data from selected studies. The OTA's reasoning is stated on page 97, to wit:

"Some researchers exclude inconclusive results in calculating accuracy rates. OTA elected to include the inconclusives on the grounds that an inconclusive is an error in the sense that a guilty or innocent person has not been correctly identified. Exclusion of inconclusives would raise the overall accuracy rates calculated. In practice, inconclusive results may be followed by a re-test or other investigations." (Portion of text underlined by authors).

The flaw in their stated reasoning is the fact that in an Inconclusive there is no identification of a guilty or innocent person, correctly or incorrectly. Inasmuch as there is no decision regarding the guilt or innocence of the examinee, there can be no error. In fact, inconclusives are a safeguard against making errors. Regrettably, the National Research Council of the National Academies' 2003 report entitled "The Polygraph and Lie Detection" parroted OTA's interpretation of inconclusives. Hopefully, the scientific community will recognize inconclusive findings as a positive not a negative component in calculating the accuracy of PV examinations.

Discussion

Some researchers and statisticians would argue that a minimum sample of 20 cases or 10 or more subjects in each condition, deception or truthfulness (Krapohl 2007) in a field study of a PV examination technique provides a valid generalization to the general population and that additional cases do not improve its validity. Such a low sample may be adequate in the evaluation and generalization of a metallurgic study of the bonding of two metals whose individual components are constant; however, in order to generalize the results of a field study of a PV examination technique to the general population, it must

contain a subject sample that covers such variables as gender, race, age, education and whenever possible at least two types of crimes or offenses. This would require a sample of at least 50 field cases supported by a statistical power of .80 or higher, using a .05 significance level. The greater the number of examinations, the more the sample would be representative of the general population.

Two studies (Pollina, et al., 2004; Kircher, et al., 1994) attempted to determine the generalization of data from laboratory mock-crime studies. In the Pollina study, the degree of physiological responses to the control and relevant test questions in a mock-crime paradigm were compared with the responses of criminal suspects from confirmed cases collected at the Department of Defense Polygraph Institute. The results showed that the responses from criminal suspects were significantly greater in both the control and relevant test questions than examinees in the mock-crime paradigm. However, the accuracy of the results of the laboratory study was not significantly different from the field cases. It should be noted that in the laboratory study,

"After each question series, the examiner asked how each participant felt about the questions and whether there was any problem with any of them, focusing specifically on probable-lie control questions."

This stimulation of the control questions is within the protocol of the Utah Zone Comparison Technique (Honts & Raskin 1988; Honts 1999) which has been severely criticized (Abrams 1991, 1999, 2001; Matte 1998, 2000; Matte, Reuss 1999) for violation of the theoretical concept of the Zone Comparison Technique developed by Cleve Backster in 1962, which holds that once the test questions have been reviewed with the examinee, the collection of the data must not be interrupted with any language that would influence the examinee's psychological set towards the control or relevant questions (Matte 2007c). The sole exception is when there is no response to both the relevant and control questions. Then the control questions only are reviewed with the examinee, in accordance with Backster's Eight-Reaction Combination Guide (Backster 1963, 1969, 1983) or Matte's 23-Reaction Combination Guide (Matte, 1981, 1996)[4]. It could be argued that the Utah method was validated with laboratory studies published in peer-reviewed journals, but this only attests to its efficacy in the realm of mock crimes with all of its intrinsic deficiencies which fail to replicate the fears and emotions experienced by examinees in the field that are threatened with serious consequences for failure. Those flaws articulated in Abrams (1991, 1999, 2001), Matte (1998, 2000), Matte, Reuss (1999) would not

reveal themselves in a non-emotional, non-threatening mock crime paradigm used in laboratory studies that elicit non-emotional orienting responses.

The latter study (Kircher, et al. 1994) admitted that

"any one of a number of possible differences between lab and field settings might affect the generalizability of laboratory models. For instance, differences in subject populations, the number and types of issues under investigation, qualifications of the polygraph examiners, test protocols, instrumentation, and subject's motivation for passing the test could limit generalizability."

However, Kircher's study reflected that

"Statistically, there was no difference between lab and field contexts in terms of the accuracy of classifications on truthful and deceptive subjects. However, as compared with its performance on laboratory subjects, the lab model tended to be less accurate on truthful suspects and more accurate on deceptive suspects."

This information was acquired from an Abstract in *Psychophysiology*, Journal of the Society for Psychophysiological Research, which did not provide details in the manner this study was conducted.

The Pollina and Kircher studies make an honest attempt to show that the results of laboratory studies of a Zone Comparison Technique can be applied to the general population. However, several important elements present in field studies were lacking in the aforesaid laboratory studies. The Fear of Error, also known as the Othello Error (Ekman 1985), by innocent examinees could mimic deception to the relevant test questions (Matte 1980, 1996; Matte, Reuss 1989; Mangan, Armitage, Adams 2008; Shurany, Stein, Brand 2009; NRC 2003). The Fear of Detection, which would cause a significant *defensive* response to the relevant questions in field studies, as opposed to the lesser *orienting* response in a laboratory study (Verschure, et al. 2004, Sokolov & Cacioppo 1997; Graham 1979; Graham & Clifton 1966; Cook & Turpin 1997), would enable the *defensive* response on the relevant question to compete against a countermeasure response on the control question, thus avoiding a false negative. In the Backster ZCT and Quadri-Track ZCT, that strong response on the relevant question would render a strong response on the neighboring control question defective, resulting in a correct deceptive score (Matte 2007c; Mangan et al. 2008a). The strong emotion of anger which can mimic the deception syndrome

can seriously affect the accuracy of a PV examination, which may be present in field cases but most absent in laboratory studies. None of the aforementioned studies by Pollina and Kircher address those most important factors in the assessment of laboratory studies' generalizability to the population.

Laboratory studies are most convenient to academics, who tend to minimize the significant differences in the emotions elicited from examinees in mock crime paradigms versus real-life field cases. The first author (Matte) while assigned to the U.S. Air Force Office of Special investigations in France, escorted one of five American National Guardsmen accused of murdering a French soldier to the chamber of the French Magistrate to await being formally charged. While standing with Matte in front of the closed door to the Magistrate's chamber, the American airman, overwhelmed with fear, started to vomit and had to be escorted to the bathroom. In another case, a policeman accused by the person he had arrested of forcibly sodomizing him, became estranged from his relatives, lost his job and his friends. In desperation, he attempted suicide. He was administered a PV examination using the Quadri-Track Zone Comparison Technique which cleared him, and all charges were subsequently dropped. These two cases, while anecdotal, offer a microcosm of the extreme fear of the consequences if found guilty that real-life suspects experience. The first author (Matte) has witnessed countless examinees, who, after being found truthful to the target issue, burst uncontrollably into tears of relief that an error was not made on their test, as verified by their physiological response to that question on the test[5]. These fears and strong emotions simply cannot be duplicated in a laboratory setting, and the only way that a PV examination technique can be evaluated regarding its capability to function effectively and accurately in the real world is through the use of field studies of real-life cases.

Academic arguments against the use of confessions as a criterion for ground truth in field examinations have been published (Iacono 1991, 2008) as objections to field studies that used confessions as ground truth (Mangan, et al. 2008a). These latest objections by Iacono (2008) were primarily based on the assumption that the confessions were coerced from the examinees confronted with the test results which were allegedly not acquired independently of the confessions. It was also argued that the errors would most likely be found in the unconfirmed cases of examinees whose responsiveness was somehow different from examinees in the confirmed cases. Furthermore, guilty examinees whose test results showed no deception would not be subjected to an interrogation and subsequent confession thus would fall into the category of unconfirmed cases. These concerns by Iacono would have some merit under the past

testing conditions he erroneously assumed still exist in all current PV examination techniques. Advances in instrumental technology, which include motion sensors, and the evolutionary progress in the psychological structure of test formats and protocol have significantly improved the objectivity, accuracy and standardization of psychophysiological veracity (PV) examinations using the polygraph. In their rebuttal (Mangan, et al. 2008b) to these objections to their use of confessions, they offer compelling arguments including research studies (Light & Schwartz 1999, Mason 1991) that support the use of confessions as a criterion for ground truth. Mangan, et al. point out that Iacono's objections presume that the PV examinations conducted in their field study were conducted in a vacuum.

"Unlike laboratory studies where there is no post-test connection, field studies of real-life cases are connected to post-test investigations and adjudications that can reveal errors or corroborate test results, which is another form of validity confirmation."

Mangan, et al. also pointed out in their rebuttal that they
"calculated the average score for the unconfirmed and confirmed cases which revealed no significant difference in the reactivity of the subjects between the confirmed and unconfirmed cases, and there was no significant difference in the inconclusive rate, all of which indicates no significant difference in the examinees whose cases were unconfirmed and the confirmed cases appear to be a representative sample of the total cases."

They further pointed out that the results of all PV examinations conducted in their field study were entirely based on the analysis and numerical scores of the physiological data collected from each examinee in strict accordance with the technique's protocol, thus totally independent of any ensuing confessions. Furthermore, all PV examinations were audio/video-recorded as required by the American Society for Testing and Materials (ASTM) and the American Polygraph Association (APA) standards of practice, which provided a quality control review that would expose any procedural violations that would invalidate the PV examination or the ensuing confession.

Further published research and arguments in support of confessions used as a criterion for ground truth in field research studies of psychophysiological veracity examinations are cited in Krapohl, Shull and Ryan's (2003) article "Does the Confession Criterion in Case Selection Inflate Polygraph Accuracy Estimates?" Krapohl, et al. concluded that

"The goal of this study was to determine whether there were differences in scores and decisions attributable to the confession criterion. Though none were found in this study, the confession criterion remains a potential source of contamination in undercontrolled studies. The present data demonstrate, however, that it is an overstatement to broadly assert that the confession criterion is a contaminant in a study. It is more defensible to state that the confession criterion is suspected when it leads to samples of cases with non-representative data, such as those with scores more extreme than the population as a whole. It should be relatively straightforward for researchers to collect and report such evidence as others have done so that skewed data can be recognized."

These principles and benchmarks are submitted as a living guide that is subject to change with the evolutionary progress of psychophysiological veracity examination techniques, instrumentation and advanced research.

[1] Raskin, et al. (1978) conducted a field study of PV examinations using the polygraph on convicted felons diagnosed psychopathic who lack a sense of guilt. Not a single guilty subject was able to produce a truthful result. In fact, there were indications that psychopaths may be somewhat easier to detect using PV examinations. However, psychopathic subjects are equally "fearful" of consequences as non-psychopaths.

[2] Single-Issue PV examinations present two threats to the examinee, namely the relevant questions dealing with the single issue or criminal act, and the neighboring control questions dealing with past behavior related to the same type of offense. The guilty examinee's psychological set will be focused on the relevant questions which should dampen out potential responses to the neighboring control questions, whereas the innocent examinee's psychological set will be focused on the control questions, which should dampen out potential responses to the relevant questions.

[3] The term "control" question has recently been replaced with the term "comparison" question to conform to the current scientific literature. However, in this thesis we use the term "control" question to insure a clear connection with previous literature in the field of forensic psychophysiology, and avoid duplication of the term comparison in succession that could cause confusion, such as "comparison of comparison versus relevant questions."

[4] Implementation of the Backster or Matte Reaction Combination Guides, after commencement of the collection of the physiological data, which may influence or redirect the examinee's psychological set, necessitates the collection of at least two additional charts scored separately to remedy previous chart defects. The necessity to actually execute any of the remedies in the aforesaid guides has been found to be rare.

[5] Since 1977, the first author (Matte) has been using the Quadri-Track Zone Comparison Technique, which contains a separate track that includes a Fear-of-Error control question for comparison with a Hope-of-Error relevant question to determine the degree of fear or hope that an error will be made on the test regarding the target issue from the examinee's responses to those questions. (Mangan, et al. 2008a; Matte & Reuss 1989; Shurany, et al. 2009).

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